The Journal of American Science

ISSN 1545-1003

Volume 6 - Number 2 (Cumulated No. 24), February 1, 2010, ISSN 1545-1003

Marsland Press, Michigan, USA

The Journal of American Science

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Journal Address:
Marsland Press
PO Box 180432, Richmond Hill, New York 11418, USA
Telephones: 347-321-7172; 718-404-5362; 517-349-2362
Emails: editor@americanscience.org; americansciencej@gmail.com; sciencepub@gmail.com
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The Journal of American Science

ISSN 1545-1003

Volume 6, Issue 2, February 1, 2010

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The Feeding Value of Biscuit Waste as Replacement for Maize in the Diet of Growing Snails (*Archachatina marginata*)

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Abstract Maize is a major source of energy and it is expensive because of competition between man and animal. Biscuit waste (BW) which attract little cost was used to replace maize fraction of the diet of snail in order to reduce cost. Four diets were formulated to contain BW at 0% (B_1) which served as the control, 50% (B_2), 75% (B_3) and 100% (B_4) as replacement for maize fraction in the diets of growing snails. Completely randomized design was used for the trial and each treatment was replicated thrice with 8 snails per replicate. The parameters taken were feed intake and weight gain. Feed conversion ratio, total feed cost and cost per weight gain were calculated. The results showed that there were no significant difference in the weight gain between the control diet B_1 and B_4 ($P<0.05$). The feed conversion ratio was relatively similar in B_1 and B_4. The dressing percent of the snails was relatively the same in all the treatments ($P>0.05$). The results of cost analysis showed that cost /kg feed and total feed cost reduced as the level of BW in the diet increased. The lowest cost per weight gain was recorded in B_4 while the highest cost per weight gain was observed in the control treatment with zero level of BW. The results indicated that the feed cost of snail diet could be reduced by replacing the maize fraction of the diet partially or wholly with biscuit waste. [Journal of American Science 2010;6(2):1-5]. (ISSN: 1545-1003).

Keywords: Biscuit waste, maize, feed utilization, dressing percentage, Cost/weight gain.

Introduction

Animal protein is very important in the diet of man for growth, repair of the body tissue and it is major constituent of the organ of the body, It has high biological values and contains all essential amino acid in the right proportion (Arthur, 1975). Beef, pork, mutton and poultry meat have been the major source of animal protein in Africa and Nigeria in particular. Recently, there is increase in production of snail and grass-cutter as alternative sources of animal protein (Cobbinah, 1993; Begg,2003; Malik and Dikko 2009; King, 2008). Snail meat contains low fat and low cholesterol level which makes the meat a good antidote for fat related diseases. The cost of production in terms of housing and feed is relatively low compared to other conventional livestock (Ejidike, 2001;Adelekan and Taiwo 2004 ; Malik and Dikko 2009). The cost of the feed forms the major part of cost of production and performance of snail in terms of growth and egg lying depends on the quantity and quality of the feed. Maize is the main source of energy and account for 40-60%of the whole diet (Payne, 2000). The cost of maize is relatively high compared to other sources hence there is need to look for alternative sources. Biscuit waste is another source of energy with protein and energy content relatively close to that of maize. The cost of biscuit waste relatively low compared to that of maize and it is considered as a waste product. Biscuit waste has been included in the diet of broiler which has resulted in reduction in the cost of feed without any adverse effect. This study was conducted to determine the effect of feeding snail with biscuit waste as replacement for maize fraction of the diet on performance characteristics and cost benefits.

Materials and Method

The experiment was carried out at the Snailery Unit of the Institute of Agricultural Research and Training (I.A.R.& T.), Moor Plantation, Ibadan which is located on Longitude 03°51E, Latitude 07°23N and Altitude 650” lies in the humid zone of the rainforest belt 0703.25 of Southwestern Nigeria with mean annual rainfall of 1220 mm and mean temperature of 26°C. A total of ninety six growing snails of mean weight 91.23±2.4g were used for the feeding trial. The snails were acclimatized for one week before the commencement of the feeding trial. Biscuit waste (BW) was collected from Efco energy company, Ibadan, Oyo state, Nigeria. The biscuit waste was later incorporated with other feedstuffs. Four diets were formulated to

contain BW at 0% (B_1) Control, 50% (B_2), 75% (B_3) and 100% (B_4) as replacement for maize fraction in the diet of growing snails. The diets were formulated to contain about 24% crude protein and energy of 2500 kcal/kgME (Table 1). Feed intake and weight gain were measured on daily and weekly basis with the use of sensitive weighing balance. Feed intake was calculated by subtracting the left-over feed from the feed given while the weight gain was calculated by deducting the initial weight from the final weight. Shell length and width were measured on weekly basis with vernier caliper. Micrometer screw gauge was used to measured the shell thickness on weekly basis. Feed conversion ratio were calculated as the ratio of feed intake to weight gain. Feed cost and cost per weight gain were also calculated. Carcass analysis was carried out at the end of the feeding trial by randomly selecting eight snails from each treatment and weighed separately. Each snail was killed by striking the shell with a club. The shell, foot and viscerals were separated and weighed separately. The chemical composition of the experimental diets and the foot were done according to the method of A.O.A.C. (1990). All data were subjected to statistical analysis using analysis of variance and the means were separated if they are significantly different using Duncan Multiple Range Test (SAS, 1999).

Based on relatively the same mean feed intake, weight gain, feed conversion ratio, dressing percentage obtained in the control diet and B_4 and the fact that the least cost/weight gain was obtained in diet containing 100% BW as replacement for maize fraction of the diet, it could be concluded that biscuit waste could partially or wholly replace maize in the diet of growing snails.

Table 1. Gross Composition of Experimental Diet

Ingredient (%)	**B_1 (0%)**	**B_2 (50%)**	**B_3 (75%)**	**B_4 (100%)**
Maize	22.00	11.00	5.5	0.0
Biscuit waste	0.0	11.00	16.5	22.0
GNC	10.00	10.00	10.00	10.00
Soyabean meal	24.00	24.00	24.00	24.00
Brewer dry grains	12.8	12.8	12.8	12.8
Rice bran	14.60	14.60	14.60	14.60
Fish meal	4.00	4.00	4.00	4.00
Bone meal	2.15	2.15	2.15	2.15
Oyster shell	9.70	9.70	9.70	9.70
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Salt	0.10	0.10	0.10	0.10
Premix	0.25	0.25	0.25	0.25
Total	**100.0**	**100.0**	**100.0**	**100.0**
Crude protein (%)	24.02	24.39	24.48	24.08
Metabolizable energy (kcal/KgME)	2605.2	2598.7	2589.23	2578.34

Results and Discussion

Table 1 shows the chemical composition of maize and biscuit waste. The crude protein of biscuit waste was slightly higher than that of maize while the ash content of biscuit waste was also higher than that of maize moreover the fibre content of maize was higher than that of biscuit waste. Low fibre and high protein levels in the have positive effect on feed intake and weight gain (Arthur, 1975).The total weight gain of the snails in all the treatments was not significantly influenced by increased level of biscuit waste in the diet ($P>0.05$) as shown in table 2. Numerically the total weight gain increased from 209.72g in B1 to 213.6g in B_4. The mean feed intake was significantly influenced by increased level of biscuit waste in the diet ($P<0.05$). The highest feed intake was recorded in the diet containing 100% biscuit waste as replacement for maize B_4 while the lowest feed intake was recorded in diet

containing 0% biscuit waste B_1. The highest feed intake recorded in B_4 could be as a result of sweet nature of biscuit waste BW coupled with low fibre content moreover the protein content of BW was a bit higher than that of maize. The weight gain recorded in all the treatments compared favourably with the report (Ejidike, 2001; Omole 2008). The feed conversion ratio which is the ratio of the feed intake weight was not significantly influenced by the varying levels of biscuit waste in the diet which implies that maize could be partially or wholly replaced by BW in the diet of growing snails. The shell length and width increased numerically as the level of BW in the diet increased though no significant differences were observed (P>0.05). The shell growth depends on the level of minerals content of the feed vis-à-vis ash content (Amusan and Omidiji; 1998). As shown in table 1 the ash content of BW was a bit higher than that of maize. The shell thickness in all the treatment was relatively the same (P>0.05). As shown in table 4, The dressing percent of the snails was relatively the same in all the treatments (P>0.05). The values varied between 41.3 in B_4 to 40% in B_1. The dressing percent observed in this study compared favourably with the reports of other researchers (Bright 1996; Amusan and Omidiji 2008). The relatively the same dressing percentage observed in all the treatments also signifies that BW could be used as replacement for maize in the diet of growing snails. The results of cost analysis shows that cost /kg feed and total feed cost reduced as the level of BW in the diet increased and this could be due to the fact that the cost of maize was higher than that of BW as shown in table 3.The lowest cost per weight gain was recorded in B_4 while the highest cost per weight gain was observed in the control treatment with zero level of BW.

Table 2. Determined Proximate Composition of the Maize, Biscuit waste and Experimental diets

Parameters	**Maize**	**Biscuit waste**	**B_1 (0%)**	**B_2 (50%)**	**B_3 (75%)**	**B_4 (100%)**
Dry Matter	96.78	95.67	95.92	94.38	94.89	93.80
Crude Protein	9.56	10.36	23.44	23.57	23.84	24.12
Crude Fibre	5.62	4.67	4.88	4.85	4.48	4.43
Ether Extract	4.56	5.98	4.79	4.89	4.94	5.08
Ash	8.94	10.21	10.34	10.56	10.78	10.94
Nitrogen Free Extract	71.32	68.78	53.01	53.19	53.51	53.72

Table 3. Performance of Snail fed Biscuit Waste as Replacement for Maize

Parameters (Means)	**B_1 (0%)**	**B_2 (50%)**	**B_3 (75%)**	**B_4 (100%)**	**± SEM**
Initial weight (g)	65.7	64.7	63.7	65.9	4.89
Final weight (g)	292.01	292.4	293.2	297.8	8.46
Total weight gain (g)	226.31	227.7	229.5	231.9	8.97
Total feed intake (g)	784.35	785.7	789.3	799.3	8.76
Feed conversion ratio (g)	3.46	3.45	3.44	3.45	0.31
Shell length increment (g)	13.38	13.39	13.45	13.44	1.87
Shell width increment	11.59	11.60	11.61	11.71	0.4
Shell thickness increment	0.15	0.15	0.15	0.16	

Means along rows with different superscript are significantly different from each other (P<0.05)

Table 4 Carcass Analysis of Snail fed Different Levels of Biscuit Waste

Parameters (Means)	B_1 (0%)	B_2 (50%)	B_3 (75%)	B_4 (100%)	± SEM
Live weight (g)	291.51	292.8	292.9	298.6	9.65
Shell weight (g)	65.01	67.05	62.39	61.24	3.9
Offal weight (g)	62.68	62.66	59.46	59.06	3.3
Foot weight (g)	120.24	120.66	120.24	118.13	5.98
Dressing percent (%)	41.25	41.21	41.05	39.56	2.97
Offal/live weight (%)	21.5	21.4	20.3	19.78	2.31
Shell/live weight (%)	22.3	22.9	21.3	20.51	2.41

Means along rows with different superscript are significantly different from each other (P<0.05)

Table 5. Cost Analysis Of Growing Snails Fed Levels Of Biscuit Waste

Parameters (Means)	B_1 (0%)	B_2 (50%)	B_3 (75%)	B_4 (100%)	± SEM
Cost/kg feed (g)	59.7 ^{a}	55.5 ^{b}	53.1 ^{bc}	50.03 ^{c}	4.1
Total feed intake (g)	0.78	0.79	0.79	0.80	
Total feed cost (N)	46.57 ^{a}	43.85 ^{ab}	41.95 ^{b}	40.02 ^{b}	3.6
Total weight gain (g)	0.226	0.228	0.230	0.221	
Cost/weight gain (N/kg)	206.06 ^{a}	192.33 ^{b}	182.39 ^{c}	181.09 ^{c}	9.9

Means along rows with different superscript are significantly different from each other (P<0.05)

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13/7/2009

Science of Semiotic Usage in Advertisements and Consumer's Perception

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Abstract: The modern consumer market has been developing as a web of symbols and signs in multidisciplinary approach to construct brand images in the consumer's perception. Simiology is an advanced subject in which enlightened the semiotics ideally. Marketing, advertising and communication are the inseparable, interwoven major carriers in distinctive market – consumer behavioral world. Marketers are constructing and deconstructing the sign and symbols to make positive image and to bring them the satisfaction to motivate to purchase productions. Potential study of the semiotics shows that the language based media and the image based media are the fundamental and the pervasive medium for the human communication. The sign and symbols can be taxonomies as intrapersonal and interpersonal. Advertisement is capable of manipulating the perception and the behavior of the consumers. Each advertisement is a cultural document and has a cultural shadow which carries to readers to share and negotiate the cultural themes. These symbolic and the iconic conversation are ritualized enactments through the dimensions of cultural esteem. This helps to preserve the culture and help to read the cultural perception becoming natural. [Journal of American science 2010;6(2):6-11]. (ISSN: 1545-1003).

Key words: Advertisements, Semiotics, Culture and Communication

1. Introduction:

"The modern commercial and consumer world is emphasized as a web of meanings and behavioral patterns among people, consumers and marketers, woven from the symbols and the signs ensconced in their time, space in the culture and society. The formation and the use of symbols in particular, can be argued that the ability in the central and differentiating characteristics of the human species which based on human action and interaction are cause for the particularity and the glory of man" (Boulding, Kenneth 1956, P 44). In the present world, signs and symbols are playing a major role and have fostered multiple viewpoints on symbolism and created paths for its province in the lives of the customers and the marketplaces. Semiotics or Semiology is a prominent subject and furthermore, considered as a movement, a philosophy or science which can be used in multidisciplinary approaches. Semiology is the advance subject to study not only the alphabet of symbolic rites, polite formulas, military signals and religious symbols, but also the study of commercials, sit-coms, soap operas, bulletin boards and now the vast usage of internet and other media. In mainly, we are using, learning, reading and deconstructing signs and symbols, even though it is too difficult to studying Semiotics ideally. In our day-to-day life too, we are learning new signs, symbols and they involve continually with their meanings and significance all the time. Language and all the other signs systems are not simply channels, if they give form and meaning to think or experience instead of just naming what was already there, than there is nothing which exists before signs and media communicate thought and experience.

Not only the market system but also internet, new technologies and all the other human activities create new images, icons, symbols and metaphors to study for us to make sense on the cyberspace. Finding the meaning of the commercial world is essential and enigmatic. In this consumer and commercial world marketers have to continually seek strategically facilitate meanings that contribute positively to brand images, satisfaction, purchase likelihood and the like from product design and packaging to advertising and retailing. Consumers are continually acquiring, experiencing, sharing, substantial accordance with the meanings they attribute to products, purchase sites and so forth.

Mostly, North American researchers in the period of 1960s and 1970s pay their attention on gathering information on consumer behavior as socio-cognitive psychological perspectives, economic that dominated the marketing and consumer behavior. The marketing and advertising industry is processing the advantages of socio-psychological discipline into the symbolism to make the effective communication on the brand and the consumer items.

2. Theoretical and conceptual frame of semiotic

One of the main branches of the semiotics in the present world is "consumer or marketing semiotics." The usages of semiotics as a whole in the marketing and consumer field (Noth 1990; pinson1988, 1993) have had two main dominant paradigms. Swiss Linguist Ferdinand

De Saussure's (1857-1913) paradigm which based on social psychology incorporates a two- component model of signifier or "sound image" and the signified or "concept". The relationship between signifier and the signified is arbitrary. Saussure believed that the language is made up of signs (like words) which communicate meanings and that all kinds of other things potentially be studied in the same way as linguistic signs. The same semiotic approach can be used to discuss language-base media and image-based media because in either case we find signs which carry meanings. Since language is the most fundamental and persuasive medium for human communication. Semiotics takes the way that language works as the model for all the other media of communication, all other sign systems.

Saussure's linguistic paradigm which has been based on social psychology has led to a focus attention on

- The role of the structure in communication, meaning and the nature of them.
- The role of the symbolism and its nature.
- The cultural relativity of communication and meaning.

According to Saussure, the relations, actions and interactions are important between words take over individual words when meaning is formed or derived. For instance, the piece on the chessboard makes relationship with all the other pieces on its. Numbers of pieces are vital on the board and their moving to one another or as a piece will alter all the pieces and their relations in the game. Relations, actions, interactions and all the moves and the positions of the pieces on the board are very important. So Language is the epitome of self- contained relational structural world. According to the Saussurean sense the paradigm is a set of signs and syntagm means signs chosen from several paradigms to form the massage. Paradigmatic relation is most important in the massage. These relations reveal the oppositions and contrast between signs in a set. Scenes and background setting forms are very vital factors to develop the key settings in the message that brings by the advertisement. These paradigmatic relations convey the meaning or a massage through the differences between the sign which are selected and those not selected.

This Saussuraean fundamental paradigmatic relations theory has been developed and modified by Baudrillar, Barthes, Derrida, Griemas and Lacan. French researchers, Barthes (1967[1964]), Durand (1970), and Peninou (1972) have applied this paradigm in their marketing and consumer phenomena. This paradigm cross the Atlantic to begin influencing marketing scholars in North America and simultaneously traversed eastward into Asia.

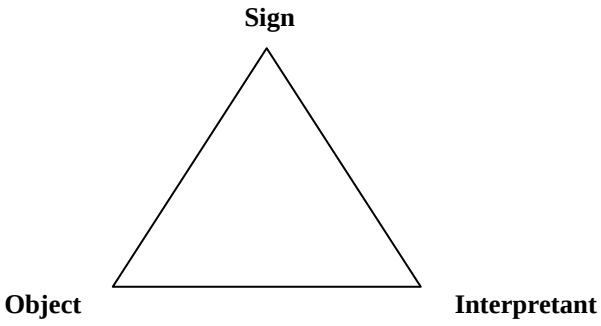
In economic context the saussurean perspective of meaning through difference has been implicated as both the fuel of healthy market competition (Gardner and Levy 1955) and an institutionalized flaw of western cultures (Sahlins 1976).

Peirce's Anglo- Saxon frame work is the second dominant semiotic paradigm which strongly based on Philosophy and touches some extent Physical science (Peirce1931 – 58). According to my view Peirce is the one who has so far delivered the broadest and most advanced theoretical frame work on the semiotics. The triadic and evolutionary semiotics of C.S.Peirce has a phenomenological angle that places signification, emotions and perceptions at the basis of his theory of how we create meaningful signs in cognitions and communication. Peirce is considered to be the co-founder of the semiotics along with the Saussure. He defines semiotics as the "doctrine" of signs stand for something else and that is understood or has some meaning for somebody. A sign is used as a substitute for another thing in order to transmit a concept about it (Peirce1958). A *sign* serves to represent or substitute *something* which may not be present, to some system capable of interpreting such substitution. Peirce adopted John Lock's vision of semiotics and set out from a logic-centered orientation. Peirce theory incorporates with a three part model.

- The representmen (sign proper)
- The object (to which the sign refers)
- The interpretant (interpretation or response with the observer/ communicator.

To strengthen the Peirce's paradigm has been included a sophisticated set of distinctions, labels and stages among the three components or objects of his model and further has made relations among the components. Like Saussure, pierce explained sign process in terms of relations. Saussure spoke the "dyadic" relations in his paradigm. But Peirce built up his paradigm on "triadic" relations (tri-relative influences) (Peirce1931-58. P. 484).

Figure 01: Triadic Semiosis Concept of Peirce



Peirce semiosis philosophy anchored in the real world which based on the people, social institution and culture. He determined the interpreter's reaction into the signs which can be transmutation and transmitted through the social environment (Sebeok, 1976). A symbolic signs relates to its object in an entirely conventional manner, as such it requires the participative presence of an interpreter to create the signifying connection. One of the major focuses of Peirce semiosis was the relationship of sign and

interpreter. He argued that the cognition is a process of knowledge and meaning generation through signs. This will be taken three forms: deduction, induction and abduction.

The scholars like Jakobson, morris and Sebeok among the others helped to spread Peirce's theory into the international recognition. However Sausser's and Peirce's dominant paradigms and their applications in consumer research and marketing are noticeably varied due to the differing ontological and epistemological heritage on them. The Saussurian paradigm which mostly based on linguistics has been used in structural text interpretive analysis of meaning.

Shortly after Saussure and Peirce, Orden and Richards (1923) spurred the development of semiotics with their classic work. In the semiotic history, American semioticeans have been played an influential role up to present. Charles Morris who tried to develop a comprehensive science of signs in the social sciences, stressed that sign has a science and subdivided it mainly as semantics, syntactic and pragmatic.

Syntactic pave the way for the signs and sign relations. Semantics in the study of the signs and object relations and pragmatics role is to study the signs and its interpretation relations. However the trichotomy of syntactic, semiotics and paradigmatic is the most enduring aspect of the Morris's semantic paradigm (Holbrook1978).

According to his classification the quality of semiotics as a whole or each of these can be pure (pure semiotics elaborate a language to talk about signs), descriptive (study actual signs) and applied (utilizes knowledge about signs for the fulfillment of various purpose ad tasks of the people and society).

According to the pre semiotic approach signs can be taxonomies as intrapersonal and interpersonal. Gift can be considered as a symbol. The gift- giving literature in consumer behavior stressed that the gift giving is a reward for various consumers' indulgence of the self for past behavior. These intrapersonal and interpersonal behaviors have been measured by the social, personal and economic behaviors. Gift are also an icon and can be taxonomies as aesthetic, educational, utilitarian and so on. Mostly advertisements subjected to the descriptive semiotics (Fiske 1982, Leymore 1975). Applied semiotics is very vital when using the sings in specific context of acquisition, consumption and disposition. For an instance, advertising and information consumption.

Most probably Morris strived to understand the linkage between Saussure and Peirce's semiotics and the semiotics in North America. Among the many other disciplines philosophers like Cassier, Langer, Anthropologists (Douglas, Levi-Strauss, Singer) Sociologists (Warner) have argued that the semiotics probably are in the symbolic dimension. In addition, Field theorists (Lwei), symbolic interactionists (Blunder) ethno methodologists (Garfinkel) structuralists (Levi-Strauss) socialization theorists (Ervin Goffman) have shared their field with the semiotics. They had responsible for bringing this inter disciplinary doctrine with vast range of topics into the public light.

3. Semiotic in Marketing Advertisements

Marketing, Advertising and communication are the inseparable, three major concepts in the distinctive market – consumer behavioral world. Specially, advertisements mainly bring the language, photo graphics, colors, and other symbols for its own usage to make consciousness on the production and its grandeur on the customers and outside. In the present world advertising is a large scale business and is a part of the national economy in many countries.

Advertisements construct, form and manipulate the perception and the behavior of its consumers and the outside. All the symbols are paying an immeasurable service of presenting and apprehending the culture and the world. Theoretical back ground clearly immerge the interdisciplinary doctrine with vast range of topics to make consciousness on the academics and public on this purpose.

One of the most prominent theories, Mick's schema theory has blended semiotics and showed the viewers its capability of specialization of the social structure, processing and involving attitudes, memory and cognition as well as written and spoken text (Brewer and Nakamura 1984, Hastie1981, Thondyke and Yekovich 1980). Goal, knowledge and text schemata are the three genres of schema theory of Mick proposed into marketing communication research. The goal and knowledge schemata are vital factors and probably make the relations with both marketers and consumers. According to Mick, the text schemata mainly involves in the linguistic massages in marketing communication. This schema theory has the ability to enrich the marketing communication research.

Some scholars like Sherry points that the advertising is a cultural document, a way of presenting and apprehending the world (Sherry 1985, P.1). Each and every advertisement is included cultural shadow and let the readers to negotiate and share the cultural theme. Symbols are manmade and man making. These symbols constructed the world and made the net work of social relations in much the same way as religion, science and arts. Religion can form a religious world. Science and arts construct the scientific and aesthetic world. Symbolic action and symbolic interaction indulge in the social stream to construct the shadows of the distinctive behaviors of human.

The symbolic and iconic conversation and conventions in the advertisements transports its audience via ritualized enactments through the dimensions of experiences the cultural esteems (Fox 1984). This

repetitive ritual will help to preserve the culture by reducing the variance in the cultural behavior and probably help to lead the cultural perceptions to become natural perceptions. Advertisements construct the definitive reality in the perception. This make the product therapy (Henry 1959) in the competitive marketing world, communicate powerfully and leads to the over consumption world.

4. Colors as a contribution to visual semiotic

Color may function as a sign for a physical phenomenon, for a psychological mechanism or for a psychological association. Color can represent s different things. Mostly, we can realize, can remember and can identify something through color. It's seems that generally colors imprint on memory in vivid manner. Colors are effectively functioning as signs and colors signify different things. It allows us to differentiate objects. Colors construct a visual world and perform highly informative functions. Colors functions as aesthetically and have the ability of duplicating the universe.

Color plays a major role as an instrument in the marketing and consumer world. It makes the relations with values, prestige, durability and utility. The relationship between signs and objects are through and effective. According to the semantic dimensions of the semiosis, classes can be known as Icon, Index and Symbol.

The main purpose of the color is to construct the perception in the human mind. It has the ability of making identity of the object in which depicted in the advertisement and brings the information about the external world. For an example, somebody can make up ones face in yellow in order to feign an illness but ideal he / she does not suffer from. This deceived by the trick, thinks as it does. The addresser tries to produce the deception by the color on the skin, as an icon in order to look like ill person. The receptor believes that the illness really exists. (Indexical relation in color) color is mostly used with the purpose of deceiving, occulting, feigning and camouflage the people (Luckiesh, 1965). In this sense colors are used in commercial transactions and specifications in industry where small piece, drop or a clot of the colors stands to indicate the appearance of the whole product.

Magarinos' subdivide of indexical signs shows three categories as signals clues and symptoms.

Signals: - Signals is a sign that appears before its objects. For a example, when a pedestrian sees the green figure on the traffic light and understand, all the vehicle stop and let him to cross the road. (T.V.ad - Sri Lanka)

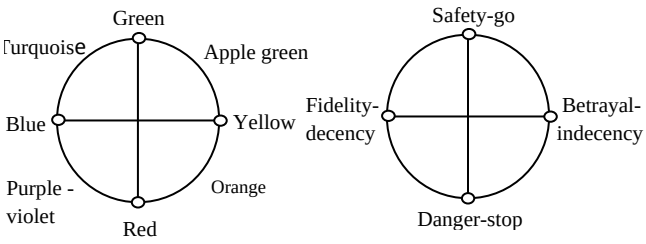
***Clue*:** - Clue is a sign that remain after its object has caused it. For an instance, dark mud spot remains for a certain time on the cloth is a clue to what happened. (T.V.ad - Sri Lanka)

***Symptom*:** - Symptom is a sign that happens simultaneously with the event that constitutes its object. All these types of indexical signs, colors usually perform a primary role not does only in the consumer and marketing world.

Symbolicity in color is another effective illustrative factor in the world. Color symbolicity can remarks and enclose various psychics, physics and other social and behavioral factors of the entire world. For instance, red = danger, stop; Yellow = warning; Green = safety, go; (color association in the traffic light).In the football match a yellow card means admonition. Red card means stop playing. But in the industrial architecture green = safety, association with the triangular shape. Yellow = precaution, associated with the triangular shape. Red = prohibition, stop, association with circular shape or fire prevention materials (Jannello). Signs do not belong definitively to one or another but vary according to the context. Sign yellow may be a signal in one context but may be a symbol in another.

In western countries, mostly, white and black associated birth and dearth (Arnheim, 1978). Color purple illustrates the royalty in the Rome Empire. Only the Generals, Senators, Victorious are allowed to wear purple color. But this indexical color association has been disappeared today. But this color coveys the meaning of nobility, dignity, elevated position and magnificence. Most probably opposite concepts are constructed coincidently with opposite hues. For instance, we can compare the relative position of hues and the color arrangements with the meanings assigned to each one in this chromatic circle.

Figure 02: Colors with Conventional Meanings



Yellow as a symbol of betrayal and indecency as opposed to blue, blue is a symbol of fidelity and decency. Green is considered as go or safety as oppose to red. Red means danger or stop.

One of the main surveys was the john Hutchings who surveyed the different cultures and traditions with purpose of studying the color symbolism they use for their clothing, foods, decorations, certain ceremonies an all the other actions in day to day life. Colors can make important symbolic patterns to shape and illustrate the texture and have the ability to make the collective consciousness

(Hutchings, 1989/1993).Mass consciousness and perception of the advertiser on the socio cultural, color and aesthetical existing of the world would bring prosper to brands to master along with the mechanics products placement. Colors construct the attractive perception on the brand and help to make the creative marketing, which can shape people's gut reaction to brands without being explicitly recalled. In present commercial world markertized advertisements too and has used this as a profitable business.

5. Semiotic and brand strategy

Brand strategy researchers have emphasized that the importance of brand communication in building up and maintain the brand equity and brand identity (Sherry 1987). Verbal, audio and visual signs powerfully symbolize and represent its capability and strength to capture the hearts and minds of the consumers. Advertisements are the main instrument for building awareness, positive associations and long-term customer loyalty on the brand. The brand is the process of the signs and symbols, which cause of imposing tangible value to a product offering. Thus, semiotics is great asserted in advertising, packing and brand logo for communication and to ties consumption to the form of brand and its production. The logo, McDonald's is one of the effective and prominent ads in the marketing and advertising industry.

Laura R Oswarld has illustrated the McDonald's logo according to the following signifying elements.

* Material - A visual icon
* Structural - Brand name imposed on the arches in white and squared front elegantly. Arches moved to the left and logo moved off to the right. Logo highlighted the suggesting movement. Arches are golden in the red back ground.
* Codified - Structural ground and the color scheme signify the company and the brand. This tells the consumers; McDonald's is not far away.
* Contextual - For example, US markets treat McDonald as cheap, unhealthy fast food. But in China and Sri Lanka, McDonald's represent highly in social class and considered as special treatment. This logo indicates the time and place as the subjective connotation .
* Performative - This logo engage in the highly performance with the consumers, spectators and calling them to building up the action towards it.

The present advertising is considered not only as an occasional conduit of product information but as also an omnipresent communication arena in which making the human perception creative and ambitious. This cannot be considered as solitary subject and persuade the people to judge the brands and make consciousness on them. Consumers understanding and all the clarifications on these occurred within the boundaries of the ads signs structure and denoted content and the consumers' history (past, current and projected) and socio – cultural milieu. Advertising is quasi – fictional, culturally constituted system of symbols in which products are strategically synchronized with scenes, props, people and action (Douglas and Isherwood, 1979, Mick, 1986).

Mostly consumers interpret advertisements as a principle way to understanding their world and themselves and finally they become the arbitrators of the advertising meaning. (McCracken, 1986),) Advertisement is a symbolic resource. It brings new ideas and better concrete versions of old ideas with which to advance their projects and defining, coordinating, planning and manipulating individuals and the society.

6. Conclusion

Advertising, Communication and marketing are cultural products which are inseparable from consumer's perception in this technological world. This tripod enlightens the production in the consumer's world and makes the product therapy to grasp the production through the powerful communication. Thus advertisement contextualizes the ideological and the fashionable world - via preferred styles, body aesthetics or social identifications and it interpreted the anti-fashion and self directed orientation. Consumer world expresses the system of values, self direction, progressive improvement or self development, social mobility and modernity, generally optimist outlook on the future. Thus modern advertising system has been leading for the hegemonic fashionable culture. Advertising culture has mediated in the macro societal structure but meaningful them in a micro practices of everyday life.

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01. 10. 2009

Performance of an endoreversible Atkinson cycle with variable specific heat ratio of working fluid

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Abstract: The performance of an air standard Atkinson cycle is analyzed using finite-time thermodynamics. In the endoreversible cycle model, the linear relation between the specific heat ratio of the working fluid and its temperature, and the heat transfer loss are considered. The relations between the net work output, the thermal efficiency, and the compression ratio are indicated by numerical examples. Moreover, the effects of variable specific heats of the working fluid on the endoreversible cycle performance are analyzed. The results show that the effect of the temperature dependent specific heat of the working fluid on the endoreversible cycle performance is significant. The conclusions of this investigation are of importance when considering the designs of actual Atkinson engines. [Journal of American Science 2010;6(2):12-17]. (ISSN: 1545-1003).

Key words: Atkinson heat-engine; Finite-time processes; Heat loss; Performance; Thermodynamics

1. Introduction

Recently, the analysis and optimization of thermodynamic cycles for different optimization objectives has made tremendous progress by using finite-time thermodynamics (Aizenbud and Band, 1982; Bejan, 1996; Chen et al., 1999; Wu et al., 1999; Chen and Sun 2004; Aragon-Gonzalez et al., 2006). Leff (1987) determined the thermal efficiency of a reversible Atkinson-engine cycle at maximum work output. A power density maximization of a reversible Atkinson cycle has been performed by Chen et al. (1998a). Their results showed that the efficiency at maximum power density is always greater than that at maximum power, and the design parameters at maximum power density lead to smaller and more efficient Atkinson engines with larger pressure ratios. Al-Sarkhi et al. (2002) compared the performance characteristic curves of the Atkinson cycle with those of the Miller and Joule–Brayton cycles by using numerical examples, and outlined the effect of maximizing power density on the performance of the cycle efficiency. Qin et al. (2003) derived the performance characteristics of a universal generalized cycle model, which included the Atkinson cycle, with heat-transfer loss. Wang and Hou (2005) studied the performance analysis and comparison of an Atkinson cycle coupled to variable temperature heat reservoirs under maximum work and maximum power density conditions, assuming a constant specific heat, too. Their results showed an engine design based on maximum power density is better than that based on maximum work conditions, from the view points of engine size and thermal efficiency. Ge et al. (2005a) derived the performance characteristics of a universal generalized cycle model, which included the Atkinson cycle with heat transfer and friction-like term losses. Zhao and Chen (2006) performed analysis and parametric optimum criteria of an irreversible Atkinson heat engine using finite time thermodynamics. Performance analysis of an Atkinson cycle with heat transfer, friction and variable specific heats of the working fluid was studied by Ge et al. (2006). Their results showed that the effects of variable specific heats of working fluid and friction-like term losses on the irreversible cycle performance are significant. Ge et al. (2007) analyzed the effects of the heat transfer and variable specific heats of working fluid on the performance of an endoreversible Atkinson cycle. Hou (2007) compared the performances of air standard Atkinson and Otto cycles with heat transfer loss considerations. Lin and Hou (2007) investigated the effects of heat loss, as characterized by a percentage of fuel's energy, friction and variable specific heats of the working fluid, on the performance of an air standard Atkinson cycle under the restriction of the maximum cycle-temperature. Chen et al. (2007) built a class of generalized irreversible universal steady flow heat engine cycle model consisting of two heating branches, two cooling branches, and two adiabatic branches with consideration of the losses of heat resistance, heat leakage, and internal irreversibility. The performance characteristics of Diesel, Otto, Brayton, Atkinson, Dual and Miller cycles were derived. Chen et al. (2008) analyzed and

compared the performance characteristics of endoreversible and irreversible reciprocating Diesel, Otto, Atkinson, Brayton, Braysson, Carnot, dual, and Miller cycles with constant and variable specific heats of the working fluid. Thermodynamic analysis of an ideal air-standard Atkinson cycle with temperature dependant specific heat is presented by Al-Sarkhi et al. (2008). This paper outlines the effect of maximizing power density on the performance of the cycle efficiency. Ge et al. (2008a, 2008b) analyzed the performance of an air standard Otto and Diesel cycles. In the irreversible cycle model, the non-linear relation between the specific heat of the working fluid and its temperature, the friction loss computed according to the mean velocity of the piston, the internal irreversibility described by using the compression and expansion efficiencies, and the heat transfer loss are considered. Ust (2009) made a comparative performance analysis and optimization of irreversible Atkinson cycle under maximum power density and maximum power conditions.

All of the above mentioned research, the specific heats at constant pressure and volume of working fluid are assumed to be constants or functions of temperature alone and have the linear and or the non-linear forms. But when calculating the chemical heat released in combustion at each instant of time for internal combustion engine, the specific heat ratio is generally modeled as a linear function of mean charge temperature (Gatowski et al., 1984; Ebrahimi, 2006). The model has been widely used and the phenomena that it takes into account are well knows (Klein, 2004). However, since the specific heat ratio has a great influence on the heat release peak and on the shape of the heat release curve (Brunt, 1998), many researchers have elaborated different mathematical equations to describe the dependence of specific heat ratio from temperature (Gatowski et al., 1984; Brunt, 1998; Egnell, 1998; Klein, 2004; Klein and Erikson, 2004; Ceviz and Kaymaz, 2005). It should be mentioned here that the most important thermodynamic property used in the heat release calculations for engines is the specific heat ratio (Ceviz and Kaymaz, 2005). Therefore, the objective of this study is to examine the effect of variable specific heat ratio on the net work output and the thermal efficiency of air standard Atkinson cycle.

2. Cycle model

The Atkinson cycle engine is a type of internal combustion engine, which was designed and built by James Atkinson in 1882 (Ge et al., 2005a). The Atkinson cycle, one of the most heat-efficient, high-expansion ratio cycles, is designed to provide efficiency at the expense of power. The Atkinson cycle allows the intake, compression, power, and exhaust strokes of the four-stroke cycle to occur in a single turn of the crankshaft. By the use of clever mechanical linkages, the expansion ratio is greater than the compression ratio, resulting in greater efficiency than with engines using the alternative Otto cycle. The cycle for this engine is depicted in figure 1. The cycle is also called the Sargent cycle by several physics oriented thermodynamic books (Ge et al. 2007).

Figure 1 presents pressure-volume $(P-V)$ and temprature -entropy $(T-S)$ diagrams for the thermodynamic processes performed by an air standard Atkinson cycle. Process $(1\to 2)$ is an adiabatic (isentropic) compression; process $(2\to 3)$ is a heat addition at a constant volume; process $(3\to 4)$ adiabatic (isentropic) expansion; process $(4\to 1)$ is heat rejection at a constant pressure.

As already mentioned in the previous section, it can be supposed that the specific heat ratio of the working fluid is function of temperature alone and has the linear forms:

$$\gamma = \gamma_\circ - k_1 T \tag{1}$$

where γ is the specific heat ratio and T is the absolute temperature. $\gamma_\circ$ and k_1 are constants.

The heat added to the working fluid, during processes $(2\to 3)$ is

$$Q_{in} = M\left(\int_{T_2}^{T_3} c_v dT\right) = M\int_{T_2}^{T_3}\left(\frac{R}{\gamma_\circ - k_1 T - 1}\right)dT = \frac{MR}{k_1}\ln\left(\frac{\gamma_\circ - k_1 T_2 - 1}{\gamma_\circ - k_1 T_3 - 1}\right) \tag{2}$$

where M is the molar number of the working fluid. R and c_p are molar gas constant and molar specific heat at constant volume for the working fluid, respectively.

The heat rejected in the isobaric heat rejection process $(4\to 1)$ may be written as

$$Q_{out} = M\int_{T_1}^{T_4} c_p dT = M\int_{T_1}^{T_4}\left(\frac{(\gamma_\circ - k_1 T)R}{\gamma_\circ - k_1 T - 1}\right)dT = MR\left[T_4 - T_1 + \frac{1}{k_1}\ln\left(\frac{\gamma_\circ - k_1 T_1 - 1}{\gamma_\circ - k_1 T_4 - 1}\right)\right] \tag{3}$$

where c_p is the molar specific heat at constant

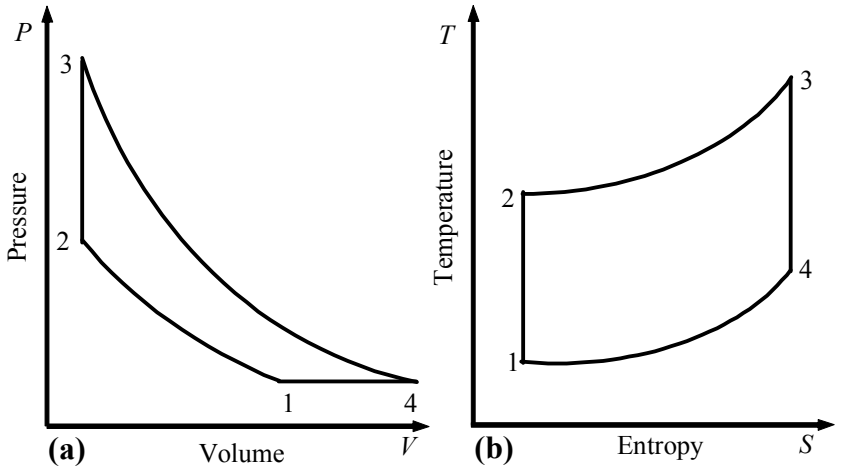

Figure 1. (a) $P-V$ diagram;(b) $T-S$ diagram for the air standard Atkinson cycle

pressure for the working fluid.

According to references (Ge et al., 2006; Ebrahimi 2009), the equation for a reversible adiabatic process with variable specific heat ratio can be writing as follows:

$$TV^{\gamma-1}=\left(T+\mathrm{d}T\right)\left(V+\mathrm{d}V\right)^{\gamma-1} \tag{4}$$

Re-arranging equations (1) and (4), we get the following equation

$$T_i\left(\gamma_\circ-k_1T_j-1\right)=T_j\left(\gamma_\circ-k_1T_i-1\right)\left(V_j/V_i\right)^{\gamma_\circ-1} \tag{5}$$

The specific compression, r_c , and compression, r_c^*, ratios are defined as

$$r_c=V_1/V_2 \tag{6}$$

and

$$r_c^*=\frac{V_4}{V_2}=\frac{T_4}{T_1}r_c \tag{7}$$

Therefore, the equations for processes ($1\rightarrow 2$) and ($3\rightarrow 4$) are shown, respectively, by the following:

$$T_1\left(\gamma_\circ-k_1T_2-1\right)\left(r_c\right)^{\gamma_\circ-1}=T_2\left(\gamma_\circ-k_1T_1-1\right) \tag{8}$$

$$T_3\left(\gamma_\circ-k_1T_4-1\right)=T_4\left(\gamma_\circ-k_1T_3-1\right)\left(\frac{T_4}{T_1}r_c\right)^{\gamma_\circ-1} \tag{9}$$

The energy transferred to the working fluid during combustion is given by the following linear relation (Chen et al. 1998b; Ge et al., 2008a).

$$Q_{in}=M\left[A-B\left(T_2+T_3\right)\right] \tag{10}$$

where A and B are two constants related to combustion and heat transfer which are function of engine speed. From equation (10), it can be seen that Q_{in} contained two parts: the first part is MA , the released heat by combustion per second, and the second part is the heat leak loss per second, $Q_{leak}=MB\left(T_2+T_3\right)$.

From equations (2) and (3), the net work output of the Atkinson cycle engine is given by:

$$W_{out}=Q_{in}-Q_{out}=$$
$$\frac{MR}{k_1}\ln\left(\frac{\left(\gamma_\circ-k_1T_2-1\right)\left(\gamma_\circ-k_1T_5-1\right)}{\left(\gamma_\circ-k_1T_4-1\right)\left(\gamma_\circ-k_1T_1-1\right)}\right)+MR\left(T_4-T_3\right) \tag{11}$$

The thermal efficiency of the Atkinson cycle engine is expressed by:

$$\eta_{th}=\frac{\frac{1}{k_1}\ln\left(\frac{\left(\gamma_\circ-k_1T_2-1\right)\left(\gamma_\circ-k_1T_5-1\right)}{\left(\gamma_\circ-k_1T_4-1\right)\left(\gamma_\circ-k_1T_1-1\right)}\right)+T_4-T_3}{\frac{1}{k_1}\ln\left(\frac{\gamma_\circ-k_1T_2-1}{\gamma_\circ-k_1T_4-1}\right)+T_4-T_3} \tag{12}$$

When the values of r_c and T_1 are given, T_2 can be obtained from equation (8), then, substituting equation (2) into equation (10) yields T_3 . The last unknown is T_4 , which can be deduced from equation (9). Finally, by substituting T_1 , T_2 , T_3 and T_4 into equations (11) and (12), respectively, the net work output and thermal efficiency of the Atkinson cycle engine can be obtained. Therefore, the relations between the net work output, the thermal efficiency and the compression ratio can be derived.

3. Numerical examples and discussion

According to references (Ebrahimi, 2009, Ghatak and Chakraborty, 2007; Ge et al., 2007, Chen et al., 2006; Ge et al., 2005b) the following constants and ranges of parameters are used in the calculations: $T_1=360\,K$, $\gamma_\circ=1.31-1.41$, $A=60000\,J.mol^{-1}$,

$M = 1.57 \times 10^{-5}\ kmol$, $k_1 = 0.00003 - 0.00009\ K^{-1}$ and $B = 28\ J.mol^{-1}K^{-1}$. Numerical examples are shown as follows.

Figures 2-5 show the effect of the parameters $\gamma_\circ$ and k_1 related to the variable specific heat ratio of the working fluid on the Atkinson cycle performance with considerations of heat transfer. From these figures, it can be found that $\gamma_\circ$ and k_1 play a key role on the work output and the thermal efficiency. It is clearly seen that the effects of $\gamma_\circ$ and k_1 on the work output and thermal efficiency are related to compression ratio. They reflect the performance characteristics of an endoreversible Atkinson cycle engine. It should be noted that the heat added and the heat rejected by the working fluid decrease with increases of $\gamma_\circ$, while increase with increasing k_1. (see Eqs. (2) and (3)). It can be seen that the effect of $\gamma_\circ$ is more than that of k_1 on the net work output and thermal efficiency. It should be mentioned here that for a fixed k_1, a larger $\gamma_\circ$ corresponds to a greater value of the specific heat ratio and for a given $\gamma_\circ$, a larger k_1 corresponds to a lower value of the specific heat ratio.

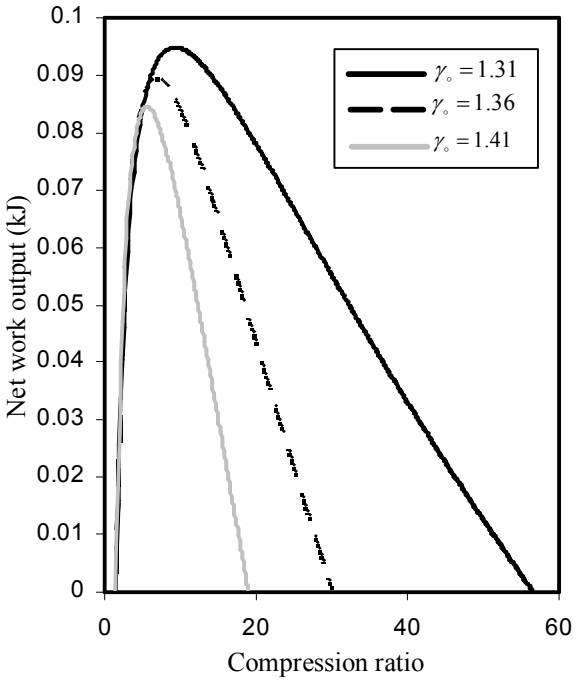

Figure 2. Effect of $\gamma_\circ$ on the variation of the net work output with compression ratio $\left(k_1 = 0.00006\ K^{-1}\right)$

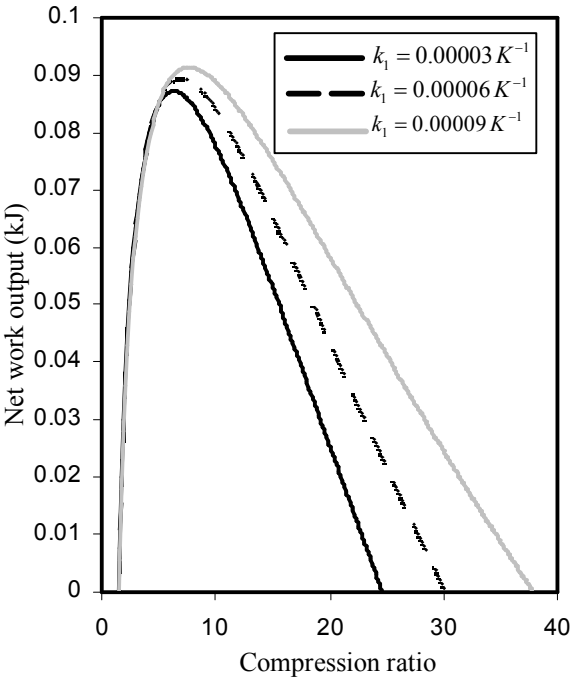

Figure 3. Effect of k_1 on the variation of the net work output with compression ratio $\left(\gamma_\circ = 1.36\right)$

The effects of $\gamma_\circ$ and k_1 on the net work output are shown in Figures 2 and 3. It can be found from these figures that the net work output versus compression ratio characteristic is approximately parabolic like curves. In other words, the net work output increases with increasing compression ratio, reach their maximum values and then decreases with further increase in compression ratio. It can also be found from the figures 2 and 3 that if compression ratio is less than certain value, the increase (decrease) of $\gamma_\circ$ (k_1) will make the net work output bigger, due to the increase in the ratio of the heat added to the heat rejected. In contrast, if compression ratio exceeds certain value, the increase (decrease) of $\gamma_\circ$ (k_1) will make the net work output less, because of decrease in the ratio of the heat added to the heat rejected. One can see that the maximum net work output, the working range of the cycle and the optimal compression ratio corresponding to maximum net work output decrease (increase) about 11% (4.8%) and 66.5% (54.7%), 43.6% (25%) when $\gamma_\circ$ (k_1) increases 7.6% (200%). This is due to the fact that the ratio of heat added to heat rejected increases (decreases) with increasing $\gamma_\circ$ (k_1) in this case. It should be noted here that both the heat added and the heat rejected by the working fluid decrease with increasing $\gamma_\circ$ (see Eq. (4)), and increase with increase of k_1 (see Eq. (5)).

The effects of $\gamma_\circ$ and k_1 on the thermal efficiency are shown in Figures 4 and 5. It can be found that the thermal efficiency increases with the increase of $\gamma_\circ$ and the decrease of k_1 throughout the compression

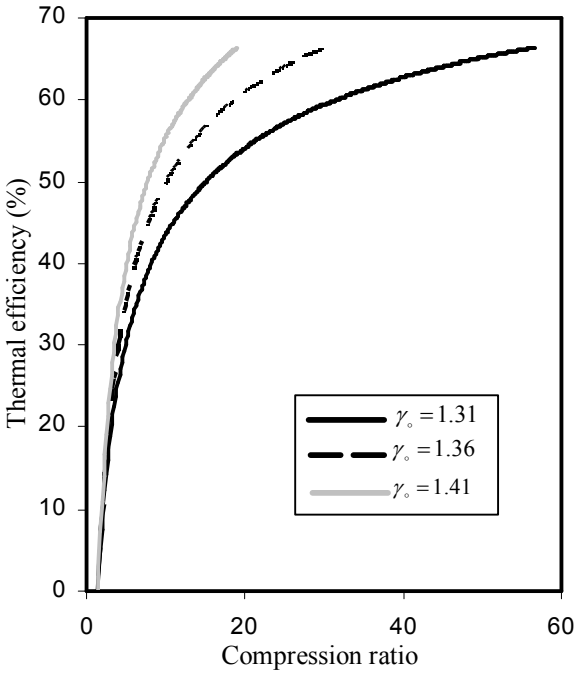

Figure 2. Effect of $\gamma_\circ$ on the variation of the thermal efficiency with compression ratio $\left(k_1 = 0.00006\,K^{-1}\right)$

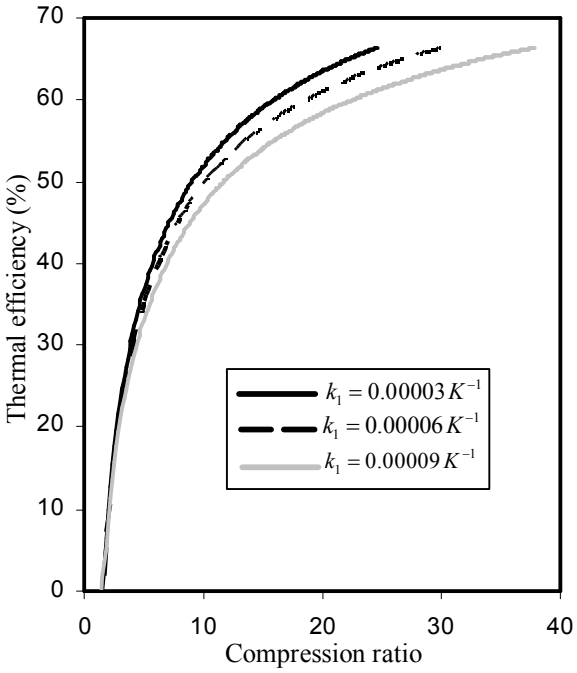

Figure 3. Effect of k_1 on the variation of the thermal efficiency with compression ratio $\left(\gamma_\circ = 1.36\right)$

ratio range. On average, the thermal efficiency increases (decreases) by about 29.7% (9.3%) when $\gamma_\circ$ (k_1) increases (increases) 7.6% (200%) over a range of compression ratios from 1.4 (1.4) to 18.9 (24.6).

4. Conclusion

In this paper, an endoreversible air standard Atkinson cycle model taking considerations of heat transfer loss and the variable specific heat ratio of working fluid is presented. The relations between the net work output and the compression ratio and between the thermal efficiency and the compression ratio of the cycle are derived. The effects of the cycle parameters, such as $\gamma_\circ$ and k_1, on the net work output and the efficiency were analyzed by detailed numerical examples. The results obtained may provide a theoretical basis for both the optimal design and operation of real Atkinson heat engines.

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9/10/2009

Fishing crafts characteristics and preservation techniques in Lekki lagoon, Nigeria

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Abstract: The fishing crafts characteristics and preservation techniques in Lekki between March, 2006 and February, 2008 were investigated. The fishing crafts in the lagoon were mainly the monohull (single hull) wooden dugout canoes, planked canoes and the planked dugout or half dugout canoes. The dugout canoes were carved out from a log of red iron wood (*Lophira alata*) which predetermines its size with length overall (LOA) which ranged between 3.10 and 6.76m, the maximum breadth (moulded) ranged between 0.71 and 1.00m. The LOA of half dugout canoes ranged between 5.33 and 10.20m, the maximum breadth (moulded) ranged between 0.86 and 1.49m and the depth moulded ranged between 0.42 and 0.77 m. The planked canoe had flat bottom hull completely built with planks fixed together with frames, u-shaped metal fasteners and nailing a strip of galvanized iron aluminum pluck caulking over the plank seams (joints). The canoe preservative used in the lagoon was by painting with bitumen, coating the back hull with cement and bitumen with ground pepper, although there has not been any scientific backing for the use of pepper against biofouling attack, the fisherfolks guaranteed its success. [Journal of American Science 2010;6(2):18-23] (ISSN: (ISSN: 1545-1003).

***Keywords*:** Fishing craft, dug out, planked canoes, biofouling, fisherfolks

Introduction

Like fishing gears, crafts have passed the test of time, evolving from logs of wood, floating calabash and papyrus raft to wooden dugout canoes, planked canoes and fibre glass, all in an attempt to improve effectiveness, complement changing water condition and various fishing gear developed and employed (Ambrose *et al.*, 2001). They stated further that in the coastal artisanal fisheries, crafts are designed to suit the following: Surf crossing, beach landing, buoyancy and stability at sea and different types of artisanal fishing techniques. Gulbrandson (1974) and Haug (1974) outlined the construction and suitability of V-shaped and flat shaped bottom canoes respectively in different water bodies and stated the restrictive use of flat bottom cause in inland protected water ways. Udolisa and Solarin (1985) gave an account of the performance of a 13-metre (LOA) wooden shallow draft vessel designed to cross over the estuarine sand bars of Imo River. Ambrose et al. (2001) recorded that the design and construction of an ideal fishing craft is an illusive idea, because the condition for an ideal crafts so varied and depends on an array of factors such as people's culture, fishing gear, water body and motorization. It is therefore easier to design a craft that will satisfy a few major concerns at a time.

According to Kwei (1961) the attachment of outboard motors to the dugout canoes presents quite a problem. It was further recorded that in Ivory Coast the fishermen used outboard motor/engine in a well in the centre of the boat to enable them to get to and from the fishing grounds faster. The fitting of outboard engine was also reported by Udolisa et al (1994) for most planked canoes in Nigeria. Kwei (1961) reported side fitting of outboard engine in Ghana. Solarin (1998) recorded the canoes types used in the Lagos lagoon where the three aforementioned types of canoes were identified.

Solarin (1998) stated that dugout canoes generally provided little space to accommodate the crew, gear and the fish caught during fishing operation. It was further reported that the dugout canoes had relatively small free board and thereby displayed low reserved buoyancy and were less stable compared to any other canoe types. It was added that all the dugout canoes were propelled with paddles.

Solarin (1998) also stated that the planked canoe with flat bottom hull was completely built with planks fixed together with frames, U-shaped metal fasteners and nails. It was further implicated that the joints were generously sealed by caulking with natural fibres or yarns especially cotton often soaked in oil mixed with the lime to prevent leakage or seepage. In Lagos lagoon less than half of the planked canoe actually used out board engine (8-15Hp) for fishing operation (Solarin, 1998).

According to Udolisa *et al* (1994) dugout canoes are carved by skilled craftsmen scattered throughout the country from green logs of Opepe (*Nauchia diderrichii),* Mahogany (*Khaya ivorensis),* Afara *(Terminalia ivorensis)* White afara *(Terminalia superb),* red iron (*Lophira alata),* Silk cotton free *(Ceiba pentandra* and *Bombax buonopozense),* Missada (*Erythrophleum suaveolens)* and Obeche *(Triplochiton scleroxylon* and *Alstonia* sp.).

Materials and Methods

Canoe types, specifications and wood materials used in their construction and mode of propulsion were investigated. Monthly inventory of the operational fishing canoes was carried out in 25 villages, settlements and fish landing sites. Principal and constructional dimensions of the canoes such as thwart distance from stern, length overall, length between perpendicular moulded depth at midship, moulded breadth at midship draft and free board were taken with a measuring tape according to the method described by Nomura and Yamazaki (1975) and Ambrose et al (2001). The canoes used in the lagoon exclusively for fishing was distinguished from those used for transportation, sand digging and for buying fish. Biofouling organisms of wooden canoes were collected by scraping part of the affected canoes and identified in the laboratory using appropriate texts (Edmund, 1978).

Results

Small-scale fishing craft type and specifications in Lekki lagoon

The fishing crafts in the lagoon were mainly the monohull (single hull) wooden dugout canoes, planked canoes and the planked dugout or half dugout canoes. The canoes used in Lekki lagoon had lesser length overall compared to those used in the other lagoon like Lagos lagoon. Constructional features of the canoes are elaborated in Table 1.

Hull Features of Canoes in the Lagoon

Dugout Canoes:

The dugout canoes were carved out from a log of red iron wood (*Lophira alata*) which predetermines its size. The thickness of the canoe hulls in Lekki lagoon ranges between 2 and 2.3cm. The length overall (LOA) ranged between 3.10 and 6.76m, the maximum breadth (moulded) ranged between 0.71 and 1.00m. Due to the nature of its construction, the hull is strong and rigid. Longitudinal re-enforcement of hull was not required while transverse strength was achieved by few number of thwarts (3-4) laid across the deck from one side of free board deck line to another. The dugout canoes had relatively small free board and thereby displayed low reserved buoyancy and were less stable compared to plank and half dugout type.

Table 1: Features of wooden canoes used in Lekki lagoon between March 2006 and February 2008

Characteristics	Dugout	Planked canoe	Half Dugout (planked - dugout)
Length overall (LOA)(m)	3.10 – 5.86	5.20 – 11.00	5.33 – 10.20
Maximum width or moulded breadth (m)	0.71 – 1.00	0.93 – 1.80	0.86 – 1.49
Draft/ maximum Depth (moulded) (m)	0.18 – 0.40	0.27 – 0.60	0.42 – 0.77
Load water line (LWL) (m)	2.60 – 4.77	2.10 - 6.10	3.52 – 8.20
Number of Thwarts	3 – 4	4 – 6	4 - 7
Cubic Number / Size (m^3)	0.42 – 2.70	1.31 – 11.88	1.93 – 11.70
Trim	More or less equal	By stern	More or less equal
Transom	Absent	Present in motorized canoe only	Present in motorized canoe only
Keel	Absent	Present	Absent
Frame	Absent	Present	Present
Gunwale	Absent	Present	Present
Bottom Profile	Round	Flat	Round
Free Board	Low	High	Medium
Breast hook	Absent	Present	Present
Stern piece	Absent	Present	Absent
Free board ratio	2:1	1:2	1:1
Bouyancy	Poor	Average	Good
Mode of Propulsion (Percentage in parenthesis)	Paddle (100) Outboard engine (0.0)	Paddle (90) Outboard engine (10)	Paddle (85) Outboard engine (15)

The aft of the canoes terminated in a stern piece which served as a platform for standing during fishing gear operations and for sitting while paddling. The shape was narrow, low curvature with long water line length. The log

was excavated from inside to form the canoe shape. Excavation was completed by burning out the interior, using dry grass as fuel. This was done to disinfect and preserve the fabric of the boat and to drive out insects and other parasites. During the burning, the wood tends to expand; then contraction on cooling was prevented by placing struts of wood across the canoe. The controlled burning with grass is to gives the canoe the characteristics black colour after carving. Paddles are made of wood, carved according to various patterns (pointed, rounded and blunted edges) and poles from bamboo or palm. Two types of paddles were observed in the lagoon (the arrow - like and the blunt end type). Plate 1 shows newly carved dugout canoe at Emina water front in Lekki lagoon.

Plate 1: A newly carved dugout canoe at Emina water front in Lekki lagoon

Half-Dugout Canoes:

This is the combination of the dugout and the planked canoe features. The round bottom hull profile of the dugout canoe was built up with planks on each side to increase the size or cubic number of the canoe. The LOA of half dugout canoes ranged between 5.33 and 10.20m, the maximum breadth (moulded) ranged between 0.86 and 1.49m and the depth moulded ranged between 0.42 and 0.77m. The heavy hull reduced buoyancy of dug-out canoe was buffered by the addition of one or more planks made of soft wood like Opepe (*Nauclea diderrichi*), Mahogany (*Khaya ivorensis*) and black afara (*Terminalia ivorensis*), to both sides of the free board and deck line. The rigidity of the hull was maintained by more thwarts laid across the deck for transverse strength. The cubic number was relatively larger than dugout canoe and ranged between 1.93 and 11.70m^3 and provided enough space to carry a lot more crew and large fishing gear such as the seine net operated at Igbodola, Iwopin and Imeki also for floating Island fishery at Ikeran Olatunji. Gunwale is another hull feature that impacts longitudinal strength and stiffness to the canoe. This was nailed to the top side of the freeboard deck line and runs from the fore to after on both side of canoe. It had a long water line with low degree of curvature. Trim was equal at both stem and stern. The canoe was propelled with paddle (85%) and outboard engine (15%).

Planked Canoe:

The canoe had flat bottom hull completely built with planks fixed together with frames, u-shaped metal fasteners and nailing a strip of galvanized iron aluminum pluck caulking over the plank seams (joints). The longitudinal and transverse reinforcement was by gunwale and the thwarts ranged between 4 and 6. The frames also provide transverse strength. The canoe had a flat keel about 5 – 9cm wide for upright sit on the roller or on the sand when being hauled on beach. Reserved buoyancy in high, at load waterline, a freeboard draft ratio of 1:2 was recorded. The canoes had a long narrow beam and equal trim. About 10% of them were provided with transom for installation of outboard engine to propel the canoe. The outboard used ranged between 8 and 40Hp from Yamaha, Suzuki, Tohatsu and Marina brand. Plates 2.1– 2.4 show the various stages in planked canoe construction at Epe.

Most dugout canoes used in Lekki lagoon were carved at Saga village by the Ijaws while the planked canoes were constructed at Epe (Lagos State Government, Ministry of Agriculture Co-operative and Rural Development, United Nation Development Programme (UNDP), Support programme on Artisanal fisheries, fisheries development unit, Ebute Afuye, Epe Local Government), Iwopin and Ebute Lekki. The most common canoe used in Lekki lagoon was planked canoe. The production of dugout canoes was restricted to Ijaw carvers at Saga village and was limited by the scarcity of timber which competed for

some other uses like in furniture and building construction. Most canoes used in the lagoon were generally tied to the planked jetties and left in water throughout the year. The wood absorbed a lot of water infested with algae such as *Spirogyra* spp which added more to the weight which eventually reduce the speed of the canoe when propelled.

Fisheries frame survey of Lekki lagoon

The numerical compositions as well as the percentages of the canoes types between 2006 and 2007 are shown in Table 2. In 2006 there were 1027 wooden canoes made up of 24.29% dugout, 54.29% planked and 21.43% planked dugout canoes. In 2007 the canoes number was reduced drastically with a total number of 995 wooden canoes made up of 248 (24.93%) dugout, 558 (56.08%) planked canoes and 189 (18.99%) planked dugout canoes. The details of the canoe units recorded in the fishing villages within the lagoon between 2006 and 2008 are presented in Table 3. The percentage decrease in the number of canoe was 3.12% between 2006 and 2007.

Plate 2.1: Planks placed on attender for framing before it is used in canoe construction at Epe.

Plate 2.3: New constructed planked canoe at Epe (back hull)

Plate 2.2: Planked canoe under construction at Epe.

Plate 2.4: A newly constructed planked canoe with strips of galvanized iron aluminum

Fishing crafts preservation techniques

Most canoes used in the lagoon were generally tied to the planked jetties and left in water throughout the year. The wood absorbed a lot of water infested with algae such as *Spirogyra* spp which added more to the weight which eventually reduce the speed of the canoe when propelled. The attack of barnacles and annelid worm (*Merciella enigmatica*) was not common in Lekki lagoon, it was only observed at Iwopin in only two canoes (planked) and one planked canoe at Ebute Lekki.

The canoe preservative used in the lagoon was by painting with bitumen, coating the back hull with cement and bitumen with ground pepper, although there has not been any scientific backing for the use of pepper against biofouling attack, the fisherfolks guaranteed its success. The pepper was used in ratio 1:2 to the bitumen, mixed thoroughly, rubbed on the

outer canoe hull and dried under the sun for 3 to 5 days before use.

Table 2: Types of fishing canoes in Lekki lagoon (Percentage in parenthesis)

Year	Wooden canoe types			Total
	Dugout	Planked	Planked dugout	
2006- 2007	249 (24.29)	558 (54.29)	220 (21.43)	1027
2007- 2008	248 (24.93)	558 (56.08)	189 (18.99)	995

Table 3: Fishing villages and the canoe units in Lekki lagoon between 2006 and 2008

Fishing village	Number of functional fishing canoes	
	March, 2006 – Feb. 2007	March, 2007 – Feb. 2008
Emina	43	43
Abomiti – nla	34	33
Abomiti – Sokoto	20	19
Ajegunle	17	16
Ikeran Olatunji	46	45
Take	19	18
Luboye	19	18
Abatitun	29	28
Iwopin	123	119
Siriwon	39	38
Dopanu	32	31
Dopanu-Ajegunle	73	72
Idata	21	20
Igbolomi	42	42
Aba – oyinbo	24	23
Ikeran –Aba Ilaje	52	51
Origbe	48	47
Oriyanrin	46	45
Imeki	45	44
Lakoye	17	16
Ebute – Lekki	51	50
Arala	22	21
Igbodola	25	24
Aba – Onigangan	31	30
Ise	109	105
Total	**1027**	**995**

Discussion

In Lekki lagoon the most common canoe used was the planked canoe. The production of dugout canoes was restricted to Ijaw carvers at Saga village and was limited by the scarcity of timber which competed for some other uses like in furniture and building construction. This agreed with Solarin (1998) who reported that dugout canoes production was limited by the scarcity of timber which competed for some

other uses like in furniture and building construction in Lagos lagoon.

Most canoes used in Lekki lagoon were generally tied to the jetties and left in water throughout the year. The wood absorbed a lot of water infested with algae such as *Spirogyra* spp. which added to the weight and reduce the speed of the canoes when propelled. The attack of barnacles was not common in the Lekki lagoon, it was observed at Iwopin in only two canoes (planked) and one planked canoe at Ebute-Lekki. The canoes were also left uncovered and water logged during the rainy season which could submerge or sink it. In most cases, if the storm were too much at any time, it may result in permanent loss of dugout canoes carved from Opepe (*Nauclea diderrichi*) due to its poor bouyancy. Exposure to the hot sun also results in cracks leading to water seepage. The preservative used for canoes in Lekki lagoon was by painting with bitumen, coating the back hull with cement and bitumen combined with grinded pepper. Although there has not been any scientific backing for the use of pepper in biofouling attack prevention, the fisherfolk have accepted its success.

The construction of more robust planked canoes is to compensate for the shortage of large dugout canoe to non-availability of big timber, to increase the deck working space and to improve their lagoon worthiness. The technological status and development prospects of small scale fishing crafts in Nigerian coastal water were documented by Ambrose *et. al.* (2001) which supported the observation in this study.

Canoe maintenance should focus on:

(a) The prevention or reduction of water absorption by the wooden structure.

(b) The prevention of rot, decay as well as the control of boring and fouling organisms.

(c) Protection against splits or cracks as reported by Solarin (1998) in Lagos lagoon.

Wooden canoes have had a wide acceptance by the fishermen and will continue even if a new material for construction is introduced. Planked canoe can be improved by increase in hull size and stiffness, water tightness of deck by appropriate coating, caulking and fastening.

Safety measures in canoes should include adequate provision of life jackets. In Lekki lagoon the use of light indicator bouy for night fishing operation is highly important because of the tugging and cargo boat movement to prevent life and net losses.

7/8/2009

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Geostatistical Analyses of Accuracies of Geologic Sections Derived from Interpreted Vertical Electrical Soundings (VES) Data: An Examination Based on VES and Borehole Data Collected from the Northern Part of Kwara State, Nigeria

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Abstract: The interpreted (geoelectric and geologic) sections of thirty-six (36) VES data collected from borehole sites in Edu, Pategi and Moro LGAs of Kwara State were compared with their corresponding borehole logs primarily to determine the accuracies of the interpretation both in terms of the number of layering and in the determination of the boundaries of the various interpreted layers. The results show that one geoelectric layer may contain up to four or more layers in the corresponding borehole logs. The percentage errors associated with the interpreted layer thicknesses may vary from ±0.72% to ±14.80%. Furthermore, the results suggest that in some instances, the accuracy of the borehole logging is suspect as the resistivity values associated with some layers suggest the layers must be something different from what the logger said they are. Thus, while the work quantitatively confirms, "a geoelectric layer is not necessarily a geologic layer", it also suggests that the borehole log may not be 100% correct. [Journal of American Science 2010;6(2):24-31]. (ISSN: 1545-1003)

Key words: vertical electrical sounding (VES), geoelectric and geologic sections/layers, borehole logs

1. Introduction

In d.c. resistivity geoelectric studies for groundwater exploration, the interpreted results of the collected Vertical Electrical Sounding (VES) data are usually presented as derived geoelectric sections. As can be seen in the works of Okwueze and Ezeanyim (1985), Okwueze, et al (1988), Van Overmeeren (1989), Ajayi and Hassan (1990), Shemang, et al (1992), Idornigie and Olorunfemi (1992) among others, the derived geoelectric sections are usually subsequently converted to generalized geological sections based on the resistivity values of the various lithologies (rock types) existing in the areas studied. This means, in most of these previous geophysical studies, typical interpreted VES data give generalized geological information using geoelectrical (VES) data. However, it is a common knowledge that an "electrical layer" is not necessarily a geological layer". Hence, this work quantitatively examines the accuracies of geoelectrical layers derived from VES data by comparing such interpretations with actual borehole logs obtained from boreholes drilled in different parts of Edu, Pategi and Moro LGAs of Kwara State. The accuracy of the logging is also examined in the light of the resistivity values of the geoelectric and/or geologic layers.

The general locations of the study areas within Nigeria are shown in fig. 1. The locations of the areas studied within the three LGAs of Kwara State are also presented in figs. 2(a) and (b).

According to Adeleye (1976) and ldornigie and Olorunfemi (1992), Edu and Pategi LGA which form part of the Lower Niger (Nupe) According to Adeleye (1976) and ldornigie and Olorunfemi (1992), Edu and Pategi LGA which form part of the Lower Niger (Nupe)Basin are approximately NW-SE trending topographic depression filled with

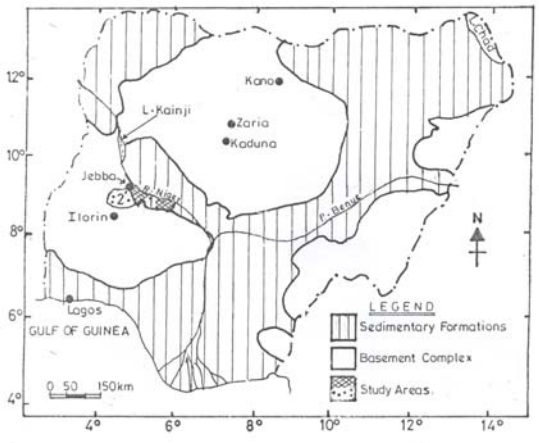


FIG-1 SIMPLIFIED GEOLOGICAL MAP OF NIGERIA SHOWING THE LOCAL GOVERNMENT AREAS STUDIED (Courtesy of GSN)

mainly Santonian (82-76Ma) to Maestrichtian (68-65Ma) sediments of sandstones, siltstone, ironstones and superficial alluvial deposits. The spatial distribution of the geologic formation, and/or materials, as well as the crystalline rocks underlying the sedimentary terrains of Edu/Pategi LGA are illustrated in fig. 3. On the other hand, the borehole log reports of the United Nations International Children Education/Emergency Fund Rural Water Sanitation, UNICEF-RUWATSAN Project (1985;1988), Messrs. Biwater Shellabear (Nigeria) Limited (1986) as well as the works of Amadi and Nurudeen (1990) and Olarewaju et al (1997) suggest that the main rock types found in the study area of Moro LGA which lie in the northwest edge of the Southwestern Nigerian Precambrian Basement Complex are: migmatites, quartzites, pelites, schists, pegmatites, biotite-hornblende, gneiss, porphyrrhitic biotite-gneiss, biotite granite, laterites and alluvial deposits.

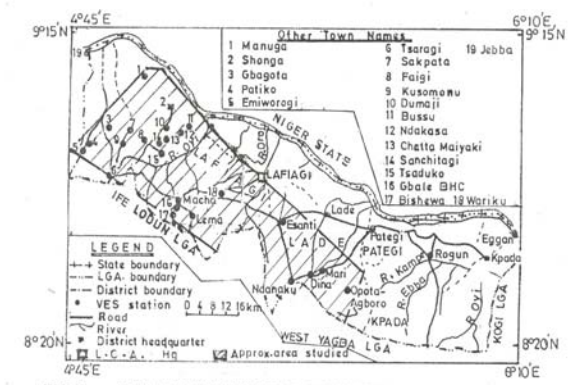


FIG. 2a : EDU AND PATEGI LOCAL GOVERNMENT AREA (LGA)

FIG. 2b: MORO LOCAL GOVERNMENT AREA (LGA)

PATEGI

FIG. 2: MAPS OF EDU AND MORO LGAS KWARA STATE SHOWING LOCATIONS OF STUDY AREAS IN THIS WORK (MAPS AFTER OFFRI, ILORIN)

In this work, thirty-six (36) VES data sets and their corresponding borehole (lithologic logs) data were collected from the UNICEF-RUWATSAN Project, Ilorin for the study areas of Edu/Pategi and Moro LGAs. Twenty-five (25) of these sets of data were collected for the predominantly sedimentary region of Edu/Pategi LGA., while eleven (11) similar data sets were obtained for the basement complex studied within Moro LGA of Kwara State.

The thirty-six (36) VES data sets and their corresponding borehole logs were therefore, collected for this work amongst other aims and objectives in order to:

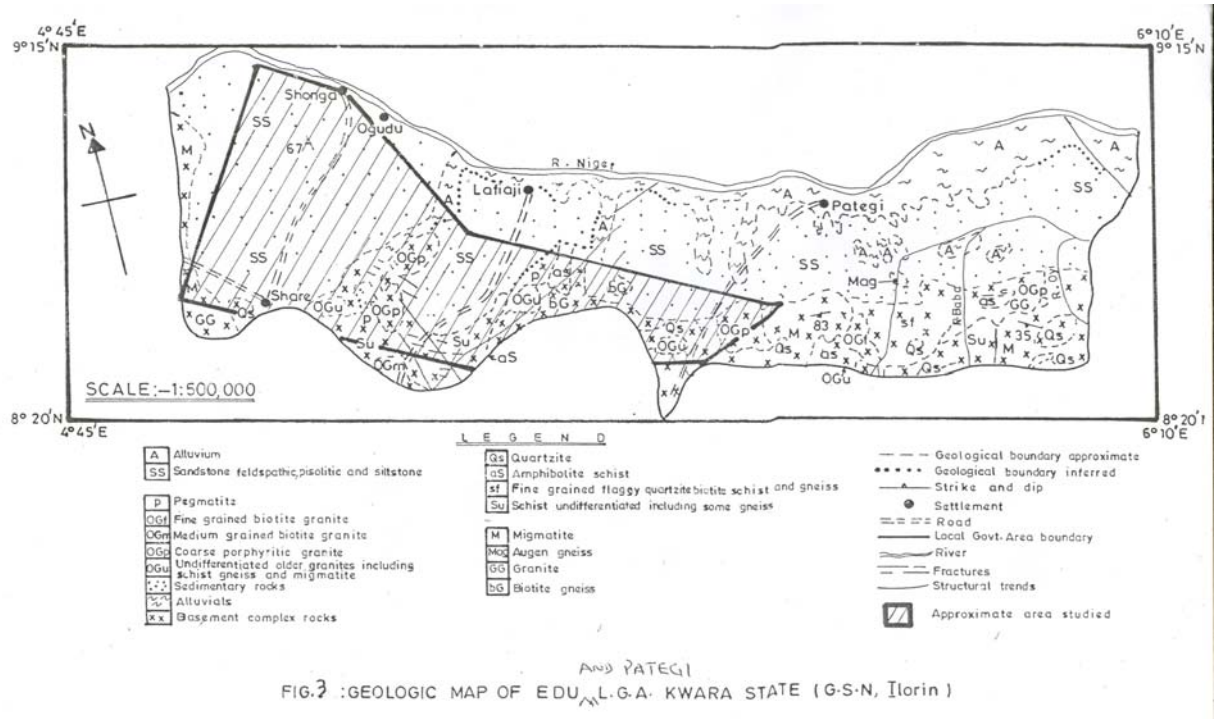
- examine the accuracies of geological deductions from interpreted electrical (VES) data with real geological data obtained from borehole logs;
- determine whether geological setting affects the interpreted (VES) data results of a study area, and
- find out whether information obtained from borehole logs can be confidently and/or adequately used to understand the geology/hydrogeology of an area.

2. Interpreting the VES Data

The interpretation of VES data is primarily concerned with determining the number (n), thickness (h) and resistivity (ρ) of each of the various layers beneath each investigated VES station. These parameters are in turn, used to derive the geological and geoelectrical sections for each VES data studied in order to determine the subsurface formations and structures of interest underlying the concerned VES site. In this study, the VES data was first interpreted using the empirical method (Van Nostrand and Cook, 1966; Shiftan, 1967). From this preliminary or "indirect" interpretation, initial estimates of the thicknesses and resistivities of the various geoelectric layers were interpreted as initial/trial model for a fast computer-aided direct interpretation. The computer program published by Mooney (1980) was modified in this project for use on the CDC Cyber 72 mainframe computer system of the Ahmadu Bello University, Zaria. A typical interpretation of the VES data, collected for VES station in Chetta Maiyaki is shown in fig. 4. For this station, the parameters of the four-layer trial/initial model (iteration rms error 9.285) was $h_1 = 2.0$m, $\rho_1 = 361.81$ Ω-m, $h_2 = 10.0$m, $\rho_2 = 550.0$Ω-m; $h_3 = 34.0$ Ω-m, $\rho_3 = 425.00$ Ω-m, and $\rho_4 = 80.18$ Ω-m while the parameters of the final models with iteration rms error 1.692 were: $h_1 = 2.6$m, $\rho_1 = 361.6$ Ω-m, $h_2 = 6.1$m, $\rho_2 = 841.5$ Ω-m; $h_3 = 57.2$m, $\rho_3 = 446.9$ Ω-m, and $\rho_4 = 44.3$ Ω-m. The geologic section (BH) of this station was derived, based on the analysis of the borehole log collected for the completed well at the VES location. The information obtained from the corresponding borehole log had been used to serve as control in the production of the geoelectric section (VES) of the interpreted VES data. The VES data collected for the remaining 35 VES data were similarly analysed following the above procedure.

3. The Work Done

To test the accuracy of the VES interpretation, the borehole log of each of the boreholes studied in this work was compared with the corresponding geoelectric section obtained from the interpreted pre-drilling VES data collected for that borehole site. The first thing to be compared was the number of lithological units in the borehole log against the electrical layers indicated by the interpreted VES data. Secondly, the agreement and/or accuracy of the VES layering viz-a-viz the corresponding borehole logs were examined. Thirdly, the accuracy and or correctness of the borehole logs most especially, the description of lithologies was then studied with respect to layer resistivity. Finally, the issue of whether or not nature of geological environment (for example sedimentary or basement regime) has any major effect on the accuracies of geoelectric layers was also investigated.



AND PATEGI

FIG.3 :GEOLOGIC MAP OF EDU L.G.A. KWARA STATE (G.S.N, Ilorin)

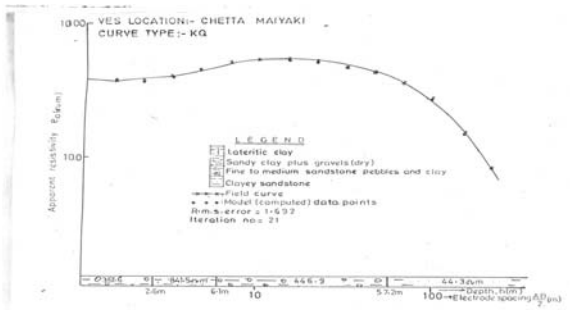


FIG. 4a: TYPICAL RESULTS OF THE INTERPRETATION OF THE VES DATA COLLECTED FOR CHETTA MAIYAKI

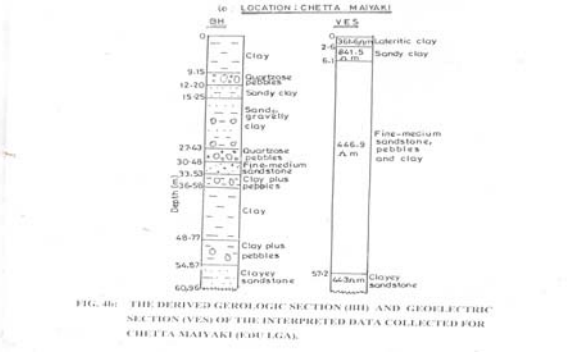


FIG. 4b: THE DERIVED GEOLOGIC SECTION (BH) AND GEOELECTRIC SECTION (VES) OF THE INTERPRETED DATA COLLECTED FOR CHETTA MAIYAKI (EDU LGA).

4. Comparing the Derived Geological Sections with Borehole Data

Consequent upon the above stated objectives of this work, four VES stations namely Shonga and Tsaragi which are located within the sedimentary Lower Niger (Bida or Nupe) Basin (Edu/Pategi LGA) as well as Gbangbalako and Atawin which exist in the Southwestern Nigeria Pre-Cambrian Basement Complex of Moro LGA have been chosen for analyses. It is pertinent to point out that Shonga lies within the alluvium of the sedimentary terrain while Tsaragi is found in the contact zone of the Lower Niger Basin. On the other hand, one of the two locations, Atawin stationed in the basement complex of Moro LGA has been identified to be underlain by a very complex geology. This is because, the seven sets of VES data and borehole logs collected for investigation of this station presented seven very different geoelectric and geologic sections. This therefore, means the four stations which have been chosen for examination are expected to be very well representative of the varied nature of the geology of the areas studied within the West-Central part (Kwara State) of Nigeria.

4.1 Discussion of the VES Stations

4.1.1 SHONGA

The borehole log/geologic section as well as the geoelectric section and the derived geologic sections obtained for the VES station in Shonga are shown in figs. 5a(i) and (ii) respectively. The geologic section (borehole log) suggests the existence of 9 geologic layers within the first 51.82m of the earth. On the other hand, the geoelectric section suggests the presence of only 4 geoelectric layers beneath this station to a depth of 53.1 m. As can be seen in fig. 5a(i), the first layer in the borehole log which consists of clayey sand, corresponds to the first geoelectric layer. In the borehole log (BH), the layer is 6.1 m thick, while it is 6.3m thick in the geoelectric (VES) section. Thus, there is a percentage error of ±3.28 % in using the interpreted geoelectric (VES) data to determine the thickness of the first layer. The next four layers in the borehole log correspond to the second geoelectric layer. This

layer which is indicated as electric layer 2 in fig. 5a(i) and whose constitution vary from clay and poorly sorted sandstone at the top to gravelly clay and poorly sorted sandstone at the bottom having a resistivity value of 520.3 Ω-m associated with it. The thickness of the layer in the borehole log is 15.24m (21.34m – 6.1m), while it is 16.10m (=22.4m – 6.3 m) in the geoelectric section. Thus, the percentage error associated with using the second layer of the interpreted VES data to determine the thickness of this group of thin layers is +5.34%. The third geoelectric layer (electric layer 3) with a resistivity value of 60□-m is made up of 3 geologic layers which consist of 3.05m thick poorly sorted sandstone at the top, a sandy clay formation which is about 7 times thicker than the overlying sandstone existing in the middle of the electric layer 3 and sandy gravel with a thickness of 6.10 m at the bottom. The net thickness of the geologic sub-layers, which constitute this electric layer 3 is (51.82 – 21.34) m = 30.48m, while it is (53.1 – 22.4)m = 30.70m in the geo-electric section. Hence, the percentage error associated with using the interpreted thickness of the third geoelectric layer (electric layer 3) to represent the three (sixth, seventh and eighth) geologic layers lying between depths 21.34 and 51.82m in the borehole log of the borehole site in Shonga is ±0.72 %. The fourth geoelectric layer, that is electric layer 4 consists of sandy clay as can be seen from the borehole log (figs. 5a(i) and (ii)); the layer is associated with a resistivity value of 26 Ω-m and lies at a depth of 51.82m in the geologic (BH) section extending from a depth of 53.1m to an infinite depth, according to the interpreted geoelectric section. Thus, there is a percentage error of ±2.39% in using the geoelectric (VES) section to estimate the depth to the interface between the electric layer 3 and the underlain geoelectric basement at the VES station in Shonga.

4.1.2 TSARAGI

The sections derived from the VES data for the site in Tsaragi which consists of the Nupe Sandstone and the crystalline rocks units within the contact zone of the Nupe Basin are illustrated in figures 5b(i) and (ii). In this case, both the borehole log (BH) and the geoelectric section (VES) suggest the existence of 4 layers at the borehole site. Fig. 5b shows that the first (sandy clay) layer in the borehole log has been resolved into two geoelectric layers that is, a very thin (0.5m) surficial layer and a much thicker (9.0 m) layer of sandy clay. The higher resistivity value of the near surface layer suggests it is more sandy than the thicker second geoelectric layer. The electric layer 1 therefore, seems to correspond to the first and second geoelectric layer in the interpreted VES section. In the geologic section, the electric layer 1 is 9.75m thick, while it is 9.00m thick in the geoelectric section. This means, there is a percentage error of ±8.33% in the interpreted thickness of the electric layer 1 for the VES station at Tsaragi. The electric layer 2 corresponds to the second and third geologic layers in fig. 5b(i) and the third geoelectric layer in fig. 5b(ii). The geologic section (BH) shows that the second and third geologic layers which consist of medium-coarse sand/sandstone, coarse sandstone and clay is 21.34m thick, while its corresponding third geoelectric layer in the geoelectric section (VES) has a thickness of 20.7m. Therefore, the percentage error associated with the interpreted thickness of the electric layer 2 is ±3.09%. It is pertinent to point out that the 3.05m thick third geologic layer which combines with the second geologic layer is shown in fig. 5b(i) as corresponding to electric layer 2 is not detected by the interpreted VES process and is thus not present in the derived geoelectric section (fig. 5b(ii)). The non-detection of this layer is probably due to the principle of suppression (Breusse, 1963; Koefoed, 1976; 1979; Okwueze *et al*, 1988). The practical implication of this principle is that, a layer is not detected on a VES curve unless it is quite thick or if it has a thickness which is about one-third of its depth of occurrence (Messrs Biwater Shellabear, 1986; Barker, 1989). However, notwithstanding the fact that the third geologic layer which consists of coarse sandstone is not sensed in the VES section, figs. 5b(i) and (ii) show that the weathered basement which represents the electric layer 3 corresponds to the geologic bedrock as well as the geoelectric basement. The electric layer 3 is shown in fig. 5b(i) as extending from a depth of 31.09m beneath the ground at the VES site located in Tsaragi to the total depth of drilling (34.14 m). On the other hand, the geoelectric section (fig. 5b(i) shows that the electric layer 3 which corresponds to the fourth geoelectric layer is interpreted to consist of clayey weathered basement with a low resistivity value of 33.2 Ω-m and extends from a depth of 29.7 m to an infinite depth below the ground level at the VES site in Tsaragi. Therefore, the percentage error associated with interpreting the depth to the electric layer 3 (geoelectric basement) is ±4.68%.

4.1.3 ATAWIN

The geologic section of one of the VES stations investigated in Atawin is presented together with the corresponding derived geoelectric section in figs. 6a(i) and (ii) respectively. While the geologic section (BH) suggests the existence of 6 layers up to a depth of 31.09 m, the geoelectric section suggests only 3 layers exist up to the 32.50 m depth which represent the top of the fresh basement. The two sections show that the first geologic layer corresponds to the first geoelectric layer which is indicated as electric layer 1 in fig. 6a(i). This electric layer (EL 1) which consists of laterite is 0.61m thick in the geologic section and 0.60m thick in the geoelectric section. Thus, there is a percentage error of ±1.64 % in using

the interpreted thickness to estimate the thickness of the surface lateritic layer at the concerned VES station (Atawin 2). Fig. 6a also suggests that the next four geologic layers in the borehole log correspond to the second geoelectric layer (electric layer 2). The figure shows that the combined thickness of these layers in the geologic section of the borehole log (fig. 6a(i)) is 30.48m, while fig. 6a(ii) indicates that, it is 31.90m in the geoelectric (VES) section (fig. 6a(ii)). This means, there is a percentage error of ±4.45 % in the interpretation thickness of the electric layer 2. As can be seen in fig. 6a, the electric layer 3 corresponds to both the geologic basement and the geoelectric basement. The derived sections show that the estimate of the depth to the fresh basement in the geologic (BH) and geoelectric (VES) sections is 31.09m and 32.5m respectively (fig. 6a). Consequently, there is a percentage error of ±4.34% in the interpreted depth to the fresh basement beneath the VES station studied at Atawin.

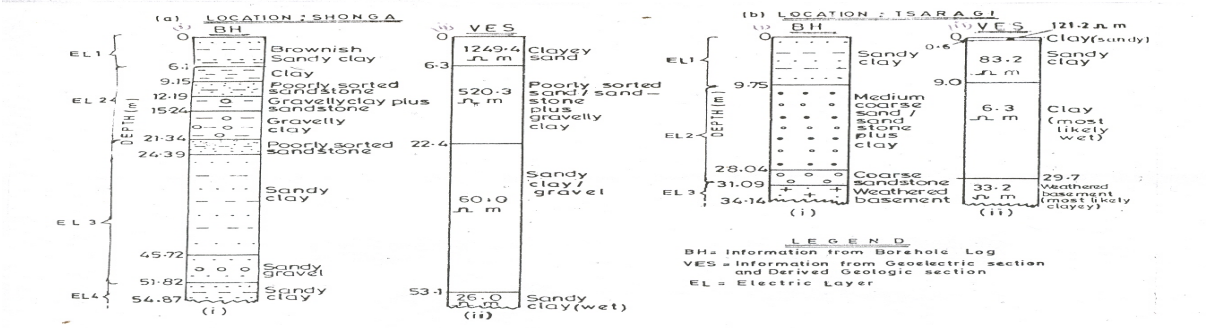


FIG. 5 : CORRELATION OF BOREHOLE LOG/GEOLOGIC SECTION (BH) WITH INTERPRETED VES DATA/GEOELECTRIC SECTION (VES) AT SOME LOCATIONS STUDIED WITHIN THE SEDIMENTRY REGION OF THE LOWER NIGER BASIN.

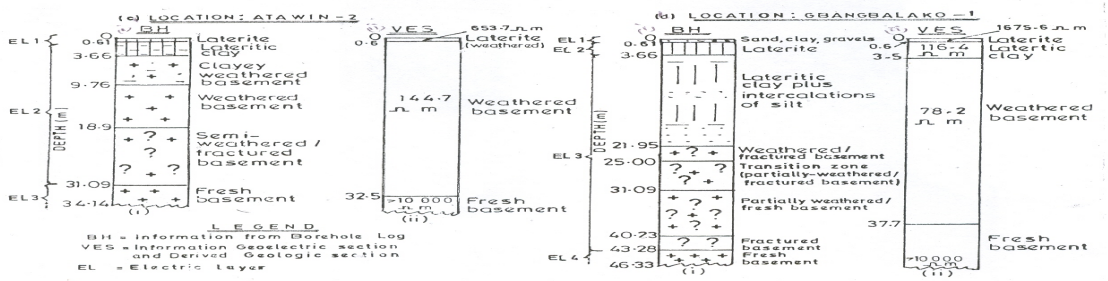


FIG. 6: CORRELATION OF BOREHOLE LOG/GEOLOGIC SECTION(BH) WITH INTERPRETED VES DATA/GEOELECTRIC SECTION(VES) AT SOME LOCATIONS STUDEID WITHIN THE BASEMENT COMPLEX.

4.1.4 GBANGBALAKO

Finally, figs. 6b (i) and (ii) indicate the geologic section obtained from the borehole log collected for the VES station examined at Gbangbalako and its corresponding geoelectric section. As can be seen in the figures, the first and second geologic layers represent electric layer and 2 respectively. The percentage errors associated with using the interpreted thickness of the first and second geoelectric layers to determine the thickness of the surface layer (electric layer 1) and the second layer (EL2) beneath the VES site at Gbangbalako-2 are ±1.64 % and ±4.92% respectively. The next five geologic layers correspond to the third geoelectric layer (electric layer 3) and is interpreted to be associated with a resistivity value of 78.2 Ω-m. The net thickness of the geologic substrata which constitute this electric layer 3 is 40.23m - 3.66m = 36.57m in the geological section, while it is 34.60 m (= 37.7m – 3.1m) in the geoelectric section. Thus, there is a percentage error of ±5.69 % in the interpreted thickness of this electric layer 3. Furthermore, the depth to the fresh basement is indicated (fig. 6b(ii)) to be 43.28 m in the borehole data while the result of the interpreted VES data shows in fig. 6b(ii) the corresponding value is 37.70m in the geoelectric (VES) section. These therefore, mean that there is an error, of ±12.89 % in the interpreted depth to the fresh basement for the VES site located at Gbangbalako village within the northwest tip of Southwestern Nigerian Pre-Cambrian. Comparison of figs. 6b(i) and (ii) indicate that the last half of the partially weathered layer which is the sixth geologic layer in the BH section and the seventh geologic layer which consists of fractured basement were not resolved in the VES section. The interpreted geoelectric section was not able to discriminate these layers possibly because there is insignificant resistivity contrast between the transition zone and the fractured basement or the layers are relatively thin with respect to their depths of. burial or both. The consequences of these possibilities are the appreciable differences in the thickness values of the electric layer 3 (EL 3) determined from the borehole data and the VES data on one hand, as well as the depth to the boundary (interface) between EL 3 and EL 4.

5. Summary and Conclusion

The results of the geostatistical analyses carried out in this work show that, in all the four representative VES stations examined, low to moderate ranges of values were estimated for the percentage errors associated with the interpreted thickness and boundary depth of the electric layers. For example, the percentage error values characterizing the VES station in Tsaragi. which lies within the contact zone of the southern extent of the Lower Niger Basin (Edu LGA) vary from ±3.009% to ±8.69%. The corresponding low percentage error values associated with the VES station studied in Atawin which is located in the Southwestern Nigeria Pre-Cambrian Basement Complex range from ±1.64 % to ±-4.45%. On the other hand, relatively moderate range of percentage error values of ±0.72% to ±5.34% were determined for the electric layers beneath the VES station in Shonga (Edu LGA) which is located within the alluvium of the Lower Niger basin and ±1.64 % to ±14.80 % for the VES station at Gbangbalako in Moro LGA. Therefore, the results of these analyses suggest that the geologic setting of a VES station does not have any effect on the reliability of the geologic and geoelectric information obtained from an interpreted VES data.

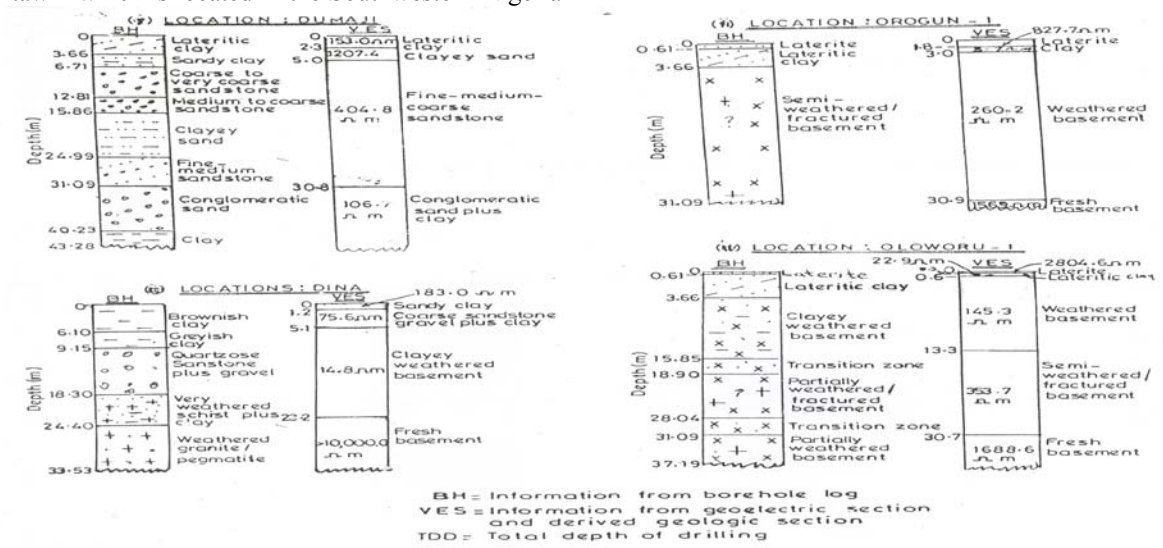


FIG. 7: THE DERIVED GEOLOGIC SECTION (BH) AND GEOELECTRIC SECTION(VES) ANALYSED WITH GOOD RESULTS FOR SOME VES STATIONS WITHIN THE STUDY AREAS.

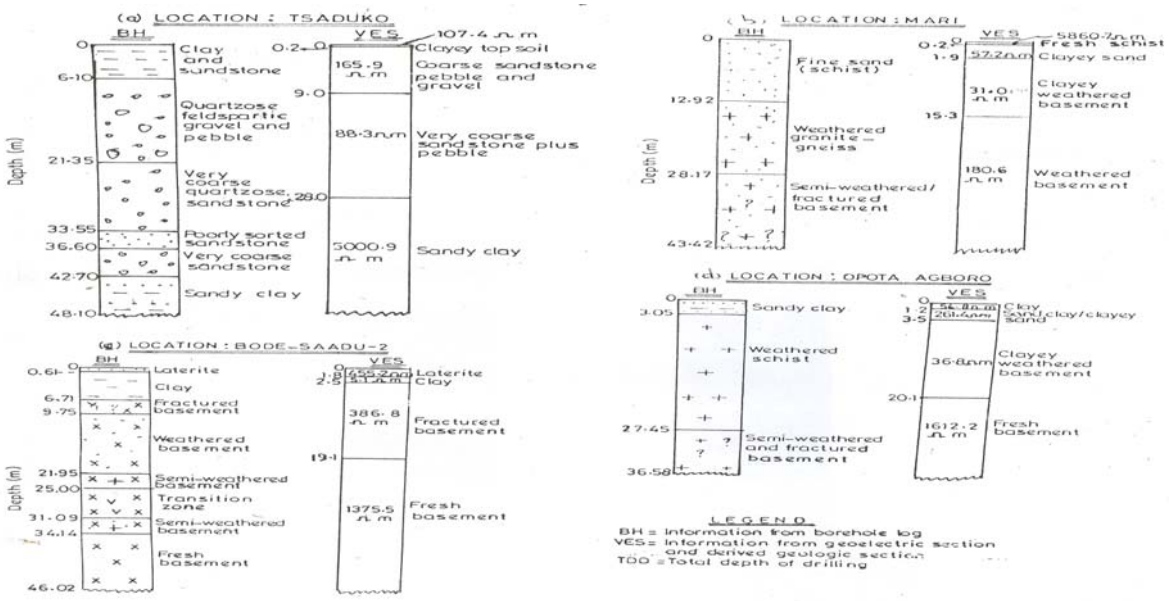


FIG. 8: THE DERIVED GEOLOGIC SECTION (BH) AND GEOELECTRIC SECTION (VES) ANALYSED WITH POOR RESULTS FOR SOME VES STATIONS WITHIN THE STUDY AREAS.

It is also worth stressing that similar geostatistical analyses of the thirty-two (32) remaining sets of data indicate that the confidence limit to put on geological deductions derived from geoelectric sections in this study is highly varied. The various geologic and geoelectric sections suggest that the differences between geologic boundaries obtained from borehole logs and the electric boundaries derived from the interpreted VES sections is insignificant for some VES locations (fig. 7) while, as shown in fig. 8, the degree of agreement between the two sections for some other VES stations is relatively poor.

The possible reasons for some of these non-reliable derived geologic and geoelectric sections are that quantitative interpretations of VES data are often hampered and or influenced by the principle of equivalence and the fact that an electric layer may not necessarily be a geological layer. According to van Overmeeren (1988), the principle of equivalence means that many different layered models may produce practically the same resistivity curves and hence, the non-uniqueness of interpreted VES data results. Moreover, the prominence of alternating thin layers of clay and clayey materials in the Lower Niger Basin (UNICEF-RUWATSAN Project, 1987) as well as the occurrence ofhighly weathered bedrocks in the VES stations studied in Moro LGA (UNICEF-RUWATSAN Project, 1985; Messrs. Biwater Shellabear, 1986; Amadi and Nurudeen, 1990) often result in effects due to suppression. In a related study, Okwueze, et al (1988) also suggested that the presence of highly weathered bedrock not only affects the resistivity of the crystalline rocks to a great extent hut is liable to result in the overestimation of the regolith by borehole drillers.

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06/09/2009

Performance Tests and Thermal Efficiency Evaluation of a Constructed Solar Box Cooker at a Guinea Savannah Station (Ilorin, Nigeria)

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Abstract: This communication reports the performance and evaluation of a Solar Box Cooker at a project site in Ilorin. The hourly variation of five different temperature measurements as well as standard water boiling tests and controlled food cooking tests carried out during part of the harmattan period of the year 2003 and 2004 are also presented. The results of this investigation showed that a maximum temperature of 88^0C was attained for the water boiling tests. The controlled cooking tests results also suggest that the constructed solar cooker would take between one-and-half hours and two-and half hours to cook such commonly eaten foods like egg and rice in this tropical station. The average collector efficiency of the solar box cooker has been estimated to be about 47.56%. Based' on the results of this work, it is recommended, that the solar device could be used as a pre-cooking and alternative to domestic cooking stove. [Journal of American Science 2010;6(2):32-38]. (ISSN: 1545-1003)

Key words: solar box cooker, water boiling tests, thermal efficiency

1. Introduction

A significant proportion of the Nigerian population as in many other developing countries in Africa, Asia and Latin America depend on fossil fuels, biomass and firewood for cooking and domestic water heating. Recent studies by Fernandez et al (2002), Bala et al (2002), Garba and Bashir (2002), Bello et al (2003) reported that in Nigeria, domestic cooking and heating account for more than 70% of the energy needs of most households. There is no gainsaying the fact that, conventional sources of energy for domestic cooking like liquefied petroleum gas otherwise called natural gas, kerosene and electricity are characterized by irregular availability, increasing costs and some are mostly not environmentally friendly. Solar energy is one of the main alternative renewable sources of energy crucial to our search for domestic fuel replacements. This is because, it is the source of almost all renewable and non-renewable sources of energy. Also, it is the cleanest, it is free from environmental hazards and it is readily available and inexhaustible. However, like the development of all other energy sources, the breakthrough of solar energy into the technological world will involve a lot of planning, organization, generation and diffusion of information as well as the provision of infrastructure or devices to harness it for efficient and various effective uses.

Nigeria is blessed with an abundant amount of sunshine which has been estimated to be 3,000 hours of annual sunshine (Buari and Sambo, 2001). Ilorin, the project site of this study is the capital of Kwara State which is located in the west-central part of Nigeria. The coordinates of Ilorin are: Latitude $8^0 3\tilde{2}$N, Longitude $4^0 3\tilde{4}$E and altitude 375m above mean sea level (Udo and Aro, 2000). The city is found in the Guinea Savannah zone which is the transition zone between the forestland of the South and the Sudan Savanna grassland of the Northcentral part of Nigeria. Umar et al (2000) have reported that the annual average daily sunshine hours and'the annual average global solar radiation in the Guinea Savannah region of Nigeria have been respectively estimated to be about 6.0 hours and 4.5kWm-2day^{-1}.

There are several case histories detailing the construction of various types of solar cookers (Sambo, et al 1992; Sambo, et al 1993, Ogunniyi, 2001; Suleiman et al, 2003; Danshehu, 2003 and Olajuyi, 2003). The results of their investigations suggested that the working fluids of their solar cookers attained maximum temperatures which range from 85^0C to 145^0C at 13.00 hours of certain days of investigation. In this project, a modified solar box cooker similar to the one constructed by Olajuyi (2003) has been investigated to evaluate its effectiveness for use as an alternative cooking device.

2. Materials and Methods

2.1 Materials Used

A solar box cooker is usually designed to mainly consist of one or two glass covers, the outer box, tile inner box, the absorber plate or the solar collector. In this work, the materials used to construct the solar box cooker investigated are mahogany, planks, foams, nails, evostics, hinges/rollers, aluminum sheets, black paint, two pane glasses, plane mirrors, nails, saw dusts, screws and brown paint.

2.2 Design and Construction Criteria

As earlier mentioned, the design of the solar box cooker constructed for this solar energy study has been based on the work of Olajuyi (2003). However, there has been a few modifications from the original design of Olajuyi (2003). A trapezoidal shaped inner box of dimension 30cm by 30cm by 20cm bounded by an outer box measuring 80cm by 60cm by 30cm was designed for this study (Fig. 1). The two boxes were made from mahogany plank. Aluminum foil was glued to the inner box to create multiple reflection of insolation and enhance absorptivity of the absorber plate which is made from aluminum sheet. For the insulation of the cooker, sawdust was used to fill the space between the outer box and inner box. The box -cooker was covered with two transparent pane glasses and one big plane mirror (60cm by 40cm) to create 'greenhouse effect' which is the basis of operation of the solar device. The design and construction procedure of the photo-thermal device studied in this work are described in details by Sulu (2003). Schematic diagram of the solar box cooker used for this study is shown in fig 1.

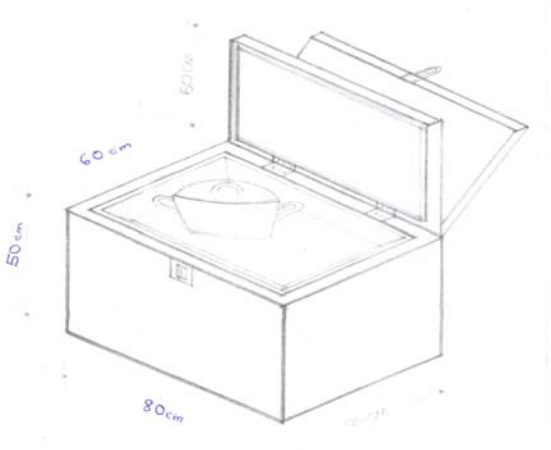

Fig. 1: Schematic Diagram of the Solar Box Cooker

2.3 Principles of Operation

The operation of a solar box cooker is based on the phenomenon/principle of the greenhouse effect. According to this principle, when an energetic short wave solar radiation falls on a glass cover, the glass surface gets heated up. The incident solar radiation I, will then be partly reflected, partly absorbed and partly transmitted by the glass cover to an absorber plate called a solar collector placed below the transparent cover in accordance with the relation (Duffie and Beckham, 1974):

$$I = r_\lambda + a_\lambda + t_\lambda$$

where r_λ = absorptivity at a particular wavelength;

a_λ = absorptivity at a particular wavelength

and t_λ = transmissivity at a particular wavelength.

The transmitted solar radiation is re-radiated by the solar collector to the space between the glass cover and the solar collector (absorber plate) as long wavelength infrared solar radiation, which is no more able to pass through the glass cover to the atmosphere. Consequently, this trapped solar radiation between the glass cover and the absorber plate is then transferred as thermal energy to the desirable materials like cooking pot and its contents placed on the absorber plate for cooking a required food item or heating water.

2.4 Method of Tests and Performance Evaluation

For the evaluation of the performance tests of the solar box cooker, the cooking device was positioned in the open space behind one of the Physics laboratories (Physics Laboratory B) of the Kwara State Polytechnic, Ilorin. The thermal system was placed in such a way that it was free of shadows of the adjacent buildings throughout the period of investigation.

Following the standard international procedures adopted by Nahar (1990), Adel et al (1986), Sambo, *et al* (1993), and Sulaiman, *et al* (2003), two sets of experimental tests were carried out during the harmattan period of the year 2003 and 2004, between 23rd November, 2003 and 25th January 2004. The performance tests conducted were: (i) water boiling test which involved temperature measurements connected with the photo thermal system between 10.00hours and 18.00hours as well as (ii) controlled cooking tests. During the experimentation on the water boiling tests, the following temperature readings were observed:

temperature of the insulator, t_A;

temperature just above the surface of the solar collector which is the cooking chamber air temperature), t_B;

and, temperature of the solar collector (absorber plate temperature), t_C.

For the water boiling tests, a black painted aluminium pot weighing about 0.215 kg containing about 500 cm^3 (0.5kg) of water- was placed on the absorber plate of the solar box cooker covered with the two pane glasses and placed outdoor for observations. Similarly, for the controlled cooking tests, the food to be cooked plus about 750 cm^3 of water contained inside the black painted pot were placed in the box and the unit was placed outside for necessary measurements to be observed and recorded. The various temperature and time measurements were measured on hourly basis between 1000hours and 1800hours using mercury-in-glass thermometers and a stop clock throughout the two months of study. The experimental set up is as shown in fig. 2.

Fig. 2: The Experimental Set-up

2.5 Solar Cooker Performance Criteria

The characteristics water boiling time, controlled cooking time and the efficiency have been found to be some important parameters established for evaluating the performance of Solar Cookers (Khalifa *et al,* 1986; Nahar, 1990; Sambo *et al,* 1993). The efficiency of the solar box cooker was estimated using the relation (Adegoke and Fasheun, 1998)

$$n_c = \frac{\left(m_p c_p + m_w c_w\right)\left(\bar{T}_w - \bar{T}_a\right)}{A_c Q_c t} \quad \text{..... (1)}$$

where m_p and m_w represent mass of pot and water respectively;

and c_p and c_w represent specific heat capacity of the material (i.e. aluminum) of the pot (920J/kg^{0}C) and water (4200J/kg.^{0}C) respectively;

$\bar{T}_w$ and $\bar{T}_a$ stand for average water and ambient absolute temperatures respectively;

A_c represents the area of the solar collector;

Q_c represents the average global radiation intensity and t stands for the daily time period of investigation,

In this work, the minimum mean global radiation value for the months of November, December and January of 398,83W/m^2 measured and computed over many years of observation for Ilorin by Babatunde (1999) has been adopted for the estimation of efficiency of the Solar box cooker. The extraterrestrial solar radiation intensity H_0, at the top of the atmosphere was computed using the relation:

$$H_0 = \frac{24}{\pi} I_{sc}\left[1 \times 0.0334 \cos\left(\frac{2\pi J}{365} - 3\right)\right] Z \quad \text{... (2)}$$

$$Z = \left(\cos L \cos\theta \sin h\theta - h \sin L \sin\theta\right)$$

$$\theta = 23.45 \sin\left[360\left(\frac{284 + J}{365}\right)\right] \quad \text{..... (3)}$$

where I_{sc} is solar constant = 1354Wm^{-2}

J is the Julian day with J = 1 on 1st January and 365 on 31st December;

L = Latitude at the site of- investigation which is Ilorin in the study with L = 8^{0}3$^{\sim}$2N.

θ is the declination angle of the sun on each day which is estimated using (Duffie and Beckham, 1974): and h is the hour angle

3. Results and Discussion

The results of the hourly variations of temperature observed on three different clear days with relatively bright sunshine viz 20/11/2004, 14/12/2004 and 24/1/2005 are presented in Tables 1 to 3. The sky was very cloudy on 20/11/2004 and the environment was characterized by cold weather condition in the early hours of the day with the sky turning a bit bright around 12.00 hours and the intensity of the sunshine started declining around 17.45 hours. In the case of one of the observed days in January (24/1/2005), the sky was partially clear and cloudy in the early hours of the day until noon when the sky became somewhat clear with bright sunshine. Figures 3,4 and 5 show the variations of the insulator temperature (t_A), cooking chamber air temperature (t_6), absorber plate temperature (t_C), working fluid (water) temperature (t_D) and ambient temperature (t_E) observed on three different favourable days of performance tests. As shown in figure 3, the maximum temperature of the working fluid of about 88^{0}C was attained around 14:00hours (2pm) on the day of investigation in November. However, figure 5 indicates that a maximum temperature of the working fluid), t_D was reached somewhat later in the day around 16:00 hours (4pm) on 24th January 2005.

According to figs. 3 and 4, it is evident that the solar box cooker plate developed a temperature of about 50^{0}C over the ambient within two hours (11:00 hours to 13:00 hours) after it was set up for investigation. The photo-thermal device later attained a maximum temperature of 88^{0}C on 25/11/2004 (see Table 1) and 88^{0}C on 14/12/2004 at around 14:00 hours (2:00pm). However, Figure 5 suggest that it took almost 4 hours before the solar device could attain the same temperature difference of 50^{0}C after its setting on favourable day of performance test carried out in January. Nevertheless, the figures (Fig. 3 to 5) have shown that the temperature differences between the solar collector plate temperature (t_C) and the cooking chamber air temperature (t_B) is not quite significant. This is possibly a reflection of the good emittance and or selective surface properties of the absorber plate. As shown in Tables 1 and 2, the differences between t_E

and t_B range between 9^0C and 18^0C. On the other hand, Table 3 shows that the differences range between 3^0C to a maximum of 9^0C which is very comparable to the results of the work reported by Sambo et al (1993). This is in fact, an encouraging heat transfer behaviour of a solar box cooker developed for cooking operation in a tropical station.

Sambo, et al (1993) reported that the required minimum food cooking temperature is 82^0C. The results of the performance tests carried out in this work suggest that this temperature was attainable during the periods of investigation in November and December. This therefore, suggests that the developed solar box cooker is quite good for optimum use during the harmattan season in the area of study which is found in the Guinea Savannah region of Nigeria. It is pertinent to point out that during the various temperature measurements observed, the two pane glasses were always opened whenever the record of the variations. However, if the mercury-in-glass thermometers could be fixed to the appropriate sections of the solar box cookers where the observation of the variation of the temperature are required then better results would possibly be obtained.

Following the encouraging results of the water boiling tests, controlled cooking tests were carried out to examine the effectiveness of the cooker. In this evaluation, we tried to observe the time required by the solar box cooker to cook egg and rice (0.180kg). The tests were conducted between 10.00 hours and 15.00 hours. The results of these test suggest that the cooker could be used to cook egg within a time period of one-and half hours (1½ hours) while the time taken by the solar box cooker to cook rice was about two-and-half hours (2½ hours).

In this study, the efficiency of the developed and constructed solar box cooker has been calculated based on the results of the water boiling tests conducted and the' expression shown as equation (i) above. The average efficiency was estimated to be about 47.56%. This value is comparable to the values obtained by Sulaiman et al (2003) for similar cookers investigated in the Sahel zone of Nigeria.

4. Conclusion and Recommendation

4.1 Conclusion

The following conclusions have been drawn from this study:

(1) The performance evaluation of the constructed solar box cooker showed that the cooker could boil water to a maximum temperature of 88.0^0C.
(2) The time taken by the solar device to cook egg and rice was respectively found to be about 1½ hours and 2 ½ hours.
(3) The estimated average efficiency of the solar box cooker was found to be about 47.56%

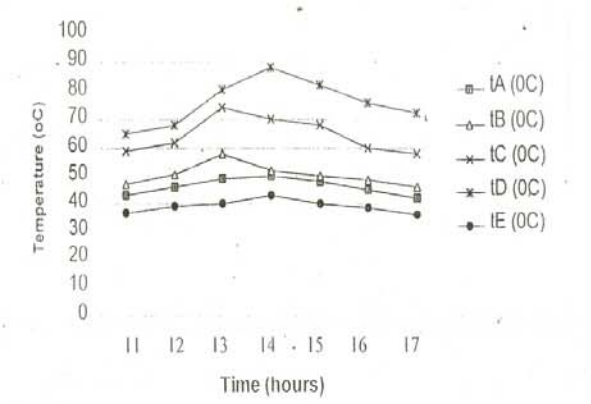

Fig 3: Results of temperature measurements observed with time on the solar box cooker on 20th November, 2004.

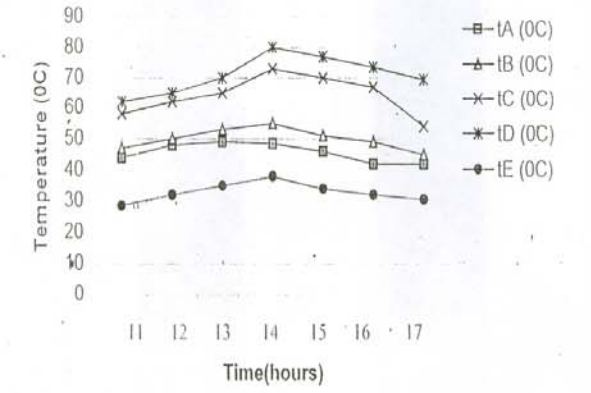

Fig 4: Results of temperature measrement observed with time on 14th December, 2004.

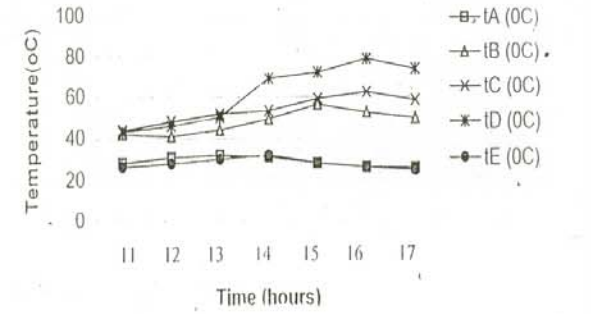

Fig 5: Results of temperature measurements observed with times on 24th January, 2005.

Table 1: Results of temperature measurements observed with time using the Constructed Solar Box Cooker on 20th November, 2004.

Time (Hour)	t_A (^{0}C)	t_B (^{0}C)	t_C (^{0}C)	t_D (^{0}C)	t_E (^{0}C)
11.00	43.0	47.0	59.0	65.0	36.5
12.00	46.0	50.5	62.0	68.0	39.0
13.00	49.0	58.0	74.0	80.5	40.0
14.00	50.0	52.0	70.0	88.0	43.0
15.00	48.0	50.0	68.0	82.0	40.0
16.00	45.0	48.5	60.0	76.0	38.5
17.00	42.0	46.0	58.0	72.0	36.0

Table 2: Results of temperature measurements observed with times using the Constructed Solar Box Cooker on 14th December, 2004.

Time (Hour)	t_A (^{0}C)	t_B (^{0}C)	t_C (^{0}C)	t_D (^{0}C)	t_E (^{0}C)
11.00	44.0	47.0	58.0	62.0	28.5
12.00	48.0	50.0	62.0	65.0	32.0
13.00	49.0	53.0	65.0	70.0	35.0
14.00	48.5	55.0	73.0	80.0	38.0
15.00	46.0	51.0	70.0	77.0	34.0
16.00	42.0	49.0	67.0	73.5	32.0
17.00	42.0	45.0	54.0	69.5	30.5

Table 3: Results of temperature measurements observed with times using the Constructed Solar Box Cooker on 24th January, 2005.

Time (Hour)	t_A (^{0}C)	t_B (^{0}C)	t_C (^{0}C)	t_D (^{0}C)	t_E (^{0}C)
11.00	28.5	42.0	44.0	43.0	26.5
12.00	31.0	41.0	48.0	46.0	28.0
13.00	32.0	44.0	51.5	50.0	30.0
14.00	31.0	49.0	53.0	69.0	32.0
15.00	28.0	56.0	59.0	72.0	28.0
16.00	26.0	52.0	62.0	78.5	26.0
17.00	25.5	49.0	58.0	73.5	24.5

4.2 Recommendation

Following the performance tests conducted and the thermal efficiency calculated for the better performance of the device, one or more reflectors should be included as part of the cover to increase the amount of isolation on the absorber. In the course of our investigation, we were forced to always open the glass covers in order to observe the variations of the cooking chamber air temperature, absorber plate temperature and the working fluid temperature. In doing these, so many errors such as effect of drought have prevented us from observing accurate and reliable temperature measurements. We therefore, recommend the fixing of required thermometers at appropriate places throughout the periods of investigation without the need to constantly open the glass covers of the solar device. We also suggest the use of more accurate temperature measuring instruments like thermocouples and platinum-resistance thermometers for conducting the various temperature measurements in future. Moreover, in this era of fuel shortages and power breakdown without notice, even the commonly used cookstoves like kerosene stoves, electrical cookers and gas stoves have caused some disappointments at certain times when in use. Therefore, the introduction of solar box cooker into the rural areas homesteads and the urban poor dwellings will greatly reduce the felling of trees as sources of fuel woods for domestic cooking and heating of water. This will undoubtedly check the effects of deforestation and desert encroachment on our environment. Finally, it is recommended that any future work of this nature, should involve the tests of the effectiveness of the use of different metals to serve as absorber plate and we also implore that future investigators should try to quantitatively evaluate the thermal efficiency of this photothermal system in relation to conventional cooking stoves.

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06/09/2009

Biofertilizer Potential of Traditional and Panchagavya Amended with Seaweed Extract

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ABSTRACT: The potential of utilizing panchagavya as biofertilizer was tested on the pulses *Vigna radiata, Vigna mungo, Arachis hypogea, Cyamopsis tetragonoloba, Lablab purpureus, Cicer arietinum* and the cereal *Oryza sativa* var. *ponni* by growing in soil amended with dried traditional and seaweed based panchagavya. Experimental seedling recorded higher rates of linear growth of both shoots and roots as compared to controls. These seedlings produced 264 to 390% more lateral roots than the control and maximum lateral root production was always observed in seedlings grown in soil amended with seaweed based panchagavya at low concentrations (1:100; panchagavya: soil). A similar observation was made on the number of leaves produced, leaf area and the number of root nodules formed in the pulses by rhizobia. A marked decrease in Chlorophyll a/b ratio, C/N ratio in the plants grown in seaweed based panchagavya indicating high chlorophyll b levels and a better nitrogen use efficiency in these plants respectively. [The Journal of American Science. 2010;6(2):39-45]. (ISSN 1545-1003).

Key words: Panchagavya, Seaweed based, biofertilizer potential, pulses, cereal.

INTRODUCTION

The current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable agriculture. Chemical agriculture has made an adverse impact on the health-care of not only soil but also the beneficial soil microbial communities and the plants cultivated in these soils. This eventually has lead to a high demand for organic produce by the present-day health conscious society and sporadic attempts are being made by farmers all over the world to detoxify the land by switching over to organic farming dispensing with chemical fertilizers, pesticides, fungicides and herbicides. In India, organic farming was a well developed and systematized agricultural practice during the past and this 'ancient wisdom' obtained through Indian knowledge systems such as 'Vedas' specify the use of 'panchagavya' in agriculture for the health of soil, plants and humans. In Sanskrit, panchagavya means the blend of five products obtained from cow, namely cow dung, cow urine, cow milk, curd and ghee (Sugha, 2005). The *Vriskshayurveda* systematizes the use of panchagavya. Few farmers in the southern parts of India have used modified formulations of panchagavya and found them to enhance the biological efficiency of the crop plants and the quality of fruits and vegetables (Natarjan, 2002). In the past three decades, crude extracts from seaweeds have been show to exhibit many bioactivities that include biostimulant, fertilizer and antimicrobial properties. Different forms of seaweed preparations such as LSF (Liquid Seaweed Fertilizer), SLF (Seaweed Liquid Fertilizer), LF (Liquid Fertilizer) and a manure prepared by using either whole or finely chopped seaweeds have been experimented and all of them have been reported to produce beneficial effects on cereals, pulses and flowering plants (Radley, 1961; Stephenson, 1974; 1981; Smith and van Staden, 1983; 1984; Tay *et al.*, 1985; Temple and Bomelle, 1989; Sekar *et al.*, 1995). In this paper, we present the results of an investigation made to evaluate the fertilizer potential of traditional and modified form of panchagavya amended with liquid seaweed preparations using some pulses and paddy as experimental plants.

MATERIAL AND METHODS

Traditional panchagavya

Traditional panchagavya was prepared following the procedures outlined by Pandurang Vaman Kane, 1941. It contained fresh cow dung - 0.5 kg; cow urine - 1.0 L; cow milk - 7.0 L; curd - 1.0 L; ghee - 1.0 L and water - 1.0 L. These ingredients were taken in a 25.0 L concrete pot, mixed well and allowed to stand in shade for 21 days with intermittent stirring. After 21 days, the preparation was allowed to dry for 180 days in shade and the

dried panchagavya was mixed with sterilized garden soil at a ratio of 1: 100 (panchagavya : soil) and used.

Seaweed based Panchagavya

Seaweed based panchagavya is a modified preparation (Natarajan, 2002) containing the aqueous extract of the alga, *Sargassum wightii*. The preparation contained Cow dung - 5.0 Kg; cow urine - 3.0 L; cow milk - 2.0 L; cow curd - 2.0 L; cow ghee - 1.0 Kg; sugarcane juice - 3.0 L; tender coconut water - 3.0 L; banana - 12 nos; yeast powder -100 g; jaggery - 100 g; water - 2.0 L. The above composition gives approximately 20.0 L of panchagavya. Cow dung and cow ghee were mixed together in a 25.0 L concrete pot and kept for 3 days with intermittent stirring to exhaust methane gas. On the fourth day all the other ingredients were added to the cow dung - ghee mixture along with spores of *Lactobacillus sporogenes* (one SPOROLAC tablet having 60 million spores / tablet) and mixed thoroughly. The mouth of the container was covered with a thin cloth and kept in the open in shade. This mixture was stirred twice everyday and after 18 days, 5.0 g of the algal extract residue was added to the preparation and used in experiments. Algal extract residue was prepared by extracting 100.0 g of shade dried *Sargassum wightii* with 5.0 L of boiling water for 30 minutes. The extract was allowed to cool, filtered through a layer of muslin cloth and dried *in vacuo* and the dry residue was used.

Assay of panchagavya preparations on the germination and development of seedlings of pulses and rice

The effect of panchagavya preparation on germination and development of rice *Oryza sativa* var. *ponni* and the pulses, *Vigna radiata, Vigna mungo, Arachis hypogaea, Cyamopsis tetragonoloba, Lablab purpureus, Cicer arietinum* seedlings were studied. The growth medium was a mixture of dry panchagavya residue and soil at a ratio of 1: 100 (traditional), 1: 50 (seaweed based) and 1: 100 (seaweed based) v/v. Seeds were surface sterilized with 1.0% mercuric chloride, washed several times in running water, soaked overnight in sterile water and allowed to germinate in dark. Germinating seeds were implanted in soil preparations kept in pots of the size 5.2" tall and 3.5" radius. Seedlings raised in sterilized garden soil were used as control. Ten replicates were used for all experimental plants. The seedlings of pulses were inoculated with *Rhizobium* R_4 (approximately $1x10^9$ cells/mL of sterile nutrient solution) twice, i.e. on the 5^{th} day and then on the 11th day in both control and test pots (except for *Oryza sativa* var. *ponni*). All the developing seedlings except *Oryza sativa* were watered on alternate days with Wilson's N-free nutrient solution. For *Oryza sativa*, normal water was used. Twenty one days old seedlings were carefully removed and their linear growth, the number of leaflets produced, leaf area, number of lateral roots formed, number of root nodules, and other biochemical parameters as detailed below were determined.

Rhizobium (R_4) was used in the inoculation of plants were grown on YMA (Yeast Mannitol Agar) medium as specified by J.M. Vincent with slight modifications (Thevanathan, 1980). Purity of the organism was checked frequently using 0.05% Congo Red YMA medium. Wilson's nitrogen-free nutrient solution (Wilson and Reisenauer, 1963) was used in the preparation of the inoculum as well as for watering the developing seedlings. An effective 72 hours old strain of *Rhizobium* R_4 strain was used for inoculating the seedlings. The seedlings were inoculated twice, first on the 5th day after germination followed by a second inoculation on the 11th day. Ten milliliters of a thick suspension of the inoculum (approximately $1x10^9$ cells/mL of sterile nutrient solution) was pipetted out around the base of each seedling. During the first few days after inoculation, care was taken in watering the plants so as to avoid washing the inoculum out of the soil. Wilson's nitrogen-free nutrient solution was used to water the developing seedlings on alternate days.

Estimation of photosynthetic pigments

Pigments from leaves of the developing seedlings were extracted with 80% acetone and the amounts of $chlorophyll_a$ and $chlorophyll_b$ were determined as described by Arnon (1949) and Yoshida *et al.*(1976).

$$Chlorophyll_a = 12.21\ A_{663} - 2.81\ A_{646}\ mg/g\ tissue$$

$$Chlorophyll_b = 20.13\ A_{646} - 5.03\ A_{663}\ mg/g\ tissue$$

Where, A_{663} and A_{646} represent the optical density (OD) values at the respective wavelengths.

Estimation of nitrogen and carbon

At different stages of development, whole plants were carefully removed from sand, cleaned and dried. Shoot, root and nodules formed in pulses were dried separately in an oven at 90^oC, until the weights remained constant. Then the dry weights of

these parts were determined. The dried plant material was ground in a glass mortar with glass pestle and the nitrogen content was determined by modified micro-Kjeldahl method (Nesslerisation) (Umbreit *et al*., 1972). Carbon content was calculated from total dry matter yield of the seedlings (Kvet *et al*., 1971; Terry and Mortimer, 1972; Turgeon and Webb, 1975; Causton and Venus, 1981).

RESULTS

The potential of utilizing panchagavya as biofertilizer was tested on the pulses *Vigna radiata, Vigna mungo, Arachis hypogea, Cyamopsis tetragonoloba, Lablab purpureus, Cicer arietinum* and the cereal *Oryza sativa* var. *ponni* by growing in soil amended with dried traditional and seaweed based panchagavya. Traditional panchagavya was used at a proportion of 1: 100 (panchagavya: soil) while seaweed based panchagavya was tried at 1: 50 and 1: 100 dilutions with soil. After 21 days, the seedlings were harvested and studied for their growth and development.

Effect on the linear growth of experimental seedlings:

Effect on shoot and root growth

Soil amended with seaweed based panchagavya increased the linear growth of both shoot and root systems in all the pulses and rice as compared to respective controls (Figures 1 & 2). Enhancement in the growth of root and shoot systems in the experimental plants was more pronounced in seedlings grown in soil amended with seaweed based panchagavya rather than with traditional panchagavya. At a ratio of 1: 100 (panchagavya: soil), shoots of the rice seedlings grown in seaweed based panchagavya exhibited nearly 100 % more growth than that of the control plants. In pulses, the percent increase in the linear growth of shoots over control plants in *Vigna radiata*, *Vigna mungo* and *Cicer arietinum* was relatively low in the range of only 16 – 20% as compared to other experimental plants, in which it was 64 – 98%. Even in seedlings grown in traditional panchagavya, the shoots of the treated plants exhibited 3 – 50% more growth than the controls. Linear growth of root in the experimental plants too exhibited a similar response to treatment with panchagavya (Figure 2). In seaweed based panchagavya treatment, a two fold increase in the linear growth of root could be observed in *Vigna radiata*, *Vigna mungo* and *Oryza sativa* as compared to controls. Roots of other experimental plants responded to the same treatment with an increase in growth ranging from 37 to 89%. Increasing the concentration of panchagavya (1: 50 dilution) decreased the effect on linear growth of both shoots and roots of the experimental plants. Nevertheless, the effect of seaweed based panchagavya was more than that observed for treatment with traditional panchagavya.

Effect on lateral root growth

As observed for the linear growth of shoots and roots, the number of lateral roots formed also was more in the seedlings raised in soils amended with both traditional and seaweed based panchagavya (Figure 3). However, use of the latter produced more lateral roots than the former in all the cases. Effect on lateral root formation was more pronounced in *Arachis hypogea* as compared to other experimental plants. Seedlings grown in soil amended with panchagavya produced 264 to 390% more lateral roots than the control and maximum lateral root production was always observed in seedlings grown in soil amended with seaweed based panchagavya (1:100; panchagavya: soil). Treatment with seaweed based panchagavya was higher than that observed for both control and traditional panchagavya.

Effect on leaf development and growth

Plants grown in soil amended with panchagavya produced more leaflets (in pulses) or leaves (in *Oryza sativa*) than their respective controls (Figure 4) and the effect was more pronounced in seedlings grown in soil amended with low levels of seaweed based panchagavya (1: 100, panchagavya : soil). In *Cyamopsis tetragonoloba*, *Lablab purpureus* and *Oryza sativa*, the number of leaflets formed in seedlings grown in seaweed based panchagavya at 1: 100 dilution was observed to be twice of that recorded for their respective controls. *Arachis hypogea*, *Cicer arietinum* and *Oryza sativa* also exhibited positive response to the treatments with both traditional and seaweed based panchagavya while *Vigna radiata* showed poor response. Seedlings grown in soil amended with traditional panchagavya produced less number of leaves per plant than those grown in seaweed based panchagavya. In all the plants, increasing the levels of seaweed based panchagavya in soil resulted in decreased production of leaves (Figure 4). Apart from the large number of leaf or leaflet production, the leaf area or the lamina of the leaves in plants grown in soil amended with panchagavya was always larger than those of the control plants (Figure 5).

The growth of leaves in all the experimental plants was high when grown in seaweed based panchagavya. In *Lablab purpureus*, the lamina size was nearly 27% larger with seaweed based panchagavya as compared to those grown in soil amended with traditional panchagavya (Figure 5). As compared to control, these seedlings produced leaves

which had 93% more surface area than that of their respective controls. Percent increase over control in the leaf area of the seedlings *of Vigna radiata, Vigna mungo, Arachis hypogea, Cyamopsis tetragonoloba* and *Cicer arietinum* grown in soil amended with seaweed based panchagavya at a ratio of 1: 100 was 27%, 35%, 46%, 140% and 37% respectively. In *Oryza sativa*, the percent increase in leaf area in response to the same treatment (1: 100 panchagavya: soil) was 96%.

Effect on photosynthetic pigments

Panchagavya amended soil had a profound effect on the quantities of chlorophylls too in leaves of the experimental plants (Figure 6). A low chlorophyll a/b ratio as compared to the control was recorded in the leaves of all the plants grown in panchagavya soil preparations. Seaweed based panchagavya was more effective than the traditional panchagavya irrespective of the dilutions tried. The ratio decreased with a decrease in the levels of seaweed based panchagavya in soil. In other words, low levels of the panchagavya in soil effectively decreased chlorophyll a/b ratio without decreasing the levels of the individual pigments. The treatment increased the quantities of chlorophyll b in the leaves of the experimental plants resulting in a low chlorophyll a/b ratio.

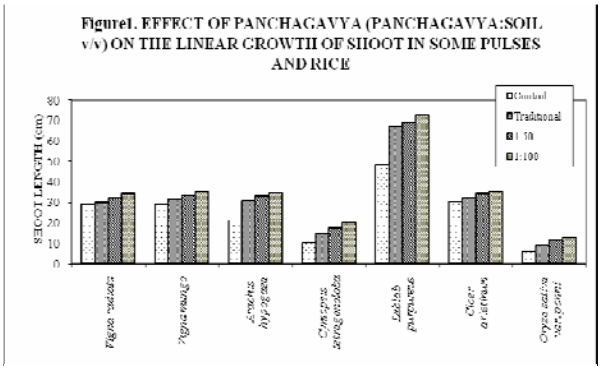
Effect on nodule formation

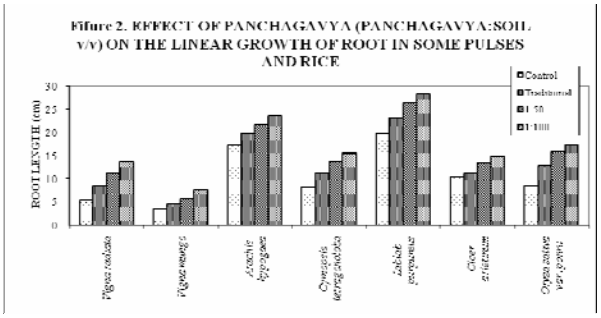
Since all the experimental plants except rice were legumes, the effect of panchagavya on root nodule formation was also studied in these legumes.

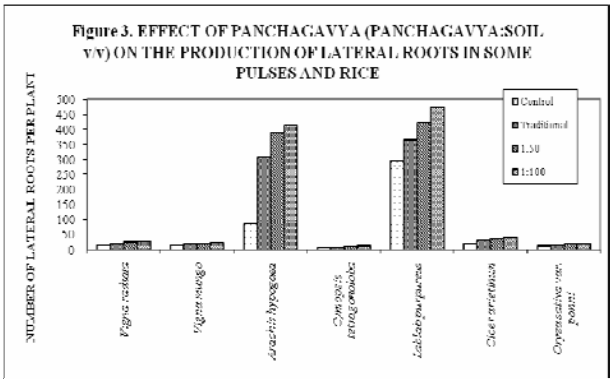
Root nodule formation was also enhanced in the presence of panchagavya. Again, the effect was marked in the seedlings grown in soil amended with low levels of seaweed based panchagavya (panchagavya: soil; 1: 100). The effect was maximum in *Arachis hypogea* and minimum in *Cyamopsis tetragonoloba*. Even traditional panchagavya treatment could cause an increase from 18% to 62% in the formation of root nodules (Figure 7).

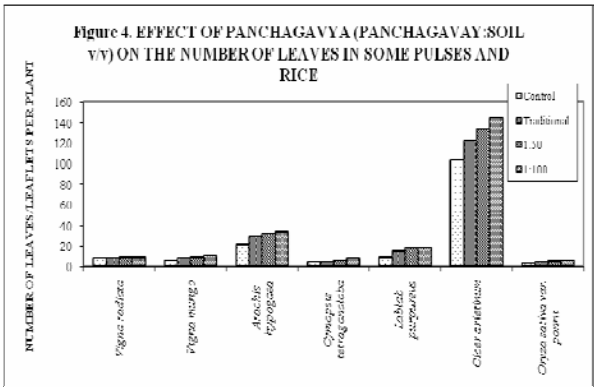
Effect on C/N ratio

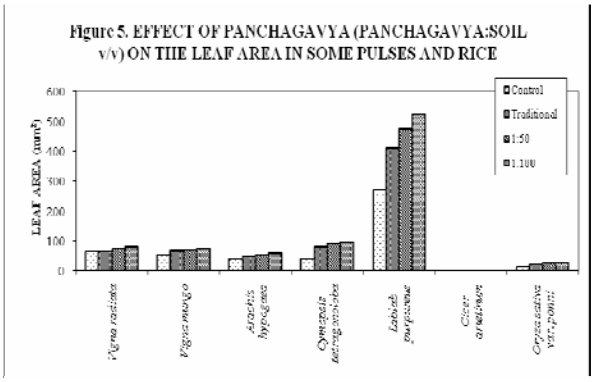
The seedlings raised in soil amended with panchagavya registered a low C/N ratio as compared to their respective controls (Figure 8). Percent reduction in the C/N ratio of seedlings grown in panchagavya amended soils was in the range of 1 – 22%. The C/N ratio of *Arachis hypogea* grown in seaweed based panchagavya preparation was 22% less than that of its control. *Oryza sativa* recorded a value that was 16% less than that of the control seedlings (Figure 8). Lowest values for C/N ratio in the experimental plants were recorded in seedlings grown in soil amended with low levels of seaweed based panchagavya (1: 100; panchagavya: soil). Even at a concentration of 1: 50 (Panchagavya: soil), the seaweed based preparation was able to reduce the C/N ratio by about 3 to 17% than the controls.

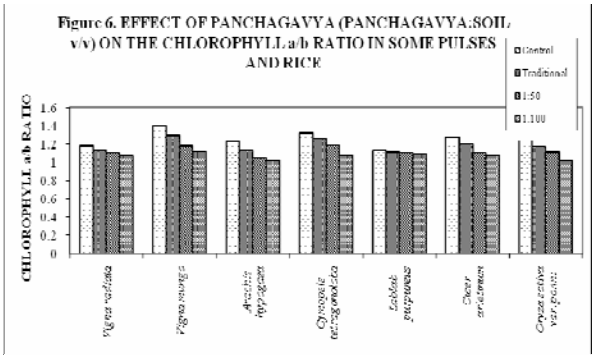


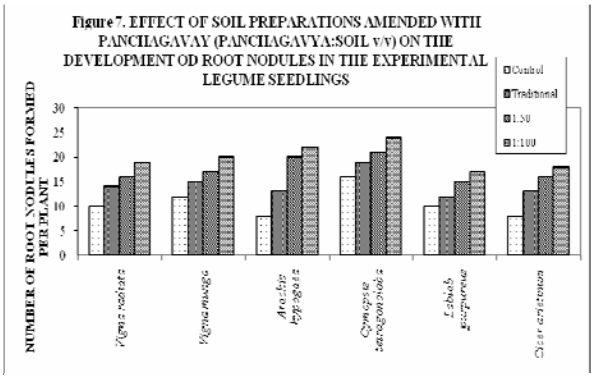


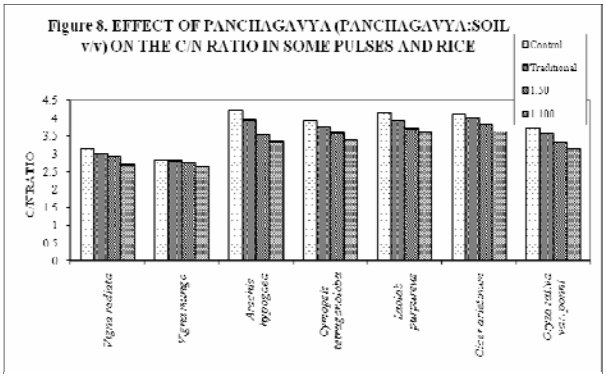












DISCUSSION

The biofertilizer potential of panchagavya prepared in the traditional way and a modified preparation amended with seaweed extract have been evaluated for their fertilizer potential using the pulses *Vigna radiata*, *Vigna mungo*, *Arachis hypogea*, *Cyamopsis tetragonoloba*, *Lablab purpureus*, *Cicer arietinum* and the cereal *Oryza sativa* var. *ponni* as the experimental plants. Some farmers in the southern parts of India use a modified panchagavya that contains many other plant products to boost fermentation and to support the growth of beneficial microorganisms. In the past three or four decades, the potential of seaweeds and their liquid extracts in agriculture as a biofertilizer and a source of growth promoters have been indicated by many (Bentley, 1960; Bhosle *et al*., 1975; Williams *et al*., 1981; Jeanin *et al*., 1991; Immanuel and Subramaniam, 1999; Thevanathan *et al*., 2005). These reports formed the basis for a new formulation of panchagavya with the inclusion of an aqueous extract of the brown alga, *Sargassum wightii* and assess for its biofertilizer potential in the present investigation.

Panchagavya is normally advocated as foliar nutrition (Caraka-Samhita, 1981; Susruta Samhita, 1985; Chauhan, 2002 b; 2004 b; 2005; Fulzele *et al*., 2001; Joshi, 2002; Garg and Chauhan, 2003 a; Saxena *et al.*, 2004) and has not been tried as manure. Nevertheless dried and powdered seaweeds have been shown to be a good source of manure when mixed with soil in small quantities for the cultivation of vegetable crops and tea. In the present investigation dried traditional panchagavya and seaweed based panchagavya were tested as manure. Dried panchagavya (both traditional and seaweed based) when mixed with soil at a ratio of 1:100 (panchagavya: soil v/v) and used as a growth medium promoted the linear growth of both the shoot and roots of the seedlings of both the pulses and the cereal, the paddy (Figures 1 and 2).The effect was pronounced in soils amended with seaweed based panchagavya even at 1:50 (v/v) dilution. The effect on all experimental plants except *Lablab purpureus*

was moderate in the sense that the linear growth did not mimic etiolation. Similarly, soils amended with panchagavya (both traditional and seaweed based) promoted the production of lateral roots, leaves, leaflets and the growth of lamina in all the experimental plants (Figures 3, 4 and 5). As compared to control, the seedlings produced leaves which had 93% more surface area than that of their respective controls. Percent increase over control in the leaf area of the seedlings *of Vigna radiata, Vigna mungo*, *Arachis hypogea*, *Cyamopsis tetragonoloba* and *Cicer arietinum* grown in soil amended with seaweed based panchagavya at a ratio of 1: 100 (v/v) was 27%, 35%, 46%, 140% and 37% respectively. Increased production of lateral roots would provide more surface area for absorption of water and minerals by the experimental seedlings than their controls. Similarly, large number of leaves or leaflets with greater surface area could be construed as an indication of enhanced photosynthetic efficiency in plants grown in soil amended with panchagavya. This is further confirmed by the marked decrease in the ratio of chlorophyll a to chlorophyll b (Figure 6) in leaves of the plants grown in soil amended with both traditional and seaweed based panchagavya. The C/N ratio also was very low in these plants as compared to controls (Figure 8). A low C/N ratio is normally indicative of a better carbon and nitrogen use efficiency than plants with high C/N ratio. Since all the experimental plants except rice were legumes, the effect of panchagavya on root nodule formation by rhizobia was also studied in these legumes. Panchagavya promoted the formation of root nodules by the inoculated rhizobia (*Rhizobium*, R4) in the experimental plants (Figure 7). The effect was marked in the seedlings grown in soil amended with low levels of seaweed based panchagavya (panchagavya: soil; 1: 100). The effect was more pronounced in *Arachis hypogea*. Even the use of traditional panchagavya as manure was able to increase nodule formation by nearly 18% to 62% (Figure 7). Though panchagavya has been claimed to have antibacterial activities (Subramaniam, 2005; Sugha, 2005), use of panchagavya as manure in the present investigation was found to promote both the survival ability and nodulating efficiency of the inoculated strain of *Rhizobium* (Figure 7). High levels of trace elements and adequate amounts of potassium and nitrogen have been shown to be present in seaweeds (Smith and van Staden, 1983, 1984; Tay *et al.*, 1985; Temple and Bomelle, 1989; Sekar *et al*., 1995). But for the low levels of phosphate, seaweed meal has been shown in this lab to be an alternative to farm yard manure in raising cereals, pulses and nodal cuttings of tea (Thevanathan *et al*., 2005). This could be the reason for the enhanced effect of seaweed based panchagavya over traditional panchagavya in promoting the growth and development of experimental pulses and cereals.

CONCLUSION

The biofertilizer potential of traditional and a modified panchagavya containing liquid seaweed preparation of *Sargassum wightii* were investigated.

Soil amended with panchagavya at a concentration of 1: 100 (panchagavya: soil v/v) increased the linear growth of both shoot and root systems of the seedlings of the pulses *Vigna radiata, Vigna mungo, Arachis hypogea, Cyamopsis tetragonoloba, Lablab purpureus, Cicer arietinum* and the cereal *Oryza sati*va var. *ponni*. Increase in linear growth of the shoots and roots was associated with a concomitant increase in the number of lateral roots produced, the number of leaves or leaflets produced, increase in leaf area, nodule formation by *Rhizobium* and a decrease in the chlorophyll a/b and C/N ratio. The effect was further enhanced when seaweed based panchagavya was used as manure at the same concentration.

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8/8/2009

Landscape change and sandy desertification monitoring and assessment: a case study in Northern Shaanxi Province, China

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Abstract The objective of this study is to develop techniques for assessing and analyzing sand desertification in the northern part of Shaanxi Province, China. In order to reveal the process of land degradation, especially the latest situation of sandy desertification, a method integrating remote sensing, Geographic Information System (GIS) and field survey was employed to build a sandy desertification dataset for analysis. Remote Sensing images included the Landsat Thematic Mapper (TM) images in 1987 and Landsat Enhanced Thematic Mapper Plus (ETM^+) images in 1999). Eight land- cover classes, including active sand dunes, fixed sand dunes, semi-fixed sand dunes, grass land, farm land, wet land, built up area and unused land and Normalized Difference Vegetation Index (NDVI), were identified.Results showed that the active sand dunes and semi-fixed sand dunes have increased with a change rate of 128.70 $km^2.yr^{-1}$ and 55.65 $km^2.yr^{-1}$, respectively, in the meantime the fixed sand dunes has decreased with a decreasing rate of 182.14 $km^2.yr^{-1}$. During the 1987s, the area of sandy desertified land reached 12,006.11 km^2 (57.17% of the total sandy area), of which severely desertified, medium desertified, and slightly desertified land areas were 4,442.23, 4,253.45and 3,310.43 km^2, respectively. By the year 1999, the area of desertified land was increased to 13,782.30 km^2 (65.63% of the total sandy area), of which severely desertified, medium desertified, and slightly desertified land areas were 5,169.89, 4,918.15and 3,694.26 km^2, respectively increasing by 1,776.19 km^2. Spatial change detection based on active sand dunes showed that the expansion area was much larger than the reversion in the past two decades, and that several active sand belts has been formed, suggesting that sandy desertification of northern part of Shaanxi Province, China, will be a long-term task.
[Journal of American Science 2010;6(2):46-53]. (ISSN: 1545-1003).

Keywords: assessment; sandy desertification; NDVI; active sand dunes; GIS;China

1. Introduction

The term “desertification” should be used side by side with the term “land degradation”. Hence “desertification” in the context of assessment is land degradation in arid; semi-arid; and sub-humid areas resulting from adverse human impact. According to the United Nations Conference on Environment and Development (UNCED, 1992), defines desertification as “land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors including climatic variations and human activities.

Sandy desertification is one of the main form of land degradation in China, especially in northern China (Wang, 2001), which has kept expanding since the 1950’s and has exerted severe impacts on regional socio-economic development and environmental security (Wang, 2006) .Harsh physiographic conditions (sparse vegetation coverage, sandy soil and water deficiency), irrational land-use practice and population augmentation are regarded as the forces of triggering sandy desertification (Zhu et al ,1994.Chen et al, 2005). Therefore, the sandy desertification assessment and monitoring are always concerned by researchers, the public and the policy-makers.

Desert and sandy decertified land occupy about 1.67 million km^2, or 17% of the total land area of China (Wang, 2003). Decertified sandy land increased by 25,200 km for the period from 1975 to 1987 about 40.5% of which was distributed in the semi-arid agro-pastoral regions of northern China (Zhu and Wang, 1993).

The objective of this study is to develop techniques for assessing and analyzing sand desertification in the northern part of Shaanxi Province, China, in the past decades. A method of integrating remote sensing (RS), geographic information system (GIS) and field survey was employed to generate a sandy desertification dataset of this region. Then change detection and land degradation process were performed based on the dataset. This study intends to provide useful information

for sandy desertification controlling and environmental management of the northern part of Shaanxi Province, China.

2. Study area

The study area, located in the northern part of Shaanxi province, lies within longitude 108 33 to 111 24 E and from 36 97 to 39 58 N with total area of 29416.6 km^2, accounting for 18.6% of the total Shaanxi province (Figure 1).In order to study the development of sandy desertification, the counties of Dingbian, Jingbian, Hengshan, Yulin, and Shenmu have been selected as study area. Counties are situated in the northern part of Shaanxi province. Geographically, the study area is located in the transitional zone, in south and east of Mu Su Desert (Inner Mongolia) and the Loess Plateau of northern Shaanxi province in China. This area has atypical continental semi-arid climate .Annual precipitation ranges from 440 mm in the south-east to 250 mm in the north-west, of which 60-80% is concentrated in the period from June to August. The annual mean temperature is about 6.0-8.5, with monthly mean temperature of 22 in July and -11 in January (Department of Geography of Peking University, 1983) .The main prevailing wind is north-westerly, with a speed of more than 5 ms^{-1} on over 200 days of the year. The elevation is between 1000 and 1907 m a.s.l (Song l (Song and Chen ， 1991).

3. Material and Methods

3.1 Data sources

Satellite remote sensing, in conjunction with geographic information system (GIS), has been widely applied and been recognized as a powerful and effective tool in detecting landscape change (Liu et al ., 2003; Li, 1996; Cai, 2001 ; Paul et al., 1992; Allen S Hope and Douglas A Stow, 1993; Anthony Gar-On Yeh and Li ,1999). Four kinds of data were used in this study, i.e., socioeconomic data, topographic data, remote sensing data, and ancillary data. Socioeconomic data were the annual statistical data released by the National Bureau of Statistics. The data published in 1986 and 2001 were acquired. All data were amalgamated to the county level. Tow topographic maps had a scale of 1: 100,000 and 1: 50,000, respectively. The remote sensing data are landsat TM images record in 1987 and 1999.Two types of ancillary data were used, a vegetation map at a scale of 1: 500,000(Lei, 1999),and a current land use map supplied Yulin Land and Resources Bureau(2000).

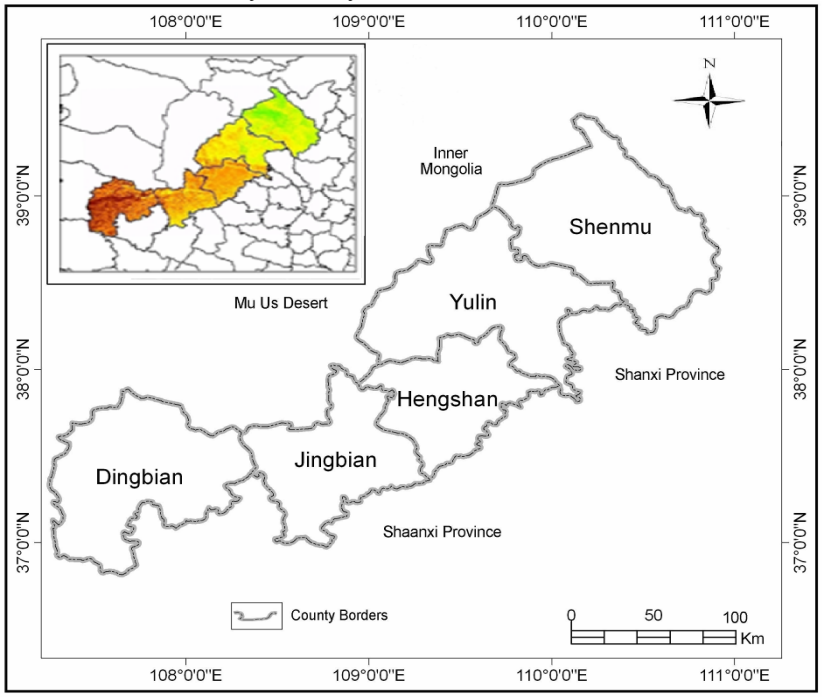

Figure 1. General location map of study area.

3.2 Data and Pre-processing

Remote Sensing images used in this study include the Landsat-5 Thematic Mapper (TM) image, and Landsat-7 Enhanced Thematic Mapper Plus (ETM^+) image, which were acquired in 24 October 1987 and 15 October 1999, respectively, the pre-processing of this dataset included geometric corrections .All images were geometrically corrected not only to eliminate geometric distortions present in the images but also to register the satellite images to ground data.. The nearest-neighbor resampling method was used in datum WGS 84 and projection UTM (49N) all images resampled to a 30 m pixel grid. In order to remove or normalize the reflectance variation between images acquired at different times, relative radiometric correction was performed to yield normalize radiometric data on a common scale (Paolini et al.,2006).Here, the histogram normalization, a simpler and more effective technique, was used to carry out the relative radiometric correction (Ding et al.,2005).

3.3 Determination of NDVI threshold

The Vegetation index can reflect a series of physics quantity of he plants, such as index of leaf's area, plant overlays degree, amount of living creature and plant category (Qingjiu et al., 1998). The index of vegetation contain many different expression methods, among them NDVI is applied in the fixed amount research of plant overlays. Therefore TM data were used to produce Normalize Difference Vegetation Index (Kidwell 1990; Dall'Olmo et al. 2002 ; Rouse et al .1974), which is defined as:

NDVI = (TM4-TM3)/ (TM4+TM3)

Where TM4 and TM3 are channels in the near infrared(NIR) and the red(R) wavelength of landsat TM data, respectively, was applied for monitoring vegetation changes in the study area within the year 1987 and 1999.

Determining the threshold of NDVI is the first step in extraction of sand desertification. Then we can use the threshold to separate vegetation information and non-vegetation information from land cover. Through comparative analysis of the NDVI images and the research area, select NDVI = 0.05 as the threshold, which can separate vegetation information and non-vegetation information from the research land cover. That is: if NDVI> 0.05, the area was considered as vegetation; instead, considered as no vegetation information.

The land desertification monitoring was performed and implemented in the GIS. Through the GIS, land desertification maps can be produced and this method can monitor areas prone to land desertification using spatial patterns from land cover classes, NDVI and main prevailing wind direction.

The correlation between NDVI and vegetation cover percentage, the selection of potential desertification areas where the vegetation cover (e.g., usually grasslands and farmlands) less than 30%, the classification of potential areas based on their position in relation to the main prevailing wind direction, and the production of land desertification areas and then the identification of land desertification changes with time.

NDVI is a greenness index and an argument can be made that greenness and vegetation cover are correlated. The vegetation cover is a primary indicator of land desertification. Before the data modelling, NDVI was density sliced. We defined that if NDVI was less than 0.078, vegetation cover percentage was less than15%; if NDVI was between 0.079 and 0.102, vegetation cover percentage was between 15–30%; If NDVI was between 0.103 and 0.138, vegetation cover was between 30–50%.

The NDVI and vegetation cover classification criteria were defined as follows: NDVI<0.079 and vegetation cover <15% as active sandy land and it is severe desertified, NDVI=0.079–0.102 and vegetation cover=15–30% as semi-fixed sandy land and it is medium desertified, and NDVI=0.103–0.138 and vegetation cover=30–50% as fixed sandy land and it is slightly desertified (Table 1). This NDVI classification was calibrated by field work and was also supported by previous studies (Guo 1990; van Genderen et al. 1993;Guo 1994; Zhang 1994).

The image pattern, tone and texture were considered to classify the land types of sandy desertification. The following four types were mapped:

1. Land severely aected by sandy desertification. This is characterized by a grayish bright color, and represent mobile sandy dunes with sickle-like shapes and high undulation which has <15% vegetation cover.

The active sand dunes are widespread, covering up to 50–70% of the total area of sandy land. The inter-dune areas are characterized by wind erosion and sand covering.

2. Land showing a medium amount of sandy desertification. This type of sandy land has a gray or grayish red color and exhibits semi-fixed sand dunes with a wave-like shape. The vegetation cover varies from 15 to 30%. The shifting sand is widespread and there are visible patches of wind erosion in farmland and grassland.

3. Land slightly aected by desertification. Grayish green and grayish red in color, it refers to fixed dunes with little shifting sand and has a vegetation cover of 30–50%

4. Land unaected by desertification. This has a uniforml saturated red color, and has no patches of shifting sand and a vegetation cover of more than 50%.

4. Results and discussion

4.1 Landscape change

Generally speaking, from the 1987s to the 1999s, there was a remarkable ecological change occurred in the study area sandy land during the study period (twelve years). The sandland landscape changed significantly and desertified land has expanded rapidly .From 1987 to 1999, the fixed sand dunes, which, covered (9669.24 km^2; 32.87%) of the total area in 1987, sharply shrank to 7483.58 km^2 (25.44%) in 1999 with a decreasing rate of 182.14 $km^2.yr^{-1}$.The semi-fixed sand dunes, however, increased from 4121.27 km^2 (14.01%) in 1987 to 4789.02 km^2 (16.28%) in 1999 with a growth rate of 55.65 $km^2.yr^{-1}$.The active sand dunes ,following the same trend as the semi-fixed sand dunes, increased from 5674.46 km^2 (19.29%) in 1987 to 7218.83 km^2 (24.54%) in 1999 with a change rate of 128.70 $km^2.yr^{-1}$.The grasslands decreased from 4244.82 km^2 (14.43%) in 1987 to 2541.60 km^2 (8.64%) in 1999 with a decreasing rate of 141.94 $km^2.yr^{-1}$,while the farmlands, increased rapidly from 1723.81 km^2 (5.86%) in 1987 to 3403.50 km^2 (11.57%) in 1999 with a growth rate of change 139.97 $km^2.yr^{-1}$.The built up area increased from 1106.05 km^2 (3.76) in 1987 to 1741.46 km^2 (5.92)in 1999 ,while the unused land decreased from 2100.35 km^2 (7.14) in 1987 to 1582.61 km^2 (5.38) in 1999 ,whereas wetlands had kept with no changed mentioned during the study period. (Table 2 and Figures 2, 3, and 4). Policies have played an important role in controlling sandy desertification, this mainly happened in the study area as we can see in the rapidly increasing of farmland from 2017.98 km^2 (6.86%) in 1987 to 3697.67 km^2 (12.57%) in 1999 of the total area, on the other hand we can see the decreasing of grassland from 4244.82 km^2 (14.43%) in 1987 to 2541.60 km^2 (8.64%) in 1999 of the total area of the study area. Although land desertification has been to some extent controlled in the study area, the issue is still serious.

4.2 Severity of sandy desertification

The sandy desertification land in the study area during the two different time intervals is indicated in Fig.5.During the 1987s, the area of sandy desertified land reached 12,006.11 km^2 (57.17% of the total sandy area), of which severely desertified, medium desertified, and slightly desertified land areas were 4,442.23, 4,253.45and 3,310.43 km^2 , respectively. By the year 1999, the area of desertified land was increased to 13,782.30 km^2 (65.63% of the total sandy area), of which severely desertified, medium desertified, and slightly desertified land areas were 5,169.89, 4,918.15and 3,694.26 km^2, respectively increasing by 1,776.19 km^2. The statistics indicate that the unchanged region for the type of sandy desertification in 1987 reached 8,993.89 km^2, accounting for 42.83% of the sandy area. While in 1999 it was reached 7,217.70 km^2, accounting for 34.37% of the sandy area. It is indicated by the above data that the land desertification process was not steady and showed a trend of developing. The developed region of sandy desertification was directed mainly from the northwest towards the southeast, especially in the desert-adjacent areas.

4.3 Spatial imbalance of sandy desertification

Table 3 shows the spatial imbalance of sandy desertification during the 12 years from 1987 to 1999. The regions with serious sandy desertification are in northwestern parts whereas those slightly influenced by desertification are in the southeastern parts belonging to loess hills. This imbalance of spatial distribution varied little during the 12-year study period, and could be accounted for by the difference of physical factors and by the diversity of land-use practices. Compared to the southeast, the northwest, which is closer to the inner part of the MU US Desert, mainly under the influence of wind erosion and eolian accumulation, has an abundant sand source.

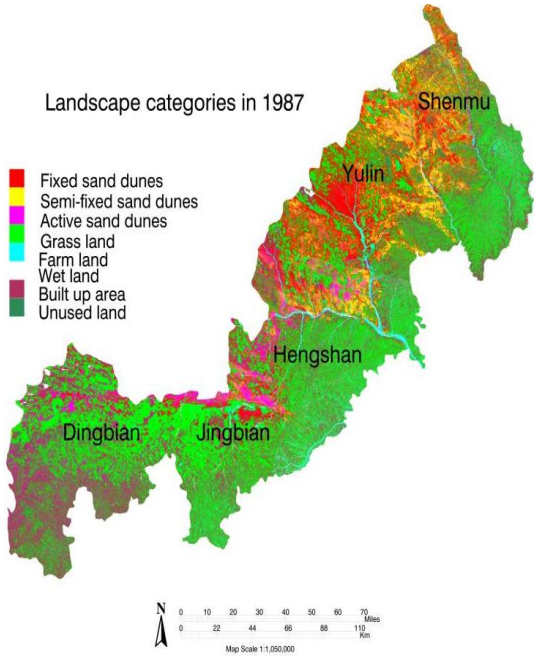

Figure 2: Landscape of the study area in 1987

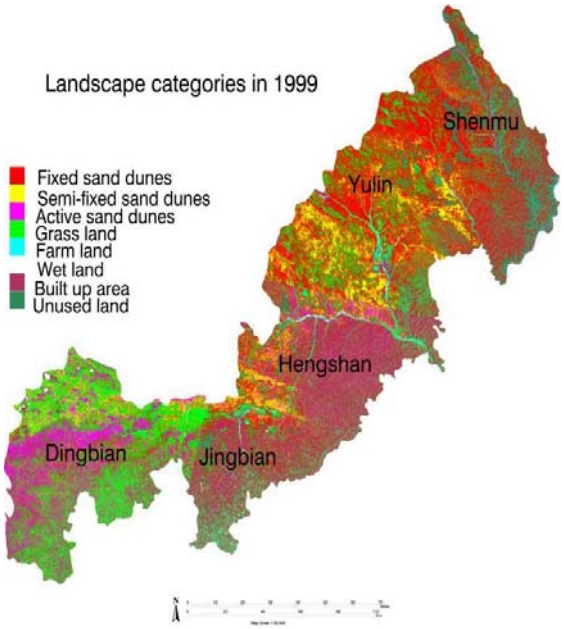

Figure 3: Landscape of the study area in 1999

Table 1: Extent of desertification hierarchical list in the study area

Desertification type	Vegetation coverage	NDVI	Classification criteria
Slight desertification	30–50%	0.103–.138	No obvious blown sand activities and land surface is covered by fixed or semi-fixed sand dunes
Medium desertification	15–30%	0.079–.102	Blown sand activities are controlled significantly, and sand movement ripples exist on sand dunes
Severe desertification	<15%	<0.079	Gobi, sand dunes and sand land denuded interdunes, denuded dune residuals, , clay mounds and wind blowouts.

Table 2: Change rate of the 6 landscape patterns from 1987 to 1999

Land cover type	**1987**		**1999**		**1987-1999**		**Change rate (+Gain,-Loss) 1987-1999**
	(km^2)	**(%)**	**(km^2)**	**(%)**	**(km^2)**	**(%)**	**($km^2.yr^{-1}$)**
Fixed sand dunes	9669.24	32.87	7483.58	25.44	2185.66	7.43	-182.14
Semi-fixed sand dunes	4121.27	14.01	4789.02	16.28	-667.75	-2.27	+55.65
Active sand dunes	5674.46	19.29	7218.83	24.54	-1544.37	-5.25	+128.70
Grasslands	4244.82	14.43	2541.60	8.64	1703.22	5.79	-141.94
Farmlands	1723.81	5.86	3403.50	11.57	-1679.69	-5.71	+139.97
Wetlands	776.60	2.64	655.10	2.23	121.50	0.41	-10.125
Built up area	1106.05	3.76	1741.46	5.92	-635.41	-2.16	+52.95
Unused land	2100.35	7.14	1582.61	5.38	517.74	1.76	+43.15
Total	29416.60	100%	29416.60	100%		**Total**	29416.60

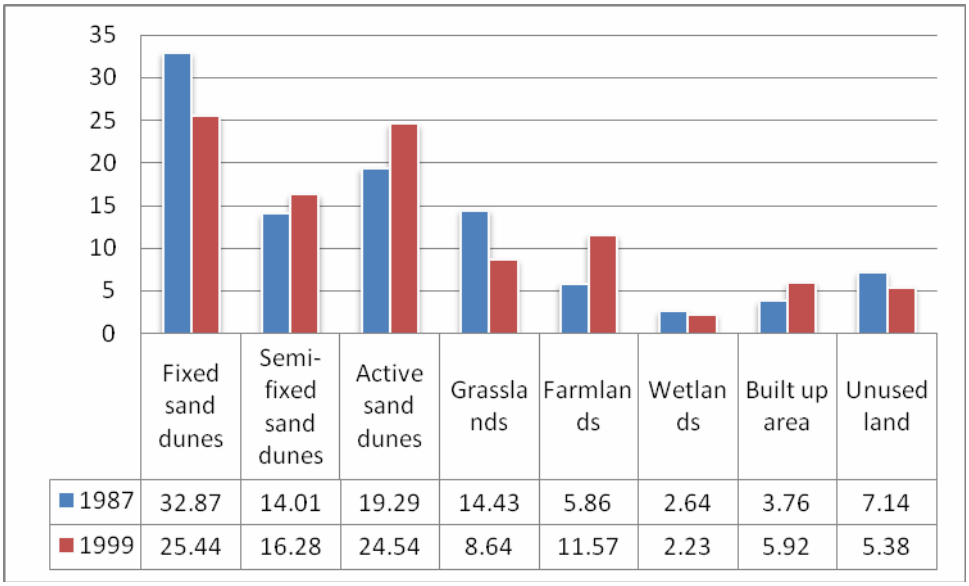

Figure 4: Area percentage of the eight landscape patterns in 1987 and 1999

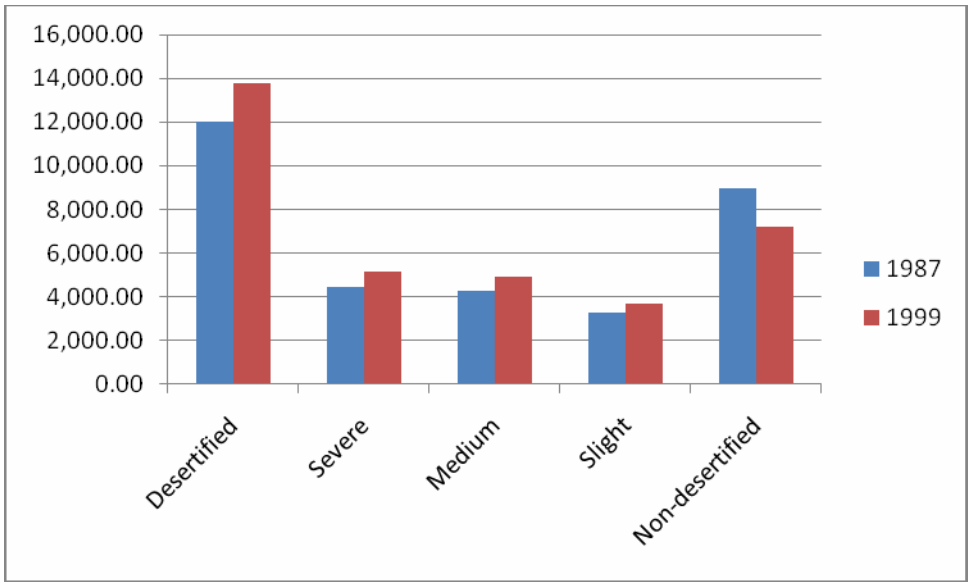

Figure 5: Area of desertified land

Table 3: Desertified land area during the study period

year	Severe desertification		Medium desertification		Slight desertification		Land unaffected by desertification	
	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)
1987	4,442.23	36.99	4,253.45	35.43	3,310.43	27.57	8,993.89	42.83
1999	5,169.89	37.51	4,918.15	35.68	3,694.26	26.80	7,217.70	34.37

5. Conclusions

During the 1987s, the area of sandy desertified land reached 12,006.11 km^2 (57.17% of the total sandy area), of which severely desertified, medium desertified, and slightly desertified land areas were 4,442.23, 4,253.45and 3,310.43 km^2, respectively. By

the year 1999, the area of desertified land was increased to 13,782.30 km^2 (65.63% of the total sandy area), of which severely desertified, medium desertified, and slightly desertified land areas were 5,169.89, 4,918.15and 3,694.26 km^2, respectively increasing by 1,776.19 km^2. The statistics indicate that the unchanged region for the type of sandy desertification in 1987 reached 8,993.89 km^2, accounting for 42.83% of the sandy area. While in 1999 it was reached 7,217.70 km^2, accounting for 34.37% of the sandy area.

The results also demonstrate that land cover changes during the past twelve years have been caused by land desertification on farmland and grassland in the area. Such changes may not only include the development of land desertification, but also explain the causes of land desertification in the study area due to over-exploitation and inappropriate land use, as well as by the invasion of wind-blown sand.

We can conclude from the results that the sandy desertification process of the northern part of Shaanxi Province, China, during the study period (twelve years) was a severe sandy desertification, characterized by the fixed sand dunes decreasing at a high speed, and the semi-fixed and active sand dunes increasing remarkably. In most of the sand land, desertification has developed rabidly, while rehabilitation of vegetation has occurred only in marginal areas in the east and south.

Acknowledgement:
Many thanks to Professor Hu Guangdao at the Institute of geology and Remote Sensing ,faculty of earth resources ,china university of geosciences For providing the data .

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9/22/2009

Exploration Potentiality Test of some Electrical Geophysical Equipment

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Abstract: Errors that emerge as either of under/over estimation of depth of investigation in electrical resistivity surveys may not necessarily be wholly due to data processing implementation structure or field measurement procedure A VES exploration procedure aimed at determining the exploration potentiality of a newly acquired resistivity equipment marked here as T, was carried out using the equipment, an older well tested version of terrameter equipment, and an adaptive generator-powered assemblage at the same location within a survey site whose geophysical and hydrogeologic parameters were well known. The result obtained at each VES for each of the equipment was compared with the known information for the site obtained from the borehole log of a functional borehole located at the site. The then newly acquired terrameter was found to consistently underestimated layer thicknesses and depth to basement in comparison with other equipment. [Journal of American Science 2010;6(2):54-57]. (ISSN: 1545-1003)

Key words: vertical electrical sounding (VES), exploration potentiality, equipment

1. Introduction

Sources of error in geophysical prospecting are most often than not associated to inaccuracies in taking field measurements or improper handling of equipment. Often times, inherent errors in instruments are seldom considered due to the mentality that anything made from across the seas, which are very neatly and attractively packaged, especially from highly technologically sophisticated societies, are perfect. Although most of the time, equipment manufactured there are to high precision, yet often times, equipment sent out, most especially as donations to developing countries, are only refurbished and are therefore prone to having system errors.

A terrameter T, was investigated to determine its level of accuracy and suitability for taking field readings. The interpreted result of its data was compared with similar result obtained with an arrangement of an electricity generator, a digital voltmeter, a digital ammeter set from a digital multimeter PM 2522, connecting wires, and four copper electrodes. This was also compared with the borehole log value obtained from a productive borehole drilled by Messrs Preussag at the Jamm'a village in the Kubanni river basin. The test site for the terrameter and the alternative arrangement is the site of the mentioned productive borehole. In both sets of instruments, the normal Schlumberger array was used.

2. Field Test Area

The field test area is the location of a productive borehole drilled in the Jama'a village in the Kubanni River Basin. The basin was chosen on the ground that a lot of work had been undertaken within the basin by numerous researchers. There is therefore an abundance of geologic and geoelectric information on the basin. The basin occupies the centre of the South-Eastern sector of the Zaria sheet (No 102 S.W.) of the 1:50,000 sheet ordinances series of the Nigeria ordinances survey maps. It is approximately bounded by latitudes $11^0$4'25" N and $11^0$10'45" N; and longitudes $7^0$36'56" E and $7^0$44'22" E (Shemang, 1990). The basin has an average area of about 150 km^2 (Egbeifo, 1978). It lies on a plateau with a height of about 570 m above sea level, and has a dendritic drainage pattern. The basin is elongated in the NW-SE direction (fig. 1), being the direction of dominant faulting and jointing in the basement complex of Nigeria (McCurry, 1970).

Akpoborie (1972) suggested that the presence of joints and fractures predominantly control the flow of underground water in the basin. Ososami (1968) found that the depth to bedrock in the basin vary in thickness from less than 1 m, to about 30 m. Egbeifo (1978) established that the depth to water table at various locations within the basin ranges between 3 m and 10 m. Olugbemiro (1985) estimated the depth to basement around Jama'a Kubanni village in the basin to be about 36 m. This was corroborated by the borehole drilling work done by Messrs Preussag Nigeria Limited in 1985. Recent geophysical work in the basement include that of Bajeh (1992), who conducted a ground magnetic survey of the basin, and estimated the depth to basement to be between 0 m and 50 m. Makinde (1996), using the Schlumberger array and a variant of the two-electrode method, established the depth to basement within the basin to be between 1.3 m and 50 m.

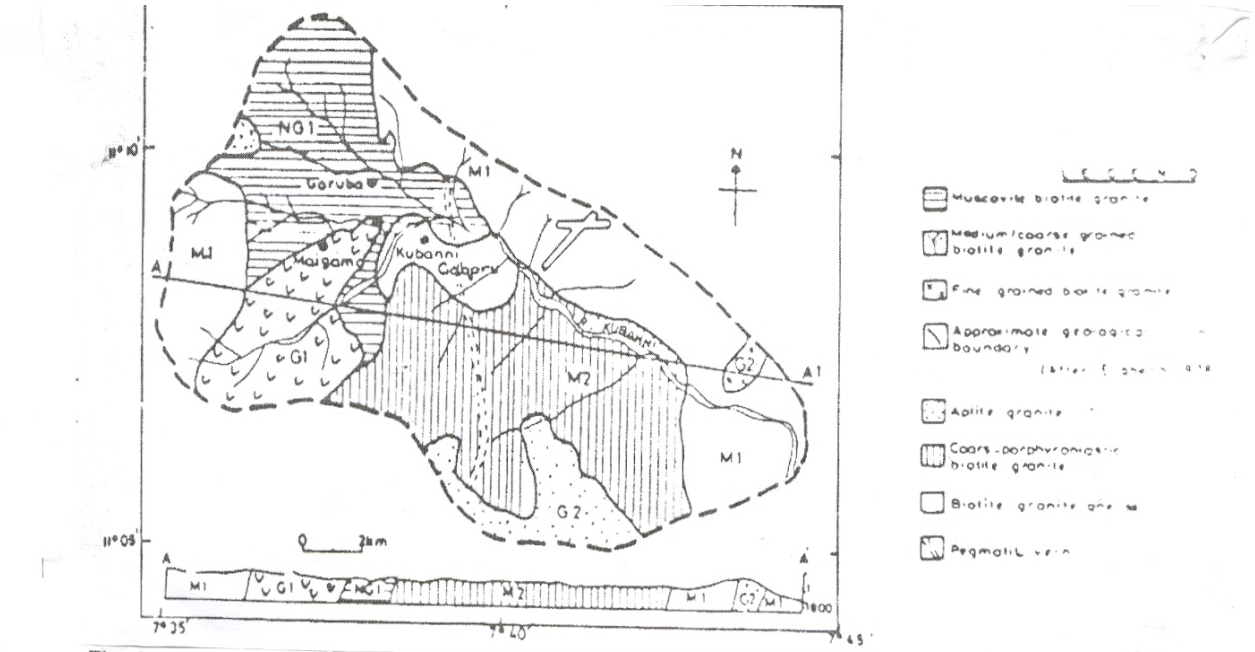

Fig. 1: Basement Geology Map of Kubanni River Basin (After Egbeifo, 1978)

3. Field Investigation

Vertical Electrical Sounding (VES) is a geophysical method used for depth profiling and exploration. The parameter of interest is the variation of resistivity, ρ with depth, which by implication enunciates the variation of conductivity, σ with depth. The underground is made up of layers of apparently inhomogeneous media. Earth electrical resistivity profiling instruments normally measure the apparent resistivity, ρ_a of the earth media. The apparent resistivity has a direct bearing on the conductivity of the fluid contained in the pores of the layers of earth in the area under investigation.

In conducting the field investigation, use was made of a terrameter T — the instrument whose performance was in doubt, an older version of terrameter, and an alternative VES instrument package consisting of an electricity generator, a digital voltmeter, a digital ammeter set from a digital multimeter PM 2522, connecting wires, and four copper electrodes. These sets, which had proved to produce accurate results were used to give the standard set of readings against which the readings from the terrameter was compared in order to be able to detect the level of inaccuracy in the terrameter. The Schlumberger array was employed in carrying out the investigation using the three sets of equipment. In using the alternative VES instrument package, two of the copper electrodes were set as current electrodes, while the other two served as the potential electrodes. Electric current I, measured with the digital ammeter, was driven into the earth through the current electrodes, while the potential developed in the earth due to the interaction between the current and the earth structure was fed into the digital voltmeter through the potential electrodes.

In carrying out the field investigation using the normal Schlumberger array, for each combination of potential electrode spacing MN, and current electrode spacing AB, which gave a measurable value of the potential developed, a configuration K- factor was calculated. This was used alongside the measured value of I and V to obtain the resistance, R and subsequently the apparent resistivity ρ_a for that field observation. The terrameter reading gives the direct value of R. The applicable general field equation in all the cases is given as:

$$\rho_a = KR \qquad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

where $R = {}^{V}/_{I}$.

According to Mares (1984), the configuration factor, K can be calculated using

$$K = \pi\left[\frac{AB^2}{MN} - \frac{MN}{4}\right] \ldots\ldots\ldots\ldots \quad (2)$$

The computed apparent resistivity was then plotted against ½ AB on a bi-logarithmic scale.

4. Results

Figure 2 shows the VES 1 plot obtained over the selected location using the terrameter T; fig. 3 the VES 2 plot obtained over the same location using the older version of terrameter; fig. 4 shows the VES 3 plot obtained over the location using the assembled VES equipment; and fig. 5 shows the borehole log (BHL) for the productive borehole at the selected location in the Jama'a Kubanni village.

An interpretation of the VES curves shows the following:

Layer	Borehole log BHL Thickness (m)	VES 1		≈ % Error wrt BHL	VES 2		≈ % Error wrt BHL	VES 3		≈ % Error wrt BHL
		ρ (Ωm)	h (m)		ρ	h (m)		ρ (Ωm)	h (m)	
1.	9.0	116	7.4	17.78	72	8.8	2.22	71	8.4	6.67
2.	18.0	69	13.8	23.33	26	17.5	2.78	28	17.3	3.89
3.	36.0	617	31.5	12.50	191	36.0	0.00	204	36.1	0.28
4.	∞	988	∞		1827	∞		1944	∞	

The above represents the average values obtained using the terrameter T, the older version of terrameter, and the assembled VES equipment.

The thickness shown is the total depth from the earth surface to the base of the identified layer.

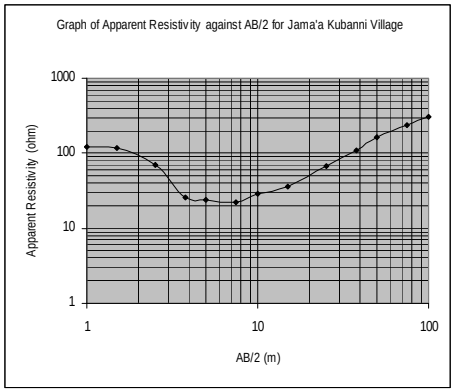

Fig. 2: VES Curve for the Terrameter, T

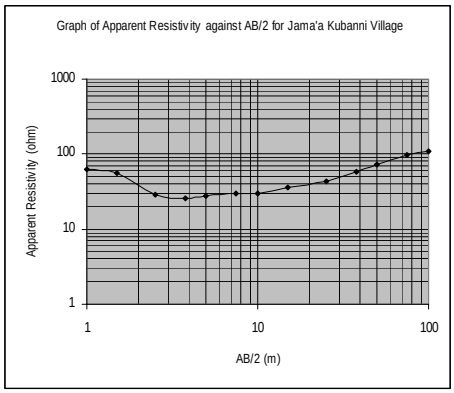

Fig. 3: VES Curve for the Older Terrameter

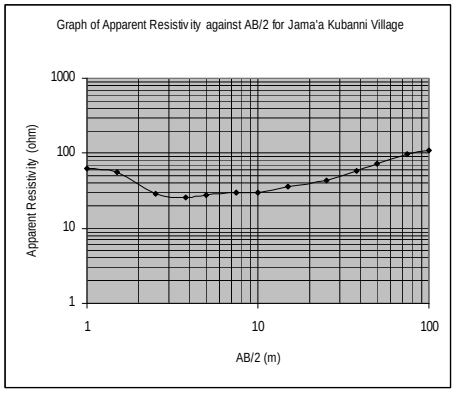

Fig. 4: VES Curve for the Assembled Equipment

5. Conclusion

From the interpreted result obtained, and shown in the table, it is evident that there is gross error in the result obtained using the terrameter T. The terrameter T was observed to have contributed errors ranging from 12.5 % to 23.33 % into the layer thickness of the earth media under investigation. Result obtained over VES 2 and VES 3 show that the older version of terrameter and the assembled VES equipment used gave almost the same result as what was given by the borehole log obtained over the Jama'a village borehole drilled by Messrs Preusag Nig. Ltd. and hence are dependable. The resuls of VES 2 and 3 are in line with similar results obtained over the same site by previous workers such as Ajyi and Hassan (1990), Shemang et al. (1992), and Bajeh (1992).

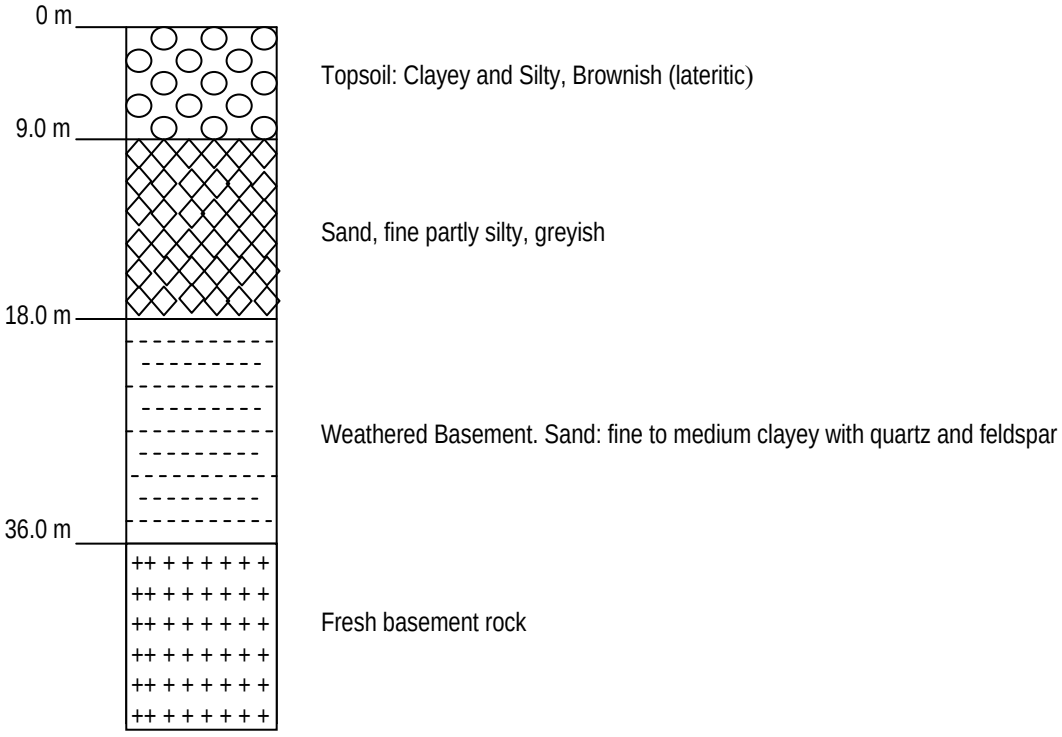

Fig. 5: Geological Well-log obtained by Preussag Nig. Ltd. at Jama'a Kubanni (After Olugbemiro, 1985)

This therefore suggests that for any newly introduced equipment, it is necessary to conduct equipment test over a site on which there is adequate geophysical information, and against information collected using already tested and trusted equipment.

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06/09/2009

Determination of Borehole Sites for Extensive Irrigation Work in Yobe State, Nigeria

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Abstract: Geo-electric resistivity soundings were carried out in Bursari, Bade and Jakusko Local Government Areas (LGAs) of Yobe State, Nigeria. This was aimed at determining favourable sites for drilling of boreholes, which will be used as recharge sources for the supply of water for use in irrigation works. The survey which delineated the various rock layers within the sub-surface at the sites, identified which of these layers would be promising for development; determined the thicknesses and depths of these aquiferous layers; and, identified borehole sites. The investigation showed that for an abundance of water supply for extensive irrigation purposes, a depth of between 90m and 110m would need to be drilled at each of these sites. [Journal of American Science 2010;6(2):58-61]. (ISSN: 1545-1003)

Key words: geo-electric resistivity soundings, aquiferous layers, borehole sites, vertical electrical soundings (VES)

1. Introduction

In the study of underground structures for the identification of water bearing layers, electrical resistivity method is usually found suitable. A study of the underground water bearing layers in parts of Yobe State of Nigeria was undertaken. The study area comprises four broad locations in Bursari, Bade and Jakusko Local Government Areas (LGAs) of the state. The following locations were investigated in this study:

(a) Jawa (Bursari LGA) — ten sites;
(b) Katuzu Ward in Gashua (Bade LGA) -- ten sites;
(c) Muguram (Jakusko LGA), — ten sites; and
(d) Jakusko (Jakusko LGA) — ten sites.

The study area is generally characterised by a flat topography. It is located within the North-East Arid Zone of Nigeria. The area is characterised by pockets of surface pools of water forming the wetland. The main objective of this study was to locate favourable sites for drilling of boreholes that would be pooled together to supply drinking water for the areas, and irrigate farmland at the peak period of the dry season. The result of the geo-electric resistivity soundings that were carried out in these parts of Yobe State, and favourable conditions for siting boreholes in the area under investigation are discussed.

1.1 Methodology

To achieve the objective, geophysical procedures were used to:

(i) delineate the various rock layers within the sub-surface at the project sites;
(ii) identify which of these layers would be promising for development;
(iii) determine the thicknesses and depths of these aquiferous layers; and
(iv) identify borehole sites.

2. Geology of the Area

The project area is located towards the western fringes of the Chad Basin and has some rocks of the Chad Formation underlying it. The Chad Basin is the largest area of inland drainage in Africa (Barber, 1965) occupying about 230,000 km^2 in the Central Sahara and the southern Sudan. About one-tenth of the basin is situated in the northern part of Nigeria. The stratigraphy and composition of the various formations are as discussed by Barber and Jones (1960), Carter et al. (1963), Reyment (1956), and Cratchley (1960). The Chad Formation is a sequence of lacustrine and fluviatile deposits of clays and sands of Pleistocene age. These sedimentary rocks dip gently and thicken eastwards towards the centre of the Chad Basin (Matheis, 1989).

The Chad Formation consists of three water-bearing horizons namely: the Upper, the Middle, and the Lower Zone (Matheis, 1989). The project area is directly underlain by the rocks of the Upper Member of the formation. Lithologically, the upper member is composed of layers of clayey grits and sands or sandstones of varying thickness. The rocks are largely concealed beneath a mantle of deposits. Artesian and sub-artesian conditions are present over wide areas of the basin having profound effect on the economy of this area (Matheis, 1989). The Upper Zone provides water for numerous dug wells throughout the rural areas.

2.1 Hydrogeology of the Area

The principal hydrological features in the project area are based on those delineating the geological units within the area. The principal features are the rocks of the upper member of the Chad Formation, which underlie the area. Groundwater potential in this upper member is estimated to be generally high, judging by

the yields observed from existing boreholes in the area. Water level estimated from hand-dug wells was on the average, 20m. This shallow level is not surprising because of pools of water forming "wet-land" in the area of study. For an enhanced successful siting of boreholes, topographically higher areas were avoided due to the increased depth to water table that might be encountered.

2.2 Geophysical Investigation of the Area

In order to determine the layer thicknesses, distribution and nature of the overburden, and depth to fractured basement, two arrays of the electrical resistivity methods were used to probe the sub-surface. These are (i) the Schlumberger and (ii) the two-electrode arrays. For the Schlumberger array, an Abem Terrameter Model SAS 300 was used, while the instrument constructed for the Ajayi-Makinde Two-electrode Method (Makinde, 1996; Ajayi and Makinde, 2000), was used for the two-electrode array. VES sounding using these arrays were carried out at forty (40) sites to determine the different elements of the overburden, and also, the depth to basement. Typical methods of laying out (Koefoed, 1979; Breusse, 1983) with the adaptable methods of interpretation (Shiftan, 1970; Mooney, 1980; and Van Nostrand and Cook, 1966) were applied to arrive at meaningful deductions. In all the locations studied, the correlation coefficient of the two arrays was between 0.926 and 0.983, indicating a high confidence level in the results. This work however reports the VES result obtained using the Schlumberger array

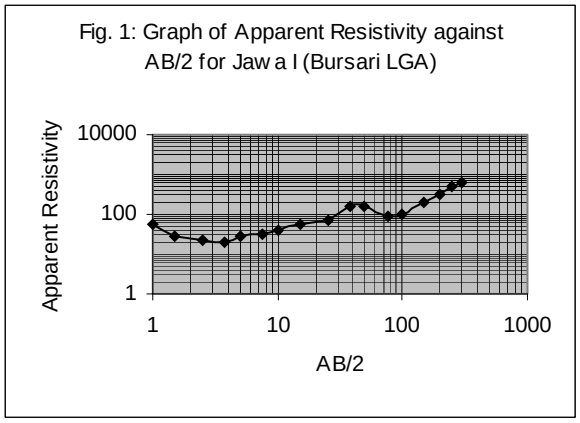
3. Data Presentation, Interpretation, Results, and Recommendation

The VES data are presented as sounding curve plots of apparent resistivity, ρ (Ωm) against electrode spacing, AB/2 (m), on a log-log graph sheet. Figure 1 to 4 shows typical VES curves obtained at each of the four broad locations within the study area. In this section, attempts have been made to demarcate/emphasize only the horizon of interest for groundwater development. The depth to the aquifer and recommended drilling depth are also given. Apparent resistivity values with depth and corresponding VES curves obtained are tabulated for each site. Only the Schlumberger, and not the two-electrode data is discussed here.

3.1 Typical Results

3.1.1 Site Name: Jawa I (Bursari LGA)

Depth (m)	Resistivity (Ωm)	Lithology
0.6090693	35.2731	Dry Sand and Clay
0.8939916	19.32896	
1.3122	15.56736	Clay
1.926046	18.13284	
2.82705	23.64356	
4.149542	32.55106	Clay and Sand
6.090694	52.08189	
8.939917	101.8883	
13.122	192.7786	
19.26047	246.5311	
28.2705	181.8437	Sand
41.49542	103.2172	
60.90695	98.81796	
89.39919	261.2138	== Weathered Basement
99999	1372.104	Fresh Basement

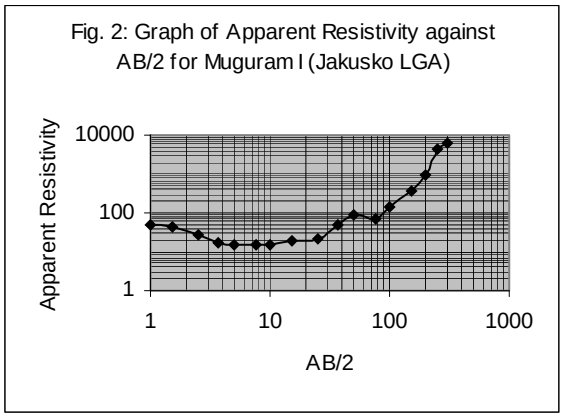


Recommendation

From the interpretation of the data related to this site, it is evident that for any appreciable volume of water to be pumped from this hole, and for that quantity to be sustained throughout the dry season, a depth not less than 90m would need to be drilled at this site.

3.1.2 Site name: Muguram I (Jakusko LGA)

Depth (m)	Resistivity (Ωm)	Lithology
0.6090693	57.14253	Dry Sand and Clay
0.8939916	42.64517	
1.3122	21.33805	
1.926046	12.048	
2.82705	13.55722	
4.149542	13.75339	Clay
6.090694	10.41828	
8.939917	13.84922	
13.122	30.49892	
19.26047	63.30762	
28.2705	123.900	Sand
41.49542	275.9972	
60.90695	712.3772	== Weathered Basement
89.39919	2066.193	Fresh Basement
99999	7084.676	

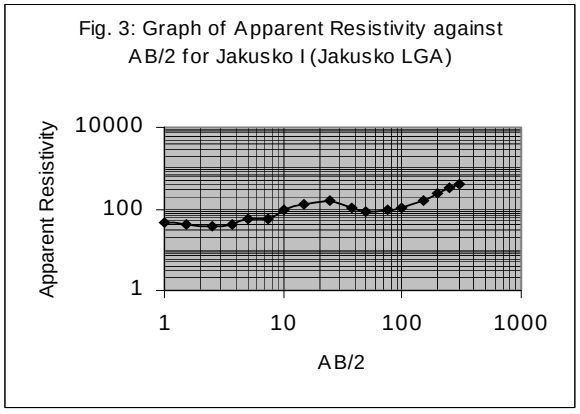


Recommendation

Based on the interpretation of the data obtained for this site, it is deduced that the hole at this site would have to penetrate to at least 90m for any appreciable volume of water to be pumped from this hole, and for that quantity to be sustained throughout the dry season,. The sandy layer (about 22m thick) should be developed.

3.1.3 Site Name: Jakusko I (Jakusko LGA)

Depth (m)	Resistivity (Ωm)	Lithology
0.6767437	48.12582	Dry Sand and Clay
0.993324	33.61568	
1.458	29.13827	
2.140052	34.94838	Clay
3.141167	56.65019	
4.610602	110.3181	
6.767439	198.0973	
9.933242	261.9577	
14.58001	220.0541	
21.40052	116.7784	
31.41167	57.21749	Sand
46.10603	55.62742	
67.6744	123.217	
99.33244	354.2248	Weathered Basement
99999	1055.852	Fresh Basement

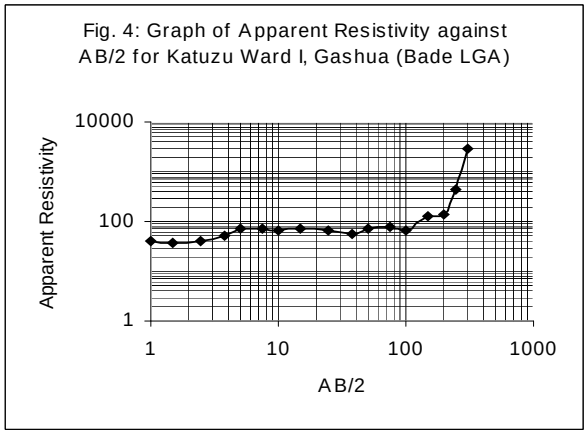


Recommendation

It is evident from the interpretation of the data collected for this site, that about 100m of hole need to be drilled here, to tap the sandy aquifer located between 12m and about 68m depth, and the weathered basement horizon that extends beyond more than 100m depths.

3.1.4 Site Name: Katuzu Ward I (Gashua, Bade LGA)

Depth (m)	Resistivity (Ωm)	Lithology
0.7519375	37.1452	Dry Sand and Clay
1.103693	35.62498	
1.62	45.17773	
2.377836	69.88837	
3.490185	93.76022	
5.122891	95.76368	
7.519376	80.38897	
11.03693	61.18612	
16.2	52.0777	
23.77835	59.54622	Sand
34.90185	63.30951	
51.22891	53.4198	
75.19376	72.48947	
110.3694	227.4889	Weathered Basement
99999	1326.941	Fresh Basement



Recommendation

From the interpretation of the data collected for this site, a depth of about 110m will have to be drilled at this site; so as to incorporate the weathered basement horizon for development.

4. Conclusion

The electrical resistivity geophysical investigation carried out in the study area comprising of 40 sites in four broad locations in Bursari, Bade and Jakusko Local Government Areas (LGAs) of Yobe State, and the VES interpretation made showed that the area contains thick overburden ranging from 90m to 110m.

This gives a wide range of water-bearing thickness and layer that can be developed for effective supply of borehole water for human and animal drinking, and irrigation work during the dry season. The investigation showed that a large expanse of the area has high potential to support this interconnected borehole programme.

The lithologies encountered showed that most of the area is characterised by dry sand and clay underlain by intercalation of sand and clay, followed by sand (usually), then by the weathered basement, underlain by the fresh basement. The figures shown bear much relationship with those of other sites, not shown. Deductions about the earth layerings within the region were in line with observations made by Okwueze et al. (1988) and, Idornigie and Olorunfemi (1992). As designed, for this project, tube wells are to be used with the pumping machines, usually fuel powered, adequately secured to ensure regular pumping of water from the wells with less human effort. For adequate supply of water, if the entire thickness of the aquifer at each site will not be screened, then whatever the length of screen to be used (usually two-thirds of the aquifer thickness) must be installed at the lower part of the aquifer. This is to allow for horizontal flow of groundwater into the well, thereby reducing the cost of energy that will be needed to lift the water to the surface. Furthermore, it will keep the aquifer away from surface contamination.

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06/09/2009

Comparison of Direct And Indirect Boundary Element Methods For The Calculation of Potential Flow Around An Elliptic Cylinder With Linear Element Approach

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Abstract: In this paper, a comparison of direct and indirect boundary element methods is applied for calculating the potential flow field (i.e. velocity distribution) around an elliptic cylinder with linear element (i.e. a new)approach. To check the accuracy of the method, the computed flow velocity is compared with the analytical solution for the flow over the boundary of an elliptic cylinder. [Journal of American Science 2010; 6(2):70-74]. (ISSN: 1545-1003).

Keywords: Boundary element methods, Potential flow, Velocity distribution, Elliptic cylinder., Linear element

1. Introduction

From the time of fluid flow modeling, it had been struggled to find the solution of a complicated system of partial differential equations (PDE) for the fluid flows which needed more efficient numerical methods. With the passage of time, many numerical techniques such as finite difference method, finite element method, finite volume method and boundary element method etc. came into beings which made possible the calculation of practical flows. Due to discovery of new algorithms and faster computers, these methods were evolved in all areas in the past. These methods are CPU time and storage hungry. One of the advantages is that with boundary elements one has to discretize the entire surface of the body, whereas with domain methods it is essential to discretize the entire region of the flow field. The most important characteristics of boundary element method are the much smaller system of equations and considerable reduction in data which is prerequisite to run a computer program efficiently. These method have been successfully applied in a number of fields, for example elasticity, potential theory, elastostatics and elastodynamics (Brebbia, 1978; Brebbia and Walker, 1980).Furthermore, this method is well–suited to problems with an infinite domain. From above discussion, it is concluded that boundary element method is a time saving, accurate and efficient numerical technique as compared to other numerical techniques which can be classified into direct boundary element method and indirect boundary element method. The direct method takes the form of a statement which provides the values of the unknown variables at any field point in terms of the complete set of all the boundary data. Whereas the indirect method utilizes a distribution of singularities over the boundary of the body and computes this distribution as the solution of integral equation. The direct boundary element method was used for flow field calculations around complicated bodies (Morino et al.,1975,Mushtaq, 2008 & 2009). While the indirect method has been used in the past for flow field calculations surrounding arbitrary bodies (Hess and Smith, 1967; Hess, 1973, Muhammad, 2008)

2. Velocity Distribution

Consider the flow past an elliptic cylinder of semi axes a and b with center at the origin and let the onset flow be the uniform stream with velocity U in the positive direction of the x-axis as shown in figure (1).

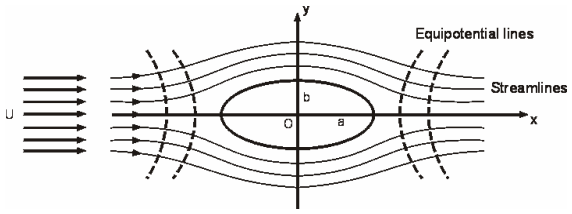

Figure 1: Flow past an elliptic cylinder

The magnitude of the exact velocity distribution over the boundary of the elliptic cylinder is given by (Milne-Thomson, 1968; Shah, 2008,Mushtaq,2009).

$$V = U(a+b)\frac{a\,y}{\sqrt{b^4x^2+a^4y^2}} \qquad (1)$$

Now the condition to be satisfied on the boundary of an elliptic cylinder is (Muhammad,2008;Mushtaq,2009)

$$\hat{n}\cdot\vec{V} = 0 \qquad (2)$$

where $\hat{n}$ is the unit normal vector to the boundary of the cylinder.

Since the motion is irrotational, $\vec{V} = -\nabla\Phi$

where Φ is the total velocity potential. Thus equation (2) becomes

$$\hat{n}\cdot(-\nabla\Phi) = 0$$

or $$\frac{\partial\Phi}{\partial n} = 0 \qquad (3)$$

Now the total velocity potential Φ is the sum of the perturbation velocity potential and the velocity potential of the uniform stream $\phi_{u.s}$

i.e. $$\Phi = \phi_{u.s} + \phi_{e.c} \qquad (4)$$

or $$\frac{\partial\Phi}{\partial n} = \frac{\partial\phi_{u.s}}{\partial n} + \frac{\partial\phi_{e.c}}{\partial n}$$

which on using equation (3) becomes

$$\frac{\partial\phi_{e.c}}{\partial n} = -\frac{\partial\phi_{u.s}}{\partial n} \qquad (5)$$

where $\phi_{e.c}$ is the velocity potential at the surface of the elliptic cylinder.

But the velocity potential of the uniform stream is given as

$$\phi_{u.s} = -U\,x$$

Then

$$\frac{\partial\phi_{u.s}}{\partial n} = -U\frac{\partial x}{\partial n} = -U(\hat{n}\cdot\hat{i}) \qquad (6)$$

Thus from (5) and (6)

$$\frac{\partial\phi_{e.c}}{\partial n} = U(\hat{n}\cdot\hat{i}) \qquad (7)$$

The equation of the boundary of the elliptic cylinder is

$$\frac{x^2}{a^2}+\frac{y^2}{b^2} = 1 \qquad (8)$$

Thus from (7)

$$\frac{\partial\phi_{e.c}}{\partial n} = U\frac{x\,b^2}{\sqrt{b^4x^2+a^4y^2}} \qquad (9)$$

Equation (9) is the boundary condition which must be satisfied over the boundary of an elliptic cylinder.

Now for the approximation of the boundary of the elliptic cylinder, the coordinates of the extreme points of the boundary elements can be generated within the computer program as follows:

Let the boundary of an elliptic cylinder is divided into linear elements. In this case the nodes where the boundary conditions are specified are at the intersection of the elements. The boundary of the cylinder can be divided into m elements in the clockwise direction by using the formula

$$\theta_k = [(m+2)-2k]\,\pi/m, \quad k = 1, 2, \ldots, m \qquad (10)$$

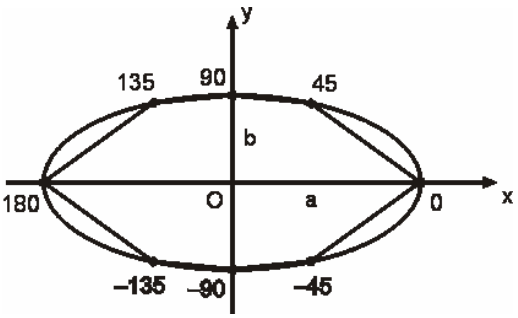

Figure 2. Discretization of the elliptic cylinder into 8 linear boundary elements

Then the coordinates of the extreme points of these m elements are calculated from

$$\left.\begin{aligned} x_k &= a\cos\theta_k \\ y_k &= b\sin\theta_k \end{aligned}\right\}, \quad k = 1, 2, \ldots, m \qquad (11)$$

Take $m = 8$, $a = 2$ and $b = 1$.

Thus the coordinates of the middle node of each boundary element are given by

$$\left.\begin{aligned} x_m &= (x_k + x_{k+1})/2 \\ y_m &= (y_k + y_{k+1})/2 \end{aligned}\right\} \quad k, \quad m = 1, 2, \ldots, 8 \qquad (12)$$

and therefore the boundary condition (9) in this case takes the form

$$\frac{\partial\phi_{e.c}}{\partial n} = U\frac{x_m\,b^2}{\sqrt{b^4x_m^2+a^4y_m^2}}.$$

The velocity U of the uniform stream is also taken as unity.

The following table shows the comparison of the direct and indirect boundary element methods for analytical and computed velocities over the boundary of an elliptic cylinder for 8,16 and 32 linear boundary elements.

Table 1: The comparison of the computed velocity with exact velocity over the boundary of an elliptic cylinder using 8 linear boundary elements.

Element	x-Coordinate	y-Coordinate	$R = \sqrt{x^2 + y^2}$	Computed Velocity Using DBEM	Computed Velocity Using IBEM	Analytical Velocity
1	-1.71	.35	.17433E+01	.87357E+00	.82676E+00	.95693E+00
2	-.71	.85	.11084E+01	.14583E+01	.14498E+01	.14688E+01
3	.71	.85	.11084E+01	.14583E+01	.14498E+01	.14688E+01
4	1.71	.35	.17433E+01	.87357E+00	.82676E+00	.95693E+00
5	1.71	-.35	.17433E+01	.87357E+00	.82676E+00	.95693E+00
6	.71	-.85	.11084E+01	.14583E+01	.14498E+01	.14688E+01
7	-.71	-.85	.11084E+01	.14583E+01	.14498E+01	.14688E+01
8	-1.71	-.35	.17433E+01	.87357E+00	.82676E+00	.95693E+00

Table 2: The comparison of the computed velocity with exact velocity over the boundary of an elliptic cylinder using 16 linear boundary elements.

Element	x-Coordinate	y-Coordinate	$R = \sqrt{x^2 + y^2}$	Computed Velocity Using DBEM	Computed Velocity Using IBEM	Analytical Velocity
1	-1.92	.19	.19334E+01	.51847E+00	.51430E+00	.55447E+00
2	-1.63	.54	.17196E+01	.11710E+01	.11735E+01	.12010E+01
3	-1.09	.82	.13611E+01	.14180E+01	.14159E+01	.14227E+01
4	-.38	.96	.10353E+01	.14950E+01	.14908E+01	.14926E+01
5	.38	.96	.10353E+01	.14950E+01	.14908E+01	.14926E+01
6	1.09	.82	.13611E+01	.14180E+01	.14159E+01	.14227E+01
7	1.63	.54	.17196E+01	.11710E+01	.11735E+01	.12010E+01
8	1.92	.19	.19334E+01	.51848E+00	.51430E+00	.55447E+00
9	1.92	-.19	.19334E+01	.51847E+00	.51430E+00	.55447E+00
10	1.63	-.54	.17196E+01	.11710E+01	.11735E+01	.12010E+01
11	1.09	-.82	.13611E+01	.14180E+01	.14159E+01	.14227E+01
12	.38	-.96	.10353E+01	.14950E+01	.14908E+01	.14926E+01
13	-.38	-.96	.10353E+01	.14950E+01	.14908E+01	.14926E+01
14	-1.09	-.82	.13611E+01	.14180E+01	.14159E+01	.14227E+01
15	-1.63	-.54	.17196E+01	.11710E+01	.11735E+01	.12010E+01
16	-1.92	-.19	.19334E+01	.51847E+00	.51430E+00	.55447E+00

Table 3: The comparison of the computed velocity with exact velocity over the boundary of an elliptic cylinder using 32 linear boundary elements.

Element	x-Coordinate	y-Coordinate	$R = \sqrt{x^2 + y^2}$	Computed Velocity Using DBEM	Computed Velocity Using IBEM	Analytical Velocity
1	-1.98	.10	.19832E+01	.28201E+00	.28299E+00	.28991E+00
2	-1.90	.29	.19264E+01	.76380E+00	.76608E+00	.77805E+00
3	-1.76	.47	.18170E+01	.10855E+01	.10871E+01	.10954E+01
4	-1.54	.63	.16631E+01	.12762E+01	.12766E+01	.12810E+01
5	-1.26	.77	.14786E+01	.13860E+01	.13855E+01	.13877E+01
6	-.94	.88	.12848E+01	.14490E+01	.14480E+01	.14491E+01
7	-.58	.95	.11139E+01	.14836E+01	.14824E+01	.14830E+01
8	-.20	.99	.10094E+01	.14990E+01	.14978E+01	.14982E+01
9	.20	.99	.10094E+01	.14990E+01	.14978E+01	.14982E+01
10	.58	.95	.11139E+01	.14836E+01	.14824E+01	.14830E+01
11	.94	.88	.12848E+01	.14490E+01	.14480E+01	.14491E+01
12	1.26	.77	.14786E+01	.13860E+01	.13855E+01	.13877E+01

13	1.54	.63	.16631E+01	.12762E+01	.12766E+01	.12810E+01
14	1.76	.47	.18170E+01	.10855E+01	.10871E+01	.10954E+01
15	1.90	.29	.19264E+01	.76380E+00	.76609E+00	.77805E+00
16	1.98	.10	.19832E+01	.28201E+00	.28298E+00	.28990E+00
17	1.98	-.10	.19832E+01	.28201E+00	.28299E+00	.28990E+00
18	1.90	-.29	.19264E+01	.76380E+00	.76608E+00	.77805E+00
19	1.76	-.47	.18170E+01	.10855E+01	.10871E+01	.10954E+01
20	1.54	-.63	.16631E+01	.12762E+01	.12766E+01	.12810E+01
21	1.26	-.77	.14786E+01	.13860E+01	.13855E+01	.13877E+01
22	.94	-.88	.12848E+01	.14490E+01	.14480E+01	.14491E+01
23	.58	-.95	.11139E+01	.14836E+01	.14824E+01	.14830E+01
24	.20	-.99	.10094E+01	.14990E+01	.14978E+01	.14982E+01
25	-.20	-.99	.10094E+01	.14990E+01	.14978E+01	.14982E+01
26	-.58	-.95	.11139E+01	.14836E+01	.14824E+01	.14830E+01
27	-.94	-.88	.12848E+01	.14490E+01	.14480E+01	.14491E+01
28	-1.26	-.77	.14786E+01	.13860E+01	.13855E+01	.13877E+01
29	-1.54	-.63	.16631E+01	.12762E+01	.12766E+01	.12810E+01
30	-1.76	-.47	.18170E+01	.10855E+01	.10871E+01	.10954E+01
31	-1.90	-.29	.19264E+01	.76381E+00	.76610E+00	.77805E+00
32	-1.98	-.10	.19832E+01	.28201E+00	.28297E+00	.28990E+00

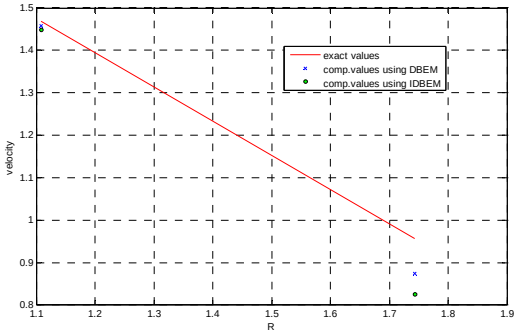

Figure 3. Comparison of computed and analytical velocity distributions over the boundary of an elliptic cylinder using 8 boundary elements with linear element approach.

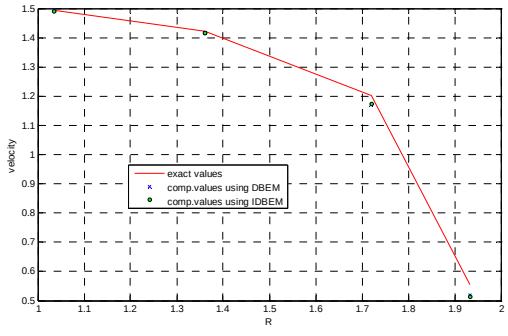

Figure 4. Comparison of computed and analytical velocity distributions over the boundary of an elliptic cylinder using 16 boundary elements with linear element approach.

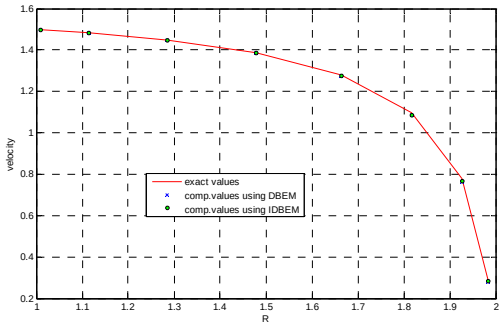

Figure 5. Comparison of computed and analytical velocity distributions over the boundary of an elliptic cylinder using 32 boundary elements with linear element approach.

3. Conclusion

A direct and indirect boundary element methods have been used for the calculation of potential flow around an elliptic cylinder with linear element(i.e. a new) approach. The calculated flow velocities obtained using these methods are compared with the analytical solutions for flows over the boundary of an elliptic cylinder . It is found that the results obtained overall with the indirect boundary element method for the flow field calculations are in excellent agreement with the analytical results for the body under consideration.

Acknowledgement

We are thankful to the University of the Engineering & Technology, Lahore – Pakistan for the financial support.

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Analysis of Precursor Decomposition Temperature in the Formation of CdO Thin Films Prepared by Spray Pyrolysis Method

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Abstract: Aqueous solution of $Cd(CH_3COO)_2.2H_2O$ is used to form Cadmium Oxide thin films on glass substrate by spray pyrolysis technique. Based on thermo gravimetric studies of chosen salt films were prepared at 200 and 350^oC insteps of 25^oC. X-ray diffraction (XRD) studies indicate the formation of cubic CdO phase with preferential orientation along (111) plane for all the film prepared at different substrate deposition temperature. Scanning electron microscopy (SEM) confirms spherical shape grains with size lying in the range 34 to 54nm as substrate temperature increases and is comparable with the XRD studies. [Journal of American Science 2010;6(2):75-79]. (ISSN: 1545-1003).

Key words: Spray pyrolysis, line broadening, microstructural parameters

1. Introduction

The chemical technique of spray pyrolysis [Chopra *et al* 1982] which is simple to handle, economically viable is used for several decades in glass industry and in solar cell production to deposit electrically conducting electrodes. Principle involved in the formation of metal oxide film is that when a droplet of sprayed metallic salt solution in the presence of oxygen atmospheres reaches the hot substrate, undergoes pyrolytic decomposition and forms a thin film. The other volatile by-products escape in the vapour phase. These methods can also produce films on substrates that are less robust materials and on large surfaces. The quality of film obtained by this methods strongly depends on various parameters like substrate temperature, solution concentration, substrate homogeneity, spray nozzle geometry, in-situ annealing treatments and so on [Chamberlin *et al* 1966; Patil *et al* Chen *et al* 1996]. Recently nanostructured metal oxide materials in thin film form were widely used in opto-electronic devices, electrochromic devices, narrow band coating, temperature controllers in satellites, chemical sensors etc. CdO is one such semiconducting materials having wide range of applications as transparent conducting oxide (TCO), solar cells, smart windows, optical communications, flat panel display, phototransistors etc., [Zhao *et al* 2002; Su *et al* 1984]. These applications are based on its physical properties which inherently depend on the preparation method. In the present work, home built spray pyrolysis unit is employed to form CdO thin film. The effect of precursor salt decomposition temperature on structural and surface morphology of CdO thin film on glass substrate is analysed and studied.

2. Experimental

To prepare CdO thin films, aqueous solution of analytical grade cadmium acetate [$Cd(CH_3COO)_2.2H_2O$] of various concentration is sprayed on glass substrate of size 1.5 cm x 7.5 cm using spray pyrolysis technique. A home made spraying system shown in figure (1) has been developed to obtain high quality thin films. The major units were i) spray gun ii) stainless steel plate heater with thermostat and iii) glass chamber with exhaust system.

The solution was sprayed at an angle of 45^o onto preheated glass substrate kept at a distance of 50cm from the spray gun. Prior to deposition, the substrate were chemically cleaned. Compressed dry air at a pressure of 2 kg/cm^2 from an air compressor via an air filter-cum regulator was used as the carrier gas

and spray rate of the solution was maintained at 3 ml/min. To avoid excessive cooling of substrates, successive spraying process was used with time period of 15 seconds between successive bursts. Substrate temperature was controlled by a chrome-nickel thermocouple fed to a temperature controller with an accuracy of ± 1°C. The temperature on top side of the substrate is measured by placing thermocouple on a reference glass substrate kept nearer to the coating substrate so as to measure the exact temperature. Large numbers of films were prepared by varying solution concentration, volume of solution and substrate temperature to analysis the optimum growth condition. For all above varying parameters solution flow rate (3ml / min) and air pressure is kept constant.

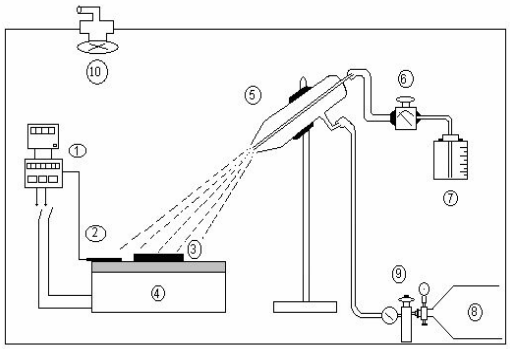

Figure 1. Schematic diagram of home built spray pyrolysis unit
1. Thermostat
2. Thermocouple
3. Substrate
4. Plate heater
5. Spray gun
6. Flow meter
7. Solution reservoir
8. Air compressor tank
9. Pressure regulator
10. Exhaust fan

Thermo gravimetric (TG) analysis for the chosen salts was carried out in air atmosphere using TA Instruments (Model SDT Q600) to determine the decomposition temperature. Film thickness was estimated by weighing method and verified with cross sectional view of SEM image. To investigate the structural detail of the film, PANalytical X-ray diffractometer (Model X'per PRO) using Ni-filtered CuKα radiation (λ = 1.5148Å), was employed with generator setting of 30mA and 40kV. Continuous scanning was applied with a scanning speed of 10°/min. A range of 2θ from 10° to 100° was scanned from a fixed slit type, so that all possible diffraction peaks could be detected. X-ray line broadening technique is adopted to determine grain size. Surface morphology of the films was investigated by using HITACHI Scanning Electron Microscope (Model S-3000H) with an accelerating potential of 18 kV. Prior to imaging, the films were sputtered with thin gold film to enhance the emission of secondary electron for better imaging.

3. Results and discussion

3.1 Structural studies

The TGA curve of dihydrated cadmium acetate precursor shown in figure (2) is a three steps process in which the inflection point coincides with the temperature corresponding to minima and maxima in DTA trace. The thermal decomposition reaction follows

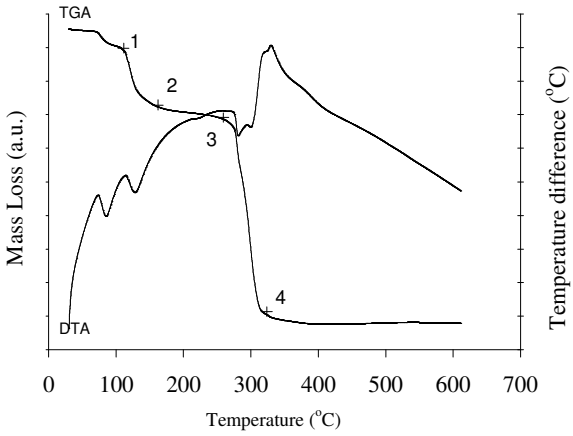

Figure 2. TG and DTA Curves for the decomposition of $Cd(CH_3COO)_2.2H_2O$ in air atmospheres at a heating rate of 10^oCmin^{-1}

$$Cd(CH_3COO)_2.\ 2H_2O \longrightarrow Cd(CH_3COO)_2 + 2H_2O$$

$$Cd(CH_3COO)_{2(s)} \longrightarrow CdO_{(s)} + CH_3COCH_{3(g)} + CO_{2(g)}$$

The weight loss of precursor begins as heating is applied at 40°C. The mass loss occurs over the temperature range 70 - 180°C corresponds to removal of two water molecules. The continuous mass loss between180 and 250°C indicates the evolution of some volatile substance. The second stage begins at 250°C, which is due to the onset of decomposition of the dehydrated $Cd(CH_3COO)_2$ that proceeds slowly through melting and completes at 315°C with a mass loss of 51% for the release of acetone and carbondioxide in gaseous phase. At about 250°C, CdO phase was formed which remains stable up to 600°C. Beyond 315°C no further weight loss takes place up to 600°C, indicating formation of stoichiometric CdO. Therefore, it is anticipated that the films deposited at various substrate temperature below 250°C were of amorphous and above it crystallization process occurs. However in the present work films were prepared between 200 and 350 insteps of 25°C to analysis for the possible formation of CdO thin film on glass substrate. Figure (3) shows the XRD pattern of film prepared at 250°C from the precursor solution concentration of 0.06M.

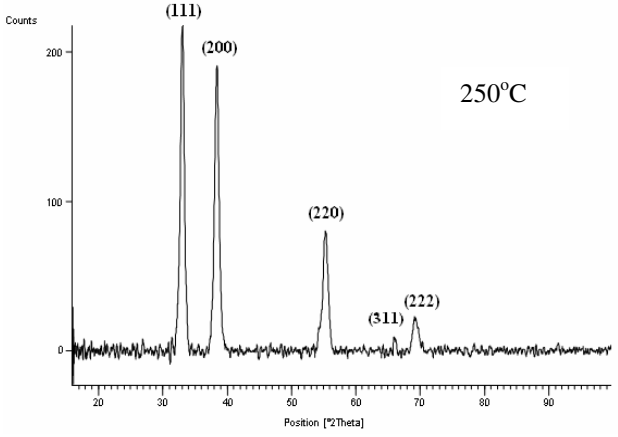

Figure 3. XRD pattern of CdO thin film prepared at 250°C from the precursor solution concentration of 0.06 M

It shows presence of different strong diffraction peaks which confirm polycrystalline cubic CdO phase formation. All the diffraction peaks of the films are indexed to (111), (200), (220), (311) and (222) as compared with standard bulk CdO [JCPDS: 05-0640]. From figure (4) peaks intensity of different plane for the film prepared at various temperatures found to increases up to 250°C and then decreases. This decrease is attributed to lesser deposition which can be confirmed from the observed film thickness which decreases from 870nm to 610nm prepared between 250°C and 350°C. Also from TG studies crystalline nature or formation of CdO should exist at 250°C and above. But it is observed

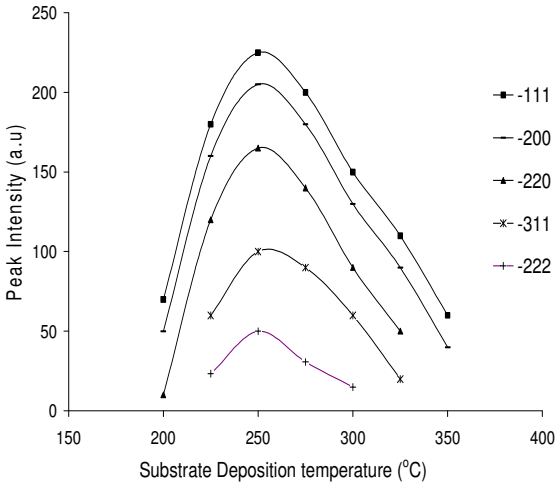

Figure 4. XRD peak intensity variation for different plane of CdO thin film prepared at different temperature from precursor solution concentration of 0.06M

the films prepared at 200°C and 225°C were crystalline in nature with orientation along (111), (200) and (220) plane. This can be explained as CdO phase may be formed during successive spray time where it undergoes a post annealing of formed amorphous layer of unhydrated molten cadmium acetate compound. However this is not observed for the films prepared from 0.1M precursor concentration where the crystalline CdO phase formed above 250°C. This is because of larger number of species involves to decompose the molten cadmium acetate compound. Thus the substrate deposition temperature is also a function of precursor concentration. Also the decrease in film thickness or peak intensity at higher temperature is due to vaporization of precursor before it reaches the substrate [Perednis *et* al 2005]. Texture coefficient (TC) is used to quantify the preferential orientation of the film deposited at different substrate temperature using the

following relation [Hadouda *et al* 1995]. In the relation I is the measured intensity, I_o is the Joint Committee on Powder Diffraction Standards (JCPDS) standard intensity and N is the number of diffraction peaks. It is found to be maximum for (111) plane for all the films deposited at different temperature. This indicates no orientation and phase change in the CdO film.

$$T_c = \frac{I_{(hkl)} / I_{o(hkl)}}{(1/N)\left[\sum_N I_{(hkl)} / I_{o(hkl)}\right]}$$

3.2 Grains and Surface morphology studies

X-ray line broadening technique is adopted to determine small crystallite (grain) size of the film by utilizing Scherrer formula [Patterson 1939].

$$D = K\lambda/\beta\cos\theta$$

Where 'β' is the breadth of the diffraction line at its full width half maximum intensity (FWHM) in radians, 'λ' is the wavelength of the incident X-ray (1.541 Å), 'θ' is the angle at which the maximum peak occurs and 'K' is the shape factor which usually takes a value of about 0.89. Grain size value found to vary from 34 to 54 nm calculated for the preferential (111) plane prepared at different temperature. It is observed from figure (5), the grain size found to increases as precursor solution concentration increased. This is due to increase in the number of species involving in the formation of CdO film. Further a uniform compressive or tensile strain (macrostrain) results in peak shift [Sciti *et al* 2007] of X-ray diffraction lines. However in the present studies there is no appreciable difference in peak shift as compared with standards value. A non-uniform of both tensile and compressive strain results in broadening of diffraction lines (microstrain). In the present studies it is assumed the broadening is due to small crystallite size. Also from figure (5) it shows grain size is lesser for the film deposited at lower temperature 200°C. It is due to droplet splashes onto the substrate and decomposes to yield smaller grains. But the surface morphology of the film prepared at this temperature shown in figure 6(a) has cracks. This is because a thin, wet layer is present on the film during deposition. Too fast drying of this layer results in stresses and subsequent cracking [Chen *et al* 1996].Figure 6(b) shows the SEM image of film prepared at 250°C. It consists of closely packed uniform spherical shape grains without crack. This indicates the film is well adherent with substrate. The grain size as seen from the image is comparable with the XRD studies. At temperature 300°C and above the deposited spray droplets are almost dry. Therefore, discrete particles are formed on the surface due to slow spreading. This can be explained that at higher temperature the precursor vapourizes before it reaches the substrate and consequently the solid particles are formed as powdery and non-adherent deposit [Perednis *et* al 2005].

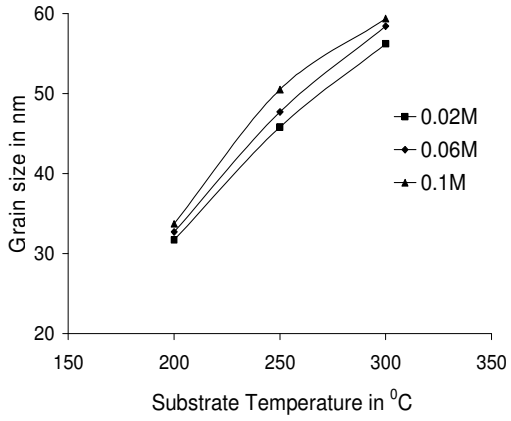

Figure 5. Plot of grain size Vs substrate temperature for different precursor solution concentration

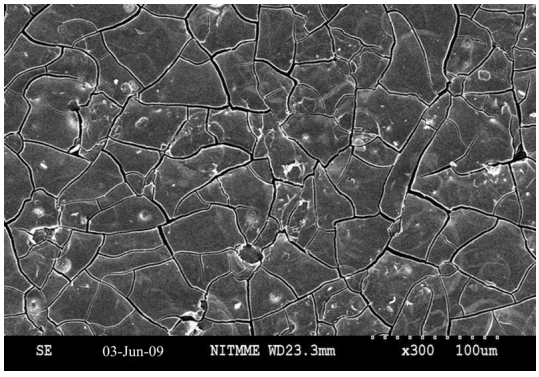

Figure 6(a). SEM image of CdO thin film prepared at 200°C from precursor solution concentration of 0.06M

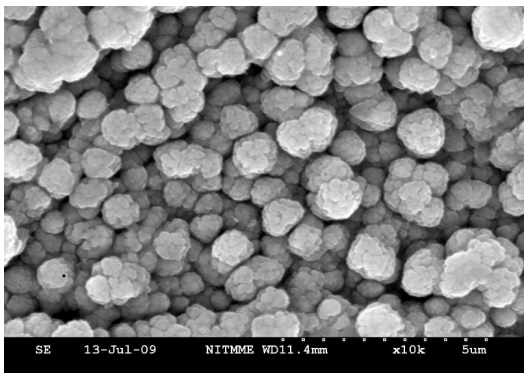

Figure 6(b). SEM image of CdO thin film prepared at 250°C from precursor solution concentration of 0.06M

4. Conclusion

Thin film of CdO on glass substrate is prepared by home built spray pyrolysis unit. TG studies indicate the formation of CdO begins at 250°C. But XRD pattern confirm CdO phase with preferential orientation along (111) plane at 200°C due to post annealing of unhydrate molten cadmium acetate compound. X-ray line broadening indicates the grain size in nano meter range and as substrate temperature increased grain size found to increases. Film prepared at 200°C has microcrack and at 250°C has spherical shape grains of 45nm size without crack and found to be adherent with substrate. Thus the substrate temperature of 250°C is an optimum temperature to obtain nano size grains of CdO thin film.

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09/21/2009

Effect Of Panchagavya On Nitrate Assimilation By Experimental Plants

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ABSTRACT - Panchagavya, a vedic formulation for increased productivity and disease resistance in plants and a modified formulation amended with seaweed extract (*Sargassum wightii*) have been investigated for their effect on the enzymes of nitrate reduction and assimilation namely, NR, NiR, GS, GOGAT and GDH in the leaves of the seedlings of the pulses, *Vigna radiata, Vigna mungo, Arachis hypogaea, Cyamopsis tetragonoloba, Lablab purpureus, Cicer arietinum* and the cereal *Oryza sativa* var. *ponni*. The seaweed based panchagavya formulation increased the levels of all the enzymes in the experimental plants when used as manure at low concentrations i.e 1: 50 and 1: 100 (panchagavya: soil). Traditional panchagavya at 1: 100 dilutions was able to exhibit an increase in the levels of NR and NiR only. The enzymes GS, GOGAT and GDH did not show any response to the use of traditional panchagavya formulation when used as manure. [The Journal of American Science. 2010;6(2):80-86]. (ISSN 1545-1003).

***Keywords*:** Panchagavya, seaweed based, NR, NiR, GS, NAD(P)H-GOGAT, NAD(P)H-GDH, Pulses, Rice.

INTRODUCTION

There is growing concern over the current agricultural practices in terms of sustainability over long periods since it might cause a gradual decline in factor productivity with adverse impact on soil health and quality (Subba rao, 1999; Stockdale, 2000). It has been widely accepted that organic farming alone could serve as a holistic approach towards achieving sustainable agriculture as it is nature based, environment friendly and ensures the conservation of resources for the future. Organic farming is quite distinct in the sense that it relies on closed nutrient cycles with less dependence on off-farm inputs. Vedic literatures (*Vrikshayurveda*) have clearly outlined a systematized agricultural practice that insisted on the use of 'panchagavya' – a mixture of the five products of cow in a specific ratio to enhance the biological efficiency of crop plants and the quality of fruits and vegetables (Natarajan, 2002). Few farmers in the Southern parts of India are using a modified preparation of panchagavya in organic farming (Gomathynayagam, 2001). In recent years, the crude extracts of seaweeds or the marine macroalgae have been shown to possess biostimulant, biofertilizer and antimicrobial properties (Borowitzka and Borowitzka, 1988; Robles-Centeno and Ballantine, 1999; Selvaraju, 2002) and, many commercial preparations are available in the market under different brand names. Seaweed extracts contain minerals, vitamins, free aminoacids and polyunsaturated fatty acids in addition to growth hormones (Yamamato *et al*., 1975; Tay *et al*., 1985; Dave *et al*., 1993; Thevanathan *et al*., 1993; Tasneem Fatima *et al*., 1994; Selvi *et al*., 1999). The combined effect of panchagavya and seaweed extract on the growth and productivity of crop plants is however, not known. In this paper, we present the results of a study on the nitrate assimilation in the seedlings of some pulses and rice grown in a soil preparation amended with seaweed based panchagavya as manure.

MATERIALS AND METHODS

Experimental plants

The pulses *Vigna radiata, Vigna mungo, Arachis hypogaea, Cyamopsis tetragonoloba, Lablab purpureus, Cicer arietinum* and the cereal *Oryza sativa* var. *ponni* were used as the experimental plants.

Preparation of soil and panchagavya for the growth of experimental plants

Traditional and seaweed based panchagavya were prepared as described (Sangeetha, 2009). Both preparations of panchagavya were brought to a solid state and the

dried panchagavya was mixed with garden soil and used for planting the seeds of the experimental plants. Traditional panchagavya was used in the ratio of 1: 100 (traditional panchagavya: soil) and the seaweed based panchagavya at a ratio of 1: 50 (v/v) and 1: 100 (v/v).

Seeds were surface sterilized with 1.0% mercuric chloride, washed several times in running water, soaked overnight in sterile water and allowed to germinate in dark. Germinating seeds were implanted in soil preparations kept in pots of the size 5.2" tall and 3.5" radius. Seedlings raised in sterilized garden soil were used as control. Ten replicates were used for all experimental plants. The seedlings of pulses were inoculated with *Rhizobium* R_4 (approximately $1x10^9$ cells/mL of sterile nutrient solution) twice, i.e. on the 5th day and then on the 11th day in both control and test pots (except for *Oryza sativa* var. *ponni*). *Rhizobium* (R4) was maintained on YMA medium. All the developing seedlings except *Oryza sativa* were watered on alternate days with Wilson's N-free nutrient solution (Wilson and Reisnauer, 1963). For *Oryza sativa*, normal water was used. Twenty one days old seedlings were carefully removed and cell free enzymes were used for the assay of the enzymes.

Extraction of cell-free enzymes

Freshly harvested leaves were rinsed in ice-cold, sterile water and homogenized with 5.0 mL of ice-cold Marsden's buffer, pH 7.4 containing 50.0 mM MOPS [3-(N-morpholino) propanesulfonic acid)], 2.0 mM EDTA, 50.0 mM ascorbic acid, 0.5 mM dithiothreitol, $CaCl_2$ (0.2 g L^{-1}), TWEEN 80 (1.0 mL L^{-1}) and insoluble polyvinyl pyrrolidone (PVP) (100 g L^{-1}) (pretreated according to Loomis, 1974). The homogenate was strained through three layers of cheese cloth and centrifuged at 7000 x g for 15 minutes. The supernatant was collected separately and centrifuged at 20,000 x g for 30 minutes. The supernatant (crude extract) thus obtained was treated with Sephadex G-25 and dialyzed overnight. The dialysate was centrifuged at 20,000 x g for 30 minutes. The resulting clear supernatant was used as the enzyme extract (Thevanathan, 1980). The entire operation was carried out at 4°C. The extraction procedure is same for all the enzymes, unless otherwise mentioned.

Assay of enzymes

Nitrate Reductase (NR; E.C. 1.6.6.1): The *in vitro* NR levels in the enzyme preparation were assayed following the procedures of Thomas and Harrison (1988). The reaction mixture for *in vitro* assay of NR in a total volume of 2.0 mL contained 0.2 mL of 0.1 M KNO_3, 0.3 mL of 0.8 M $MgSO_4$, 0.5 mL of 720 µM NADH and 1.0 mL of the enzyme extract. The reaction mixture was incubated at 30°C for 30 minutes and the reaction was stopped by the addition of 5.0 mL of ice cold 95% ethanol and 0.2 mL of 1.0 M Zinc acetate. The resultant suspension was centrifuged at 2000 x g for 5 minutes, and the nitrite content of the supernatant was determined by the addition of 1.0 mL sulphanilamide (0.2% W/V) followed within two minutes by 1.0 mL of N (1-napthyl) ethylene diamine dihydrochloride (NEDD) (0.05% W/V) (Snell & Snell, 1949). The absorbance of the solution was measured at 543 nm. Controls lacked NADH. Enzyme activity was expressed as n mole nitrite formed per gram protein per hour.

Nitrite Reductase (NiR; E.C. 1.6.6.4): *In vitro* NiR levels were assayed by a modified method of Joy and Hageman (1966). The reaction mixture in a total volume of 2.0 mL contained 100 µ moles potassium phosphate buffer (pH 7.5), 1.5 µ moles potassium nitrite, 1.0 µ moles methyl viologen dye and 0.2 mL of the enzyme extract. The reaction mixture was kept over ice, over layered with a thin layer of liquid paraffin to prevent rapid oxidation of chemically reduced methyl viologen and then incubated in a water bath at 30°C. The reaction was then initiated by pipetting freshly prepared sodium dithionite below the paraffin layer. The contents were gently stirred to ensure uniform distribution of the reduced dye and incubated at 30°C for 30 minutes. Reaction was terminated by shaking the contents vigorously till the disappearance of blue color. Reagent blank and boiled enzyme control were run simultaneously. After the termination of reaction, 2.0 mL of distilled water was added to the reaction mixture. Residual nitrite was determined by diazotization (Snell & Snell, 1949) as described earlier for nitrate reductase except that 0.1 mL aliquots were removed and made up to 3.0 mL with distilled water. The absorbance was measured at 540 nm against substrate blank. Nitrite reductase activity was expressed as n mole NO_2^- consumed per minute per gram protein.

Glutamine synthetase (GS; E.C. 6.3.1.2): Glutamine synthetase was assayed by the γ-glutamyl hydroxamate assay of Shapiro and Stadtman (1970), with the exception that the pH of the two-fold assay mixture was changed to 7.4 (Thevanathan, 1980). The the two-fold assay mixture in a final volume of 25.0 mL contained 2.0 mL of 1.0 M imidazole (pH 7.4), 15.0 mL of 0.1 M

glutamine (pH 7.4), 1.5 ml of 0.01 M $MnCl_2.H_2O$, 0.06 mL of 1.0 M $MgCl_2$, 2.0 mL of 0.01 M ADP – trisodium salt, 1.0 mL of 1.0 M $Na_2HASO4.7H_2O$ (pH 7.4) and 1.5 mL of 2.0 M $NH_2OH.HCL$. The pH of the two-fold assay mixture was brought to pH 7.4 with 2.0 N NaOH before use. To 0.5 mL of the two-fold assay mixture, 0.4 mL of water and 0.1 mL of enzyme were added and incubated at 37°C for 10 minutes. The reaction was stopped by the addition of 2.0 mL of ferric chloride reagent to the reaction mixture. The optical density was read at 540 nm and authentic γ-glutamyl hydroxamate was used as standard. Controls lacked sodium arsenate and ADP. Ferric chloride reagent was prepared by mixing 4.0 mL of 10% $FeCl_3.6H_20$, 1.0 mL of 24% Trichloroacetic acid, 0.5 mL of 6.0N HCl and 6.5 mL of water. Specific activity of GS is expressed as n mole γ- glutamyl hydroxamate formed per minute per mg protein.

Glutamate synthase (GOGAT; E.C.2.6.1.53) and NAD(P)H-Glutamate dehydrogenase (NAD(P)H - GDH; E.C. 1.4.1.4): Both enzymes were assayed using the same enzyme preparation. The enzymes GOGAT and NAD(P)H-GDH were assayed following the procedure of Thevanathan (1980). The reaction mixture for GOGAT contained 1.0 mL of 0.2 M potassium phosphate buffer (pH 7.0),).2 mL of 10.0 mM 2-oxoglutarate (neutralized with KOH, 0.2 mL of 1.0 mM NAD(P)H, 0.1 mL of enzyme and 4.0 mL of water. Glutamine (0.1 mL; 100 mM) was added 4 minutes after the addition of all the other reagents. The decrease in extinction at 340 nm was monitored. Σ_{340} NAD(P)H = 6.22 x 10^3 1 $mole^{-1}$ cm^{-1} is employed in calculating the amount of NAD(P)H oxidized. Activity of the enzyme is expressed as n mole NAD(P)H oxidized per minute per mg protein.

Activity of the enzyme was assayed following the procedure of Ahmad and Hellebust (1984) with some modifications. The reaction mixture in a final volume of 2.9 mL contained 1.5 mL of 0.1 M HEPES buffer (pH 7.8), 1.0 mL of glycine (75 µ moles), 0.1mL of ammonium acetate (300 µ moles) 0.1mL of 2-oxoglutarate (25 µ moles) and 0.1mL of NAD(P)H (0.25 µ moles). The reaction was initiated by the addition of 0.1 mL of dialyzed crude enzyme preparation and activity of the enzyme was determined by following the 2-oxoglutarate – dependant oxidation of NAD(P)H. The optical density was read at 340 nm. Results were presented as n moles NAD(P)H oxidized min^{-1} mg^{-1} protein at 30°C.

RESULTS

Nitrate assimilation by plants involves the participation of the enzymes of nitrate reduction and ammonia assimilation namely, nitrate reductase (NR), nitrite reductase (NiR), glutamine synthetase (GS), glutamate synthase (GOGAT) and glutamate dehydrogenase (GDH). The effect of growing plants in soil amended with panchagavya preparations on these enzymes was studied by determining the levels or activities of the enzymes in the leaves of the experimental plants.

I Enzymes of nitrate reduction

a. *In vitro* Nitrate reductase (NR; E.C. 1.6.6.1)

In the control plants, the in vitro NR levels were always high in the leaves of *Oryza sativa* (413 n moles of NO_2 formed h^{-1} g^{-1} protein) as compared to other experimental plants. Among the pulses, *Vigna mungo* recorded the highest activity for the enzyme (311 n moles of NO_2 formed h^{-1} g^{-1} protein). The seedlings grown in soil amended with seaweed based panchagavya always registered higher activity for *in vitro* NR than their respective controls and those treated with traditional panchagavya as well (Figure 1).

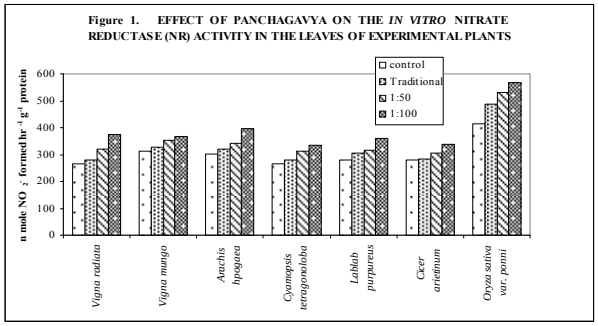


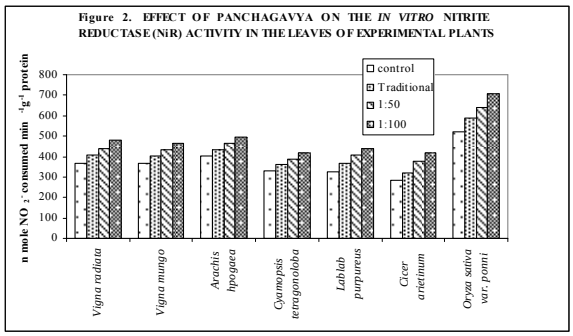
Figure 1. EFFECT OF PANCHAGAVYA ON THE *IN VITRO* NITRATE REDUCTASE (NR) ACTIVITY IN THE LEAVES OF EXPERIMENTAL PLANTS

Seaweed based panchagavya when used in low concentration (panchagavya: soil; 1: 100 v/v) recorded maximum activity for the enzyme in the leaves of all experimental plants. As compared to control, the quantum of increase in the *in vitro* NR levels in the leaves of these seedlings was in the range of 18 to 40%. Increasing the concentration of the seaweed based panchagavya in soil (panchagavya: soil; 1: 50 v/v) resulted in a decrease in the observed quantum of increase in NR levels as compared to other treatments. The seedlings grown in soil preparation amended with tradition panchagavya marginally increased the levels of the enzyme in all pulses. Nevertheless, the treatement was able to enhance the levels of the enzyme to appreciable quantities in rice.of increase in NR. However, the

seedlings grown in soil amended with seaweed based panchagavya had 17 to 32% more NR in their leaves in as compared to those grown in soil amended with traditional panchagavya.

b. *In Vitro* Nitrite reductase (NiR; E.C. 1.6.6.4)

Nitrite reductase levels in all the experimental plants were higher than that of Nitrate reductase (Figure 2). As observed for NR, panchagavya increased the *in vitro* NiR levels too in all the experimental plants. Similarly, the soil preparation with seaweed based panchagavya was more effective in enhancing the levels of NiR than the soil preparation with traditional panchagavya. Even at high concentration (1: 50; panchagavya: soil), appreciable levels of increase in the activity of NiR of leaves were evident in seedlings grown in soil amended with seaweed based panchagavya.

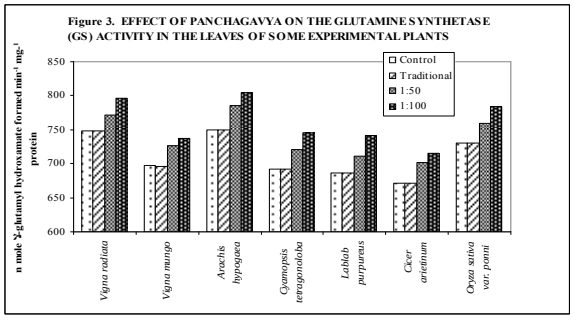


At this concentration, seaweed based panchagavya was able to increase NiR activity by 15 to 31% and at 1:100 dilution i.e. at low levels of panchagavya, the magnitude of increase was in the range of 22 to 47%. *Cicer arietinum* registered the maximum with 47% increase over its control (Fig. 10). Panchagavya in combination with seaweed extract was effectively promoting nitrate reduction in the experimental plants including rice.

II Enzymes of ammonia assimilation

a. Glutamine synthetase (GS; E.C. 6.3.1.2)

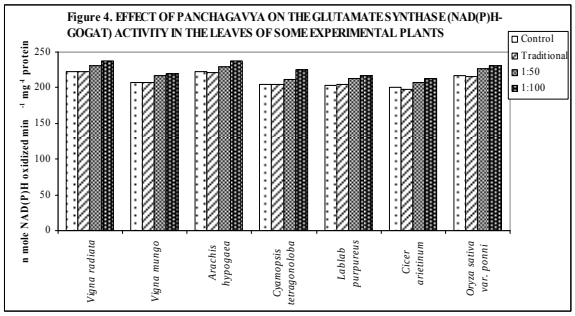
Glutamine synthetase levels were high in the legumes *Arachis hypogea* and *Vigna radiata* as compared to other experimental plants. Traditional panchagavya treatment either marginally decreased the levels of GS or had no effect (Figure 3). On the contrary, seaweed based panchagavya promoted GS activity in the leaves of experimental plants.



At 1: 100 dilution with soil, seaweed based panchagavya caused 7% increase in the levels of GS in *Arachis hypogea, Cyamopsis tetragonoloba, Lablab purpureus* and *Oryza sativa* as compared to both control and those grown in soil preparation amended with traditional panchagavya.

b. Glutamate synthase (NAD(P)H-GOGAT; E.C.2.6.1.53)

Initial GOGAT levels were more than 200 n moles min^{-1} mg^{-1} protein in all experimental plants (Figure 4). At both 1: 100 and 1:50 dilutions with soil, seaweed based panchagavya was able to marginally increase the levels of the GOGAT in the experimental plants. On the other hand, traditional panchagavya caused a slight decrease in GOGAT levels which is otherwise statistically significant in *Arachis hypogea, Cicer arietinum* and *Oryza sativa*.

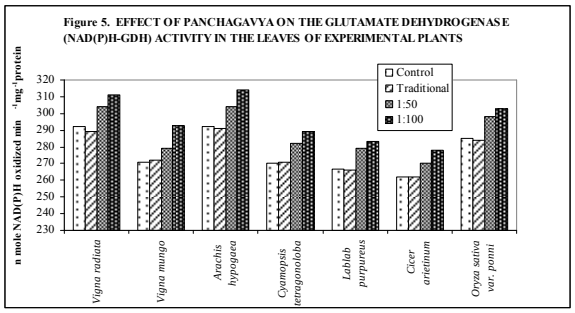


c. Glutmate dehydrogenase (NAD(P)H-GDH; E.C. 1.4.1.4)

NAD(P)H dependent GDH activity in the leaves of the experimental plants are shown in Figure 5.

Levels of NAD(P)H-GDH are nearly 40% less than that observed for GS. As observed for glutamate synthase, GDH also showed statistically significant decrease in its level in some experimental plants namely, *Vigna radiata, Arachis hypogea,*

Lablab purpureus and *Oryza sativa* when they were grown in soil amended with traditional panchagavya. Nevertheless, the enzyme recorded significant increase in its level in all experimental plants grown in seaweed based panchagavya irrespective of its concentration in soil. Percent increase in NAD(P)H-GDH levels in plants grown in soil amended with seaweed based panchagavya at 1: 100 dilution was in the range of 5 to 8%.



DISCUSSION

An investigation on the effect of panchagavya (both traditional and seaweed based) on the *in vitro* levels of the enzymes of nitrate assimilation namely, nitrate reductase (NR), nitrite reductase (NiR), glutamine synthetase (GS), glutamate synthase (GOGAT) and glutamate dehydrogenase (GDH) the potential of panchagavya amended seaweed extract as a manure at low levels in enhancing the activities of these enzymes.

The *in vitro* levels of NR were always high in the leaves of seedlings grown in soil amended with panchagavya as compared to the control seedlings (Figure 1). The effect was more pronounced in seedlings grown in seaweed based panchagavya than those grown in traditional panchagavya registering high levels of the enzyme in the leaves of seedlings grown in soil preparations containing low levels of seaweed based panchagavya. The quantum of increase in the *in vitro* NR levels in the leaves of these seedlings was in the range of 18 – 40% (Figure 1). *In vitro* NiR levels too exhibited a similar response to treatment with panchagavya based soil preparations (Figure 2). The leaves of the experimental seedlings grown in soil preparations containing low quantities of seaweed based panchagavya had 22 – 47% more NiR than the leaves of the respective controls. Induction in the levels of NR and NiR in the experimental plants by panchagavya manure indicates its stimulatory effect on the nitrate reduction efficiency in these plants, when used at low quantities. An efficient nitrate reduction system would mean the generation of reduced nitrogen, ammonia in huge quantities and this in turn would warrant an efficient system of assimilation of the reduced nitrogen. The initial products of reduced nitrogen assimilation in plants have shown to be glutamine and glutamic acid (Aprison *et al.*, 1954; Leaf, 1959; Mulder *et al*., 1959, Jordan, 1960; Fowden, 1962; Kates and Jones, 1964; Grimes and Fottrell, 1966; Sims *et al*., 1968; Kretovich *et al*., 1970; Thevanathan, 1980; Bhavani, 1983; Gangadharan, 1995; Veerabadran, 1995). The enzymes glutamine synthetase (GS) (Thevanathan, 1980; Bhavani,1983; Subramanian and Rajalakshmi, 1989; Gracia Fernandez *et al*., 1994;), glutamate synthase (GOGAT) (Thevanathan, 1980 ; Bhavani, 1983; Galvan *et al*., 1984; Fischer and Klein, 1988; Zehr and Falkowshi, 1988;) and glutamate dehydrogenase (GDH) (Kretovich *et al*., 1970; Brown *et al*., 1974; Gayler and Morgan, 1976) have been shown to be the key enzymes involved in the primary assimilation of ammonia involved in both lower and higher plants. These enzymes have been detected in the experimental plants in sufficient levels to account for the observed nitrate and nitrite reductases (Figures 3, 4 and 5). Unlike that observed for NR and NiR, traditional panchagavya manure did not induce the levels of GS in the experimental seedlings and in fact decreased the levels of GS in *Vigna radiata*, *Cicer arietinum* and *Oryza sativa* var. *ponni* (Figure 3). Nevertheless, seaweed based panchagavya manure was able to cause a clear induction in the levels of GS to an extent of 5 – 7%. A concomitant increase in the levels of GOGAT (NAD(P)H – dependant) could be observed in leaves of the experimental plants grown in seaweed based panchagavya manure only. Traditional panchagavya manure either reduced the levels of both glutamate synthase and glutamate dehydrogenase or had any effect on these enzymes. Nevertheless, seaweed based panchagavya manure could induce an increase in the levels of NAD(P)H-GDH too (Figure 5). These results indicate that seaweed based panchagavya can be used as a manure at very low concentration (1:100 v/v; manure: soil) rather than traditional panchagavya. The positive stimulatory effect on NR and NiR in the experimental plants and the negative effect on the enzymes of ammonia assimilation i.e. GS, GOGAT and GDH of traditional panchagavya manure warrants further studies to account for its discrimination against the enzymes of ammonia assimilation.

CONCLUSIONS

Seaweed based panchagavya exhibited a promotory effect on the enzymes of nitrate reduction

i.e. NR and NiR and the ammonia assimilation i.e. GS, NAD(P)H-GOGAT and NAD(P)H-GDH in the experimental pulses and rice, when used as a manure in the soil preparation at a dilution of 1 : 50 and 1 : 100 (seaweed panchagavya : soil). Traditional panchagavya exhibited a negative effect on the enzymes of ammonia assimilation in these plants.

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9/1/2009

The Final Hurdle To Be Crossed In The Eradication Of Dracunculiasis In Nigeria

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Abstract: The guinea worm disease, dracunculiasis, was targeted for elimination in several countries with the hope of global eradication before the end of 1995. This eradication deadline was not met and WHO then hoped to certify eradication by 2005. At the 2006 World Health Assembly (WHA) in Geneva, the World Health Organisation (WHO) convened an informal meeting on the eradication of dracunculiasis and additional measures needed to stop transmission of the disease in all of the remaining endemic countries by the end of 2009 was discussed. Several countries have been certified as guinea worm disease free, however cases continue to be reported in Nigeria. This short report highlights importation as the major impediment to eradicating the disease in the country. [Journal of American Science 2010;6(2):87-88]. (ISSN: 1545-1003).

Keywords : Guinea worm disease, Dracunculiasis, Guinea worm eradication, Nigeria.

Introduction

Dracunculiasis, a disabling, painful, debilitating, water-borne helminthic disease with multiple adverse consequences on health, agriculture, school attendance, and the overall quality of life of the affected communities predominates among the rural communities of many developing countries whose population depend upon unprotected water sources for drinking. Key intervention strategies to eradicate dracunculiasis are safe water supply, vector control using abate, health education and case management.

In 1986, WHO designated dracunculiasis as the next disease scheduled to be eradicated by 1995 after smallpox (Hopkins and Ruiz-Tiben, 1991). This eradication deadline was not met and WHO then hoped to certify eradication by 2005. At the 2006 World Health Assembly (WHA) in Geneva, WHO discussed additional measures needed to stop transmission in all of the remaining endemic countries by the end of 2009 (CDC, 2006).

Several countries have been certified guinea worm disease free, however cases continue to be reported in Nigeria (CDC, 2001). 690 Nigerian villages reported cases in 2001 and in 2007, only 32 cases were reported and just as Nigeria was preparing to cross the finish line to interrupting transmission nationwide an unexpected outbreak of dracunculiasis was discovered (CDC, 2007).

Guinea worm disease outbreaks

The 2007 outbreak was in two villages in Enugu State (CDC, 2007). Investigations revealed 28 active cases in Ezza Nkwubor village, and 2 cases in Ezza Ugwuomu village nearby. The latter two patients, a mother and her child, had just come from the first village. Ezza Nkwubor is inhabited exclusively by Ezza people who migrated from Ezza speaking communities in Ebonyi State. The source of the outbreak in Nkwubor village is believed to be a village in Ezza North LGA of Ebonyi State, which had a major outbreak in April 2005 and 3 cases in February 2006, and from which some persons migrated to Ezza Nkwubor village. The Ezza people are renown farmers, who migrate over large distances, and they have been implicated as having imported guinea worm disease into communities several times during the eradication program. Enugu state had never been endemic since the state was created in the 1990s.

Not so recently, CDC (2006) also reported an imported case of dracunculiasis in a village in Zamfara state, North-East Nigeria in May 2006. Transmission of drancunculiasis from the patient, a male farmer, was not contained. Zamfara state has not reported indigenous cases of drancunculiasis before January 2004. The probable origin of this case of drancunculiasis remains to be ascertained.

During the course of my studies on the epidemiology and control of the guinea worm disease in villages in Oyo state, south-west Nigeria, I witnessed an outbreak in Olomi-tutu village in 1994. The village had 27 households with a population of 215 people. Almost all the permanent residents were Yoruba. The main source of income was subsistence agriculture.

There were no schools, health centres and no potable water supply. The village depended for water on dug-holes in the dry season and

on an abandoned fish pond in the village during the rainy season. Since the dug-holes were quite far from the village centre neccesitating a walk of a mile or more, farmers generally filled their kegs from these holes on their way to and from the farms. Water for domestic purposes was obtained at one or two days interval.

Report Of An Outbreak

No cases had been reported in Olomi-tutu village since case searches in the 80s. Older villagers stated it was the first time they were experiencing guinea worm infection after about 40 years and reported that an infected man visited their village the preceding year. Where the man came from was not ascertained. On the 14th of January,1994, a letter dated 13/1/94 was received by the Director of Personnel Management at the Local Government Headquarters from Olomi-tutu village stating their need for medical assistance to combat a serious guinea worm epidemic. The Assistant Guinea worm Coordinator and I paid a visit to Olomi-tutu on the 18th of January, 1994.

Findings, Treatment And Interventions

The muddy fish pond was inspected. The villagers were told to clear the debris- covered surface of pond and erect wooden planks where person drawing water could stand instead of wading into the water. These they did before our next visit.

We returned on Friday 21st January 1994 with more health officials. The infected parts of the body, mostly legs, were immersed in water when there is a lesion so that the worm can protrude and be wound on a stick. The sites of infection were cleaned with an antiseptic and bandaged to prevent worm from retracting and villagers from dipping the affected part in pond water. Panadol, multivitamins, procaine penicillin injection were given to infected villagers, one filter lid to a household were given to villagers. The pond was treated with chloride of lime. Small health educational bills written in the local language were given to villagers to educate them on the guinea worm disease. The villagers were instructed to boil and filter drinking water and prevent infected people from wading into pond.

This village and two other infected villages in the Local Government Area were included in my study. Incidence of infection in the three villages was 8.5% in 1994, 3.9% in 1995 and 0.5% in 1996. In all, 78 (14% of total population in the three villages) persons were infected. Cases were presented between September and March. Most (67.1%) of the new cases and highest percentage of freshly emerging worms occurred between January and February (Morenikeji and Odaibo, 2007).

Conclusion

Importation is the main reason for the continued presence of the disease in Nigeria. There is need to make health education cover infected and at-risk non-infected communities and for continued unwavering energy input of all agencies committed to the struggle as cases decrease so that the 2009 deadline can be met.

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9/4/2009

Metallothionein induction in edible mangrove periwinkles, *Tympanotonus fuscatus var radula* and *Pachymelania aurita* exposed to Oily Drill Cuttings

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Abstract: Metallothionein levels were monitored over 32 days in two gastropod species *Tympanotonus fuscatus* and *Pachymelania aurita* exposed to oil coated drill cuttings. In *T. fuscatus*, metallothionein levels were enhanced in all treatment groups during the study, with highest level concentrations being observed in organisms exposed 0.01 96h LC_{50} drill cutting concentration. Metallothionein levels in *Pachymelania aurita* on the other hand was reduced in test animals exposed to the drill cuttings in comparison to their background level. The implications of the finding and possible inclusion of metallothionein in biomonitoring programmes involving the evaluation of impact of drill cuttings disposal on aquatic ecosystems are discussed. [Journal of American Science 2010;6(2):89-97]. (ISSN: 1545-1003).

Key words: Metallothionein, induction, mangrove periwinkles, Drill Cuttings

1. Introduction

Several tools are available for measuring impacts from environmental stressors at different levels of biological organisation (Depledge and Hopkin, 1995). Conventionally pollution has been monitored by measurement of levels contaminants in environmental receptors including measurement of bioaccumulation of toxicant in the body tissues of organisms. Currently, emphasis has shifted to measurement of biological responses to complement traditional methods in biomonitoring programmes (Damiens *et al*, 2004). Biological responses otherwise known as biomarkers are sensitive indicators but need to be prognostic to be relevant (Galloway *et al.,* 2002). There proper application according to Handy *et al.,* (2003) is in building a weight of evidence case that pollution is affecting the health of organisms and that certain classes of chemical are responsible. Some commonly measured biomarkers include metallothionein, a common indicator of heavy metal exposure; lysosomal stability, a general indicator of stress; EROD activity, which commonly indicates oxidative stress and acetylcholinesterase inhibition, a marker of organophosphorus and carbamate pesticide exposure.

Biomarker responses are affected by environmental factors (English and Storey, 2003). Times taken to induce the biomarker as well as the persistence of the biomarker are issues to consider in incorporating biomarkers in biomonitoring studies (Howard *et al.,* 2002). Biomarker based approaches has gained immense support and research in developed world (Brown *et al.,* 2004; Ringwood *et al.,* 2004; Handy *et al.,* 2003; Galloway *et al.,* 2002; Viarengo *et al.,* 1999; Moore *et al.,* 1999) but their use in developing world especially in Nigeria is non-existent possible due to lack of local literature and expertise.

Metallothioneins are cysteine rich, low molecular weight proteins of about 7 kDa and apparent molecular weight of 13 kDa. MT pool is made up of different isoforms with certain amino acids substitutions but for the highly conserved cysteine residues (George and Olsson, 1994). The isoforms have different physiological roles and different ways of induction, depending on the cell types and tissues. Metallothioneins are believed to be important in homeostasis of heavy metals such as copper and zinc, and detoxification of heavy metal (Butler and Roesijadi, 2001), thus they are commonly associated with heavy metal pollution. Their induction confers metal tolerance to organisms (Klaasseen *et al.,* 1999) due to their ability to bind some heavy metals such as cadmium and copper (Coucelo *et al*, 2000). This concentration of heavy metals has raised questions on possible trophic transfer especially in edible species (Wang, 2002). In addition accumulation of heavy metals may disturb essential metal homeostasis by causing changes in cellular metal binding and speciation patterns. Because they are additionally synthesis following heavy metals exposure, metallothioneins have been proposed as a potential biomarker for heavy metal exposure (De Smet *et al.,* 2001; Roesijadi, 1994). Evidence of protection against oxidative stress by metallothionein has been

demonstrated in sheep epithelial cell (Pitt *et al.,* 1997) as well as in invertebrates (Viarengo *et al.,* 1999). Metallothionein has also been shown to protect against non metallic chemicals such as carbon tetrachloride (CCl_4). For instance, Klaassen and Liu (1998) reported that MT induction by Zn in the hepatic cells of mice were able to bide ^{14}C from ^{14}C-CCl_4 in the MT-induced animals than in controls, with a concomitant reduction of covalent binding of ^{14}C-CCl_4 to cellular protein and lipid. Furthermore, induction of metallothionein is affected by various biotic and abiotic factors (English and Storey, 2003; Leung *et al*., 2001; Ghoshal *et a.,* 1998). It has been suggested that inclusion of measurement of MT in biomonitoring will of necessity include the quantification of the different isoforms and their induction patterns (Lacorn *et al.,* 2001), major site of induction and the determination of the half-life/persistent (Leung and Furness, 2001; Howard *et al.,* 2002).

The objective of this study was to study the metallothionein responses of two common gastropod species of Lagos lagoon on exposure to drill cuttings. Drill cuttings are produced during exploitation of crude oil, and in Nigeria their discharges are allowed after treatment in offshore water according to guidelines of the Department of Petroleum Resources (DPR, 2002). Accidental discharges however in inland waters and swamps areas are not ruled out and may affect the natural biota in the influence of exploitation areas. This study is therefore a step in studying a common biomarker response of local organisms exposed to sublethal concentration of drill cuttings.

Tympanotonus fuscatus and *Pachymelania aurita* were chosen for the study because of their abundance in the Niger Delta region and around the mangrove swamps and sandy shores of the Lagos lagoon complex. Two subspecies of *T. fuscatus* are found in West Africa, *T. fuscatus fuscatus* (Linne) with tubercular spines and *T. fuscatus* (var radula) with smooth or granular shell ornamentations. Both types are found at the inter-tidal zone usually one variety predominates in a particular creek or shore. However there is increasing evidence to suggest that both varieties could be ecotypes of the same species (Oronsaye, 2002). *P. aurita* is regarded as a dominant member of the faunal community of the Lagos lagoon with a mean annual production rate that varied from -1.59 g and 0.79 g/0.5 m^2/yr and a production: biomass ratio that varies between 0.02 and 0.12 (Brown, 1991). Both gastropod species are edible and very rich in protein (Egonmwan, 1980, Adebayo-tayo *et al.,* 2005), and thus serve as important source of protein to local inhabitants, but their high microorganisms content is a health issue which raises concern over their consumption (Adebayo-tayo *et al.,* 2005).

2. Materials and Methods

Animals

The animal species used in the study were adult stages of the following:

1. *Tympanotonus fuscatus* var *radula L* (periwinkle) (Mollusca, Gastropoda, Megagastropoda, Melanidae), (length 32-35 mm , diameter of aperture 0.7 – 9.0 mm)
2. *Pachymelania aurita* (periwinkle) (Mollusca, Gastropoda, Megagastropoda, Potamidae), (length 35 – 40 mm, diameter of aperture 0.8 – 1.0 mm).

P. aurita and *T. fuscatus* species were collected from field by hand picking into a holding bucket from the edge of the Lagos Lagoon and adjacent mangrove swamps at low tide. They were taken to the laboratory and left in holding tanks with a thin layer of sediment serving as substrate and food source to organism, and some water to allow them to acclimatise to laboratory conditions. Lagoon water and sediments were also simultaneously collected for use in the bioassay procedures.

Test Chemicals

The toxicant used for the bioassays is drill cuttings which were collected from Shell Development Petroleum Corporation. The cuttings were coated with the oil based mud used during the drilling process.

General Bioassay procedure

Biomarker studies were carried out using plastic tanks, which measured 30 cm x 25 cm x 16 cm. The collected sediments were sun dried to standardise moisture content, and thereafter passed through a sieve (0.25mm) to obtain uniform substrate particles. 100 g of sediment was introduced into the experimental chamber and lagoon water was used as the diluents for the entire bioassay test conducted.. Sediments were first spread to form a uniform layer in the bioassay container. Thereafter, pre-determined concentrations of drill cuttings were added followed by the addition of 1 liter of water less the volume of the drill cuttings. The contents of the container were then gently mixed to achieve even distribution of cuttings on the sediment before the introduction of test species. This procedure was adopted in all cases of bioassay.

Sublethal Toxicity Test

Static renewal method was adopted during exposure period. Test solutions and sediment were renewed on day 4, 8, 16 and 32. For the series of bioassays, one hundred and twenty (120) specimens of each test species were exposed to drill cuttings including control in two replicates (20 animals per treatment per replicate). The concentrations of drill cuttings used were derived from the 96hLC_{50} value

obtained for the toxicant in a previous study with the organisms, and are as follows:

Drill cuttings was tested against *T. fuscatus* as follows:

- 10.24ml (i.e. 0.01 of the 96hLC_{50}) plus 989.76 ml lagoon water,
- 1.024ml (i.e. 0.1 of the 96hLC_{50}) plus 998.976 ml lagoon water, and
- Untreated control.

The test concentrations for *P. aurita* were as follows:

- 12.2ml/l (i.e. 0.01 of the 96hLC_{50}) plus 987.78 ml lagoon water,
- 1.22 ml/l (i.e. 0.1 of the 96hLC_{50}) plus 998.78 ml lagoon water, and
- Untreated control.

Tissue preparation

For each treatment, specimens of each species were randomly collected from bioassay chambers on day 4, 8, 16 and 32 for analysis. Samples from different individuals of the same species were pooled to minimise individual variability. The digestive glands of the organisms were chosen for metallothionein studies. In removing the digestive gland of the periwinkles, the anterior shell was gently broken and the digestive gland removed.

Metallothionein Determination

Metallothionein levels were assessed on the digestive gland homogenates content of the samples by evaluating the sulphyhydryl (-SH) residue according to Ellman (1959); Viarengo *et al* (1997). The amount of MT was defined assuming a cysteine content of 23. The MT concentrations of 3 replicates for each measurement were calculated using reduced glutathione (GSH) as a standard and expressed as (n mol MT).g^{-1}. Chemicals were obtained from Ikzus Environment, Italy.

Reagent and working solutions preparation:

Sulfhydryl reference (reduced glutathione) standard was prepared by adding 0.725 Sol C_2 (resuspension buffer Component 2) to a microtube. The reaction buffer (sol D) was obtained by mixing 200ml stabilised Ellman's buffer and 3.4ml concentrated Ellman's reagent and equilibrated at 23^{o}C. Absolute ethanol was also equilibrated at –20^{o}c. The homogeniting buffer was obtained by adding 1 part of sol B (protease inhibitor) to 99 parts of sol A extraction buffer. The resuspension buffer was prepared by mixing equal amounts of sol C_1 (resuspension buffer, Component 1) and sol C_2 (resuspension buffer, Component 2). The blank solution was obtained by mixing 50µl Sol C (resuspension buffer, Component 1) and 1.950 µl Sol D (reaction buffer).

Procedure for the extraction and evaluation of metallothionein content

0.5 g of tissue was homogenised at 0-4^{o}C using the already prepared homogenating buffer and centrifuged at 30,000g at 4^{o}c for 20min. The protein content was then determined from the supernatant by means of Bradford assay. The supernatant was collected in a 2 ml tube. 1.5 ml of cold absolute ethanol was added to the tube and incubated at –20^{o}c for 30-60min. the mixture was then centrifuge at 12-16,000g at 4^{o}c for 5 minutes. 1.95 ml of the previously prepared reaction buffer, which was equilibrated at room temperature (RT) was then added. The resulting mixture was mixed, incubated for 2 minutes at room temperature and then centrifuge at 12-16,000g. Absorbance was thereafter read at 412nm against the blank solution, and a standard curve was obtained by plotting absorbance against the concentration. Absorbance was also read for samples at 412. To calculate metallothionein concentration, the $ABS^{MT}{}_{412}$ value of sample was interpolated over the standard curve to obtain the concentration (nmol) of sulfhydryl groups, i.e. cysteine residues (nmol Cys^{MT}), due to metallothionein present in the sample. To obtain the concentration of metallothionein (nmol MT) per gram of tissue, the following was applied:

$$(\text{nmol MT})g^{-1} = \frac{(\text{nmol } Cys^{MT})}{0.1\text{g. } n^{\circ cys}}$$

where: 0.1g is the amount of tissue equivalent to 0.3ml of supernatant subjected to precipitation.

$n^{\circ cys}$ is the number of cysteine residue present in the investigated metallothionein.

To express metallothionein concentration per mg of the total protein present in the supernatant, the following was applied:

$$(\text{nmolMT}).mg^{-1} = \frac{(\text{nmol } Cys^{MT})}{mg.n^{\circ cys}}$$

where: mg is the amount of protein present in the 0.3ml supernatant subjected to ethanol precipitation.

Statistical Analysis

One-way analysis of variance (ANOVA) was used to compare the means of results obtained, and where a significant difference ($P < 0.05$) was obtained, Duncan test was used to detect the source of difference. Unpaired Sample t-test was also used to test for significant difference between means of biomarker results obtained between *T. fuscatus* and *P. aurita*. All statistics were first determined at $P < 0.05$ significant level, and where high significant difference was observed, a significant level of $P < 0.01$ or $P < 0.001$ is applied.

3. Results

For *T. fuscatus* MT values ranged from 0.7568 nmol g^{-1} to 1.5510 nmol g^{-1} (mean = 0.9742 nmol g^{-1})

in control organisms, 0.7677 nmol g^{-1} to 4.3571 nmol g^{-1} (mean = 2.3361 nmol g^{-1}) in organisms exposed to 1.024 ml/l, and 0.7677 nmol g^{-1} to 2.0959 nmol g^{-1} (mean = 1.3417 nmol g^{-1}) in 10.24 ml/l exposed organisms **(Table 1).** Metallothionein level was enhanced in all treatment groups including control during the experiment. The concentrations were significant for all treatment groups (ANOVA, $P < 0.05$). Post hoc test with Duncan indicated that for all treatment groups there was significant difference ($P < 0.01$) in MT concentration on all sampling days. MT was however greater induced in organisms exposed to drill cuttings than in control organisms, with higher values in *T. fuscatus* exposed to 0.01 96h LC_{50} than those exposed to 0.1 96h LC_{50} drill cuttings concentration. Concurrently with the observed enhanced production of MT was increase in total protein in the organism during the study (**Table 1**). The observed increase in protein production was higher in control and in 0.01 96h LC_{50} drill cutting concentration exposed *T. fuscatus* than in *T. fuscatus* exposed to 0.1 96h LC_{50} drill cutting concentration, but a higher percentage of the new protein was converted to MT in 0.01 96h LC_{50} drill cutting concentration exposed *T. fuscatus,* but not in control and in 0.1 96h LC_{50} drill cutting exposed *T. fuscatus* (**Figure 1).**

In *P. aurita,* the observed background MT level was higher than that of *T. fuscatus.* The values of MT recorded during the experiment ranged from 3.4430 $nmol^{MT}$ g^{-1} to 3.8865 $nmol^{MT}$ g^{-1} in control organisms (mean = 3.4998 $nmol^{MT}g^{-1}$), 0.1902 $nmol^{MT}g^{-1}$ to 3.8807^{MT} nmol g^{-1} (mean = 2.2543 $nmol^{MT}g^{-1}$) in organisms exposed to 1.22 ml/l, and 0.3301 $nmol^{MT}g^{-1}$ (mean = 1.4554 $nmol^{MT}g^{-1}$) to 3.3865^{MT} nmol g^{-1} in 12.22 ml/l exposed organisms **(Table 2)**. In the control, the concentration of MT was comparatively unchanged with time, and the values were always higher than those of exposed groups on all sampling days but for day 32 when the level of the group exposed 1.22 ml/l was essentially equal to the control value. Both drill cuttings exposed groups exhibited similar trend of MT fluctuation. In both groups, MT was severely depressed on day 4, and thereafter started to rise.

Induction of MT was higher in organisms exposed to 1.22 ml/l compared to organisms exposed to 12.22 ml/l, such that by the end to the end of the exposure period, MT concentration in organisms exposed to 1.22 ml/l was higher than the background value. Induction of MT in the 12.22 ml/l exposed organisms continued to be depressed as the concentration remained lower than the background value **(Table 2, Figure 2)**. Correlation between MT concentration in the digestive gland of *P. aurita* and exposure time was positive for control (b = 0.965) and for *P. aurita* exposed to 0.01 96hLC_{50} drill cuttings (b = 0.523) and weakly negative for *P. aurita* exposed to 0.1 96hLC_{50} drill cuttings concentration (b = -0.096).

Table 1: Protein and metallothionein concentrations in *T. fuscatus* on sublethal exposure to drill cuttings (mean ± SD)

Incubation Time (Day)	n^o Cys	Wt of tissue (g)	Protein (mg/l)	nmol Cys^{MT}	nmol MT g^{-1}
0	23	0.1	5.483 ± 0.014^{d}	1.766 ± 0.00^{d}	0.7677 ± 0.00^{c}
4	23	0.1	4.958 ± 0.014^{e}	1.741 ± 0.00^{d}	0.7568 ± 0.00^{d}
8	23	0.1	9.299 ± 0.000^{c}	1.567 ± 0.00^{c}	0.6812 ± 0.00^{e}
16	23	0.1	21.790 ± 0.014^{b}	2.564 ± 0.00^{b}	1.1146 ± 0.00^{b}
32	23	0.1	22.574 ± 0.108^{a}	3.567 ± 0.01^{a}	1.551 ± 0.00^{a}
Incubation Time (Day)	**n^o Cys**	**Wt of tissue (g)**	**Protein (mg/l)**	**nmol Cys^{MT}**	**nmolMT g^{-1}**
0	23	0.1	5.483 ± 0.014^{c}	1.766 ± 0.00^{e}	0.7677 ± 0.00^{e}
4	23	0.1	4.237 ± 0.020^{e}	2.894 ± 0.00^{c}	1.2581 ± 0.00^{c}
8	23	0.1	4.508 ± 0.014^{d}	2.471 ± 0.00^{d}	1.0745 ± 0.00^{d}
16	23	0.1	20.761 ± 0.012^{b}	9.713 ± 0.00^{b}	4.2232 ± 0.00^{b}
32	23	0.1	22.269 ± 0.026^{a}	10.021 ± 0.00^{a}	4.3571 ± 0.00^{a}
Incubation Time (Day)	**n^o Cys**	**Wt of tissue (g)**	**Protein (mg/l)**	**nmol Cys^{MT}**	**nmolMT g^{-1}**
0	23	0.1 ± 0.014	5.483^{e}	1.766 ± 0.00^{e}	0.7677 ± 0.00^{e}
4	23	0.1 ± 0.013	7.112^{d}	1.898 ± 0.00^{d}	0.8254 ± 0.00^{d}
8	23	0.1 ± 009	9.23^{c}	2.486 ± 0.00^{c}	1.0809 ± 0.00^{c}
16	23	0.1 ± 0.014	16.516^{b}	4.459 ± 0.00^{b}	1.9387 ± 0.00^{b}
32	23	0.1 ± 0.063	16.738^{a}	4.821 ± 0.00^{a}	2.0959 ± 0.00^{a}

Mean ± SD; *n* =3 (mean and SD are calculated from three measurements, considering three pooled samples at each concentration. Means not sharing the same superscript (a, b, c, d or e) in each column are significantly different ($P < 0.001$, Duncan).

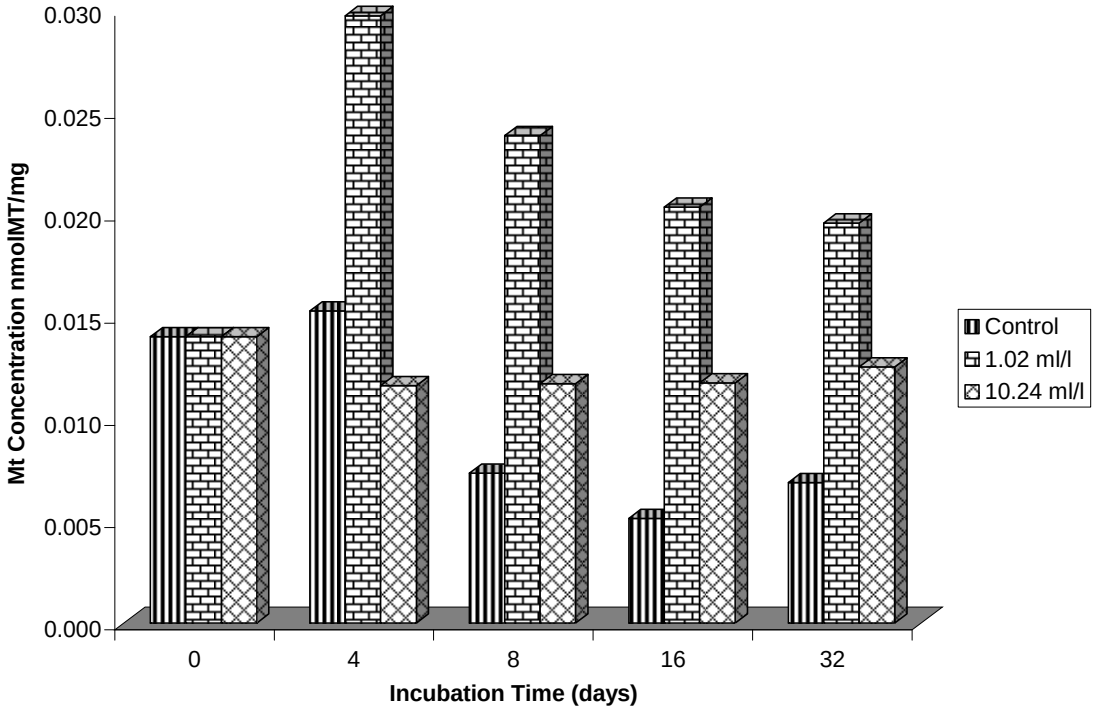

Figure 1: Metallothionein per total protein levels in the digestive gland of *T. fuscatus*

Table 2: Induction of metallothionein in *P. aurita* on sublethal exposure to drill cuttings (mean ± SD)

Incubation Time (Day)	n° Cys	Wt of tissue (g)	Protein (mg/l)	nmol Cys^{MT}	nmol MT g^{-1}
0	23	0.1	11.147 ± 0.025^{d}	7.789 ± 0.00^{e}	3.3865 ± 0.00^{a}
4	23	0.1	10.915 ± 0.013^{e}	7.809 ± 0.00^{d}	3.3952 ± 0.00^{b}
8	23	0.1	20.906 ± 0.012^{c}	7.919 ± 0.00^{c}	3.443 ± 0.00^{c}
16	23	0.1	38.688 ± 0.028^{b}	8.01 ± 0.00^{b}	3.4828 ± 0.00^{d}
32	23	0.1	42.666 ± 0.145^{a}	8.72 ± 0.00^{a}	3.7914 ± 0.00^{e}
Incubation Time (Day)	**n° Cys**	**Wt of tissue (g)**	**Protein (mg/l)**	**nmol Cys^{MT}**	**nmol MT g^{-1}**
0	23	0.1	11.147 ± 0.025^{e}	7.789 ± 0.00^{b}	3.3865 ± 0.00^{d}
4	23	0.1	13.246 ± 0.025^{d}	0.438 ± 0.00^{e}	0.1902 ± 0.00^{a}
8	23	0.1	21.931 ± 0.054^{c}	1.478 ± 0.00^{d}	0.6426 ± 0.00^{b}
16	23	0.1	23.266 ± 0.029^{b}	7.294 ± 0.00^{c}	3.1714 ± 0.00^{c}
32	23	0.1	27.940 ± 0.014^{a}	8.926 ± 0.00^{a}	3.8807 ± 0.00^{e}
Incubation Time (Day)	**n° Cys**	**Wt of tissue (g)**	**Protein (mg/l)**	**nmol Cys^{MT}**	**nmol MT g^{-1}**
0	23	0.1	11.147 ± 0.025^{e}	7.789 ± 0.00^{a}	3.3865 ± 0.00^{e}
4	23	0.1	24.431 ± 0.0356^{a}	0.759 ± 0.00^{e}	0.3301 ± 0.00^{a}
8	23	0.1	21.323 ± 0.064^{b}	1.284 ± 0.00^{d}	0.5583 ± 0.00^{b}
16	23	0.1	16.106 ± 0.052^{d}	2.939 ± 0.00^{c}	1.2778 ± 0.00^{c}
32	23	0.1	16.766 ± 0.029^{c}	3.965 ± 0.02^{b}	1.724 ± 0.00^{d}

Mean ± SD; *n* =3 (mean and SD are calculated from three measurements, considering three pooled samples at each concentration. Means not sharing the same superscript (a, b, c, d or e) in each column are significantly different (Duncan, $P < 0.001$).

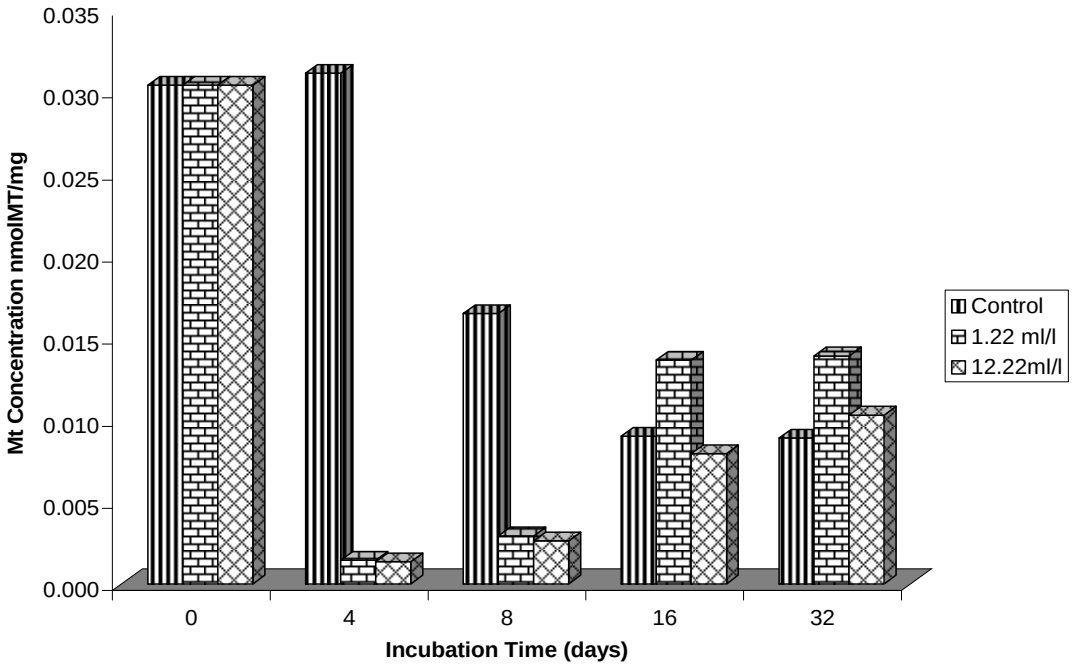

Figure 2: Varying levels of Metallothionein as fraction of total protein in the digestive gland of *P. aurita*

ANOVA revealed that there was statistical difference ($P < 0.001$) in MT concentration for each treatment in the digestive gland of *P. aurita* during the study. Post hoc analysis with Duncan test showed that MT concentration was significantly different ($P < 0.001$) on each sampling day for all treatment. Comparison of MT levels in control *P. aurita* with that of the drill cuttings exposed groups showed that there was significant difference (ANOVA, $P < 0.001$) among them.

As was observed in *T. fuscatus* the average protein concentration increased above the background level during the study. The observed increase in protein concentration was higher in control organisms relative to drill cuttings exposed groups. A further examination of the results show that in control, but for the observed increase on day 4, the relative concentration of MT relative to total proteins steadily reduced on all sampling days during the study. In drill cuttings exposed organisms, there was a fall in the concentration of MT relative to total protein on day 4, after which the ratio started to increase, but the basal ratio was not achieved in both groups during the study.

4. Discussion

In this study, metallothionein level in *T. fuscatus* increased in all treatment groups including control. However, over time MT synthesis was greatest in species exposed to 0.01 96h LC_{50} drill cutting concentration compared to control and species exposed to 0.1 96h LC_{50} rill cutting concentration. At low exposure concentration, the organism initially favoured MT production to other proteins but with time, the production of enzymes and proteins was enhanced and the ability to produce more MT increased. At higher concentration of drill cuttings, the organism responded by mobilisation of enzymes (proteins) necessary for MT induction, but the ability to produce proteins was inhibited with the result that the organism production of MT was suppressed. Increase in MT production was observed only after day 16 following substantial increase in protein production during this period. A study of relative concentration of MT to total protein showed that in *T. fuscatus*, low exposure to drill cuttings promoted proteins synthesis including metallothionein. On the other hand enhanced protein synthesis was not proportionate to MT production in control and at higher exposure to drill cuttings, hence MT compared to total proteins concentration was reducing in these groups. The findings suggest that on exposure of *T. fuscatus* to sublethal concentration of drill cuttings, the organisms channelled energy for growth and reproduction into production of enzymes and metallothionein to fight the stressed environmental condition.

In *P. aurita*, exposure to drill cuttings elicited different responses in each treatment group during the study. In control, though the change in MT levels during the study was significant, the difference in the average mean value observed on any sampling was very low with high levels of protein synthesis. In drill cuttings exposed *P. aurita* on the other hand MT production was suppressed though increased concentration of proteins was observed during the

period. Consequently, the ratio of MT to total protein decreased at the end of the study period.

Therefore the exposure to drill cuttings suppressed the production of MT, while at the same time enhanced the production of other proteins in *P. aurita.* At very low (0.01 96hLC_{50}) concentration exposure, the organism tended to recover with time and normal MT production rate resumed. It may be that exposure of *P. aurita* to very low concentration of drill cuttings resulted in the inhibition of endogenous MT, and the organism in response increased protein synthesis of enzymes required for metallothionein production as was observed as time of exposure increased. At higher exposure concentration (0.1 96hLC_{50}), MT production was severely suppressed. The organism in response elevated protein production necessary for metallothionein production. Over time the synthesis of MT increased but at a rate lower than that observed in low concentration exposed organism as the amount of other proteins decreased. Thus exposure of *P. aurita* to higher concentration of drill cuttings resulted in the inhibition of MT production. The organism tried to compensate by increasing the production of enzymes and proteins for production of MT, but this compensatory mechanism was severely inadequate as the organism's ability to produce endogenous MT remained suppressed and the organism remained stressed.

Induction of metallothionein is usually a primary response to heavy metal pollution both in fish (Killie *et al.*, (1992); Hogstrand *et al.,* (1996)) and in invertebrates (Viarengo and Nott, (1993); Roesijadi (1994)) It has also been associated with acclimation of fish (Dixon and Sprague, 1981) and invertebrate (Sathyanathan, 1996) to metal. Induction of MT however is not restricted by heavy metals alone. For instance, Ghoshal *et al* (1998) have demonstrated MT induction in response to restraint stress. Its induction has also been associated with non-mettallic elements as well with endogenous biological processes. MT induction has been linked to reduced growth in laboratory experiments in fish (Roch and McCarter, 1984) and in field experiment with invertebrates (Leung *et al.,* 2001). In the present study, additional synthesis of MT by *T. fuscatus* could be attributed to a physiological response of the organism on exposure to the chemical and suggested that energy for growth and reproduction was concentrated to increase the production of this protein. The implication is that organisms chronically exposed to low levels of drill cuttings are more likely to have stunted growth and lower reproductive rate and population density than reference organisms. In *P. aurita,* exposure to drill cuttings suppressed metallothionein production in a concentration dependent manner. The implication was that the organism's ability to cope with stress may have been compromised, making the organism more vulnerable to external stressors. Our findings demonstrated the presence of MT in the two gastropod species studied and the variations in their induction on exposure to sublethal concentrations of the toxicant.

Ours is a preliminary study on the response of MT in these gastropod species and our findings lend credence to the inclusion of metallothionein as a general biomarker during biomonitoring programmes during evaluation of impacts of drill cuttings on aquatic lives. However, its application in this regard demand further study on characterization and quantification of the isoforms, confounding factors and most importantly the responses of the organisms in their natural environments.

Acknowledgements:

Authors are grateful to the School of Postgraduate Studies, University of Lagos, Nigeria for financial support to carry out this work.

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14/09/2009

Morphometric and molecular variability of three *Artemia* strains (El–Max and Wadi El-Natrun, Egypt and San Francisco Bay, U.S.A)

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Abstract: Random amplified polymorphic DNA (RAPD) technique was used to analyze the degree of similarity among two Egyptian *Artemia* strains (Wadi El Natrun and El-Max) together with a commercially popular U.S.A strain (San Francisco Bay). Discriminate analyses of morphometric characters and laboratory tests for reproductive isolation were performed to investigate whether the conclusions drawn from traditional comparative tools are congruent with the pattern of genetic divergence detected by DNA markers. Correlation coefficients between the DNA banding patterns were calculated; these served as input values for the construction of a UPGMA dendrogram (Unweighted Pair- Group Method with Arithmetic Mean Average). RAPD analysis showed a reliable and reproducible differentiation between the three examined *Artemia* isolates. There was good agreement of some morphometric aspects for isolation, such as the length of first antennae, distance between compound eyes, the general shape (ventral view) and width of the brood pouch, % of abdomen length/total length and length of furca. Discrimination based on morphometric characters separated *A. tunisiana* (Wadi EL- Natrun strain) from the other two populations (El-Max and San Francisco Bay strain). While El- Max strain was genetically demonstrated to be different from the San Francisco Bay strains and very distinct from it, despite they showed considerable biometric similarities. The same was true, accumulative proximity matrix showed 96% similarity between Wadi El-Natrun and San Francisco Bay strains, despite the evident morphometric differences between them. Hybridization tests supported the concept of strain isolation. [Journal of American Science 2010; 6(2): 98-107]. (ISSN: 1545-1003).

Keywords: *Artemia*, divergence, genetic, hybridization, morphometric, RAPD

1. Introduction

Artemia is one of the best known aquatic organisms, and is considered to be a paradigmatic crustacean that can help to fill gaps in knowledge in evolutionary and comparative biology of arthropods and closely related groups (Abreu-Grobois, 1987; Browne and Bowen, 1991; Marco et al., 1991; Gajardo et al., 2002). Moreover, the easy transportation of cysts and cultivation of populations under laboratory conditions have permitted broad inter- population comparisons.

The genus *Artemia* is regarded as a complex of bisexual species and super species, as well as a large number of parthenogenetic forms, morphologically very similar, and species are very likely to have diverged from living in the Mediterranean area some 5.5 million years ago (Abreu-Grobois, 1987 and Badaracco et al., 1987). The hypothesis of the Mediterranean as the centre of radiation for *Artemia* is also supported by the diversity of *Artemia* types currently found in one area i.e. bisexuality and parthenogenesis on the one hand, together with diploidy and polyploidy on the other hand (Gajardo et al., 2002). *Artemia* populations are found in about 600 natural salt lakes and man-made salterns scattered throughout the tropical, subtropical and temperate climatic zones, along coastlines as well as inland (Van Stappen ,2002). In Egypt, *Artemia* resources are mostly restricted to five spots, among which El-Max saline and Wadi El-Natrun are the most productive areas (El-Sherif, 1989 and El-Bermawi, et al., 2004).

Speciation is still a highly debated topic and this evident from the many species concepts (Templeton, 1989 and Avise, 1994) and speciation mode (Turelli et al., 2001). Based on morphological bases, Clark and Bowen (1976) able to distinguish six sibling species (after many cross breeding tests): *Artemia franciscana, A. tunisiana, A. urmiana, A. monica, A. persimilis* and *A. parthenogenetica.* Later on, speciation has been conducted by means of cytogenesis, allozyme studies and chromocentre numbers (Abreu-Grobois, 1987; Pilla and Beardmore, 1994; Perez et al., 1994). Furthermore, different molecular approaches exist, including gene cloning, DNA sequencing and mtDNA analysis (Gajardo et al., 2001 and 2004; Eimanifar et al., 2006 and Ruiz et al., 2008). For instance, random amplified polymorphic DNA (RAPD) analysis developed by Williams et al. (1990), is a PCR-based method using a single short random primer which, under low stringency conditions, gives rise to amplification

products wherever the primer binds on opposite strands within an easily amplifiable distance. This method is widely used for the study of population genetics in a large variety of species (Wang et al., 1993). The RAPD technique has been used to construct genetic maps (Rowland and Levi, 1994), detect genetic variation (Garcia et al., 1994), assist in breeding programs (Garcia and Benzie, 1995) and for phylogenetic studies, which led to valuable isolation (Badaracco et al., 1995; Sun et al., 1999 and Camargo et al., 2002). In most cases, strains would be considered identical if their RAPD patterns are identical with several primers.

Despite strain isolation by distance and environmental conditions, *Artemia* populations in all strains could be linked. It is very likely that birds play an important role in dispersing *Artemia*, especially in artificial coastal saline (Ogilvie and Ogilvie, 1986). In genetic terms there is a potential for gene flux among these isolated populations. The study of the species and accurate identification of all *Artemia* populations are undoubtedly required for selected morphological and genetic characteristics.

The present study aims 1) to test the phylogeny relationship between the two Egyptian strains (El-Max and Wadi El- Natrun), 2) to test the hypothesis that they may be divergent from the American species *Artemia franciscana* (San Francisco Bay) and 3) to investigate whether the conclusions drawn from traditional comparative tools (morphology, biometry and hybridization) are congruent with the pattern of genetic divergence detected by DNA markers.

2. Material and Methods

2.1 Collection of cysts

Local *Artemia* cysts were collected from one coastal saltwork (El- Max) and one inland saline lake (Wadi El-Natrun), all situated in northern Egypt. The coastal El- Max saltwork (31° 08′ N, 30° 07′ E) is located along the Mediterranean coast. Wadi El-Natrun (30° 10′ N,30° 27′ E) is one of the depressions of the Western Desert of Egypt. Only bisexual population was found in Wadi El- Natrun, and parthenogenetic was detected at El-Max saltwork. Cysts were stored and transported to the laboratory in plastic bags, then cleaned and dried. San Francisco bay cysts were obtained from King British Aquarium Accessories Co Ltd, Bradford, U.K.

2.2 Culture techniques

All cysts were hatched in artificial sea water (Tropic Marine, S=37‰) under conditions of continuous illumination and aeration. Culture vessels, artificial sea water and aeration equipment were autoclaved. The culture vessels were maintained at a temperature of 28°C. Newly hatched nauplii were transferred directly to flasks with initial density 2 nauplii/ml of culture medium and kept under the previous conditions. After 2 days from hatching, individuals in each of the culture flasks were fed every 2 days on Liquifry (0.4 ml) until around stage 10 (Weisz, 1946). From stage 10 through the late stage, each culture consists of approx. 100 individuals; brine shrimp were supplied with 0.6 ml of Liquifry every 2 days. This feeding regime, worked out in details in initial experiments, ensured that growth was not resource limited (El‒ Gamal, 1997). The culture medium was replaced every 4 days. Under these conditions, adults were evident after 4 weeks. All the strains were bisexual except El-Max strain, was parthenogenesis.

2.3 Biometry

Cysts are fully hydrated after incubation at room temperature for at least 3hrs (Lavens and Sorgeloos, 1987) in artificial sea water. From each population a random sample was taken and diameter of 50 hydrated cysts was measured using an eye-piece micrometer. The length of 50 recently hatched nauplii (stage 0) and 50 cultured adult females (all adults were 30 days old) from each strain were anaesthetized in chloroform saturated seawater and measured using the same equipment. Body length was taken as the distance from the front of the median eye to the posterior margin of the body in nauplii, while in adults to the posterior margin of the telson. More morphological parameters were quantified in each female as: length of the first antennae, distance between the compound eyes; abdominal length; % abdominal length /total length; width of the third abdominal segment; width of the ovisacs; length of furca; and number of setae/furca.

2.4 Molecular methods

Unless otherwise stated, buffers and protocols were used according to Sambrook et al. (1989).

2.4.1 Genomic DNA extraction and purification

Frozen tissues of *Artemia* (30 mg) were kept at room temperature for 2 min to be slightly softened without thawing the tissue completely, then pulverized**.** The minced tissue was transferred to 1.5 ml Eppendorf tube, before incubating (2-3 hrs) with mild shaking at 55°C in 0.5 ml lysing buffer (2 ml, 5M. NaCl; 1ml, 1M. Tris HCl, pH 8; 5ml, 0.5M. EDTA, pH 8; 5ml, 10% SDS; 87 ml H_2O and 0.1 mg/ml proteinase K). The mixture was centrifuged (13,000 x g, 1 min) and the supernatant was retained and genomic DNA was purified using phenol-chloroform method. The DNA was then precipitated by the addition of 2.5 volume of ethanol at room temperature after adding 1/10 volume of 3M sodium acetate. DNA samples were cooled for 10 min on ice and DNA was pellet by centrifuging for 10 min at 10,000 x g, washed in 70% ethanol and dried at room temperature before resuspending in TE buffer (1ml,

1M Tris. HCl, pH8; 0.02ml 0.5 M EDTA, pH8; 98.98ml H_2O). Finally, DNA was stored at 4°C for further analysis.

2.4.2 Amplification of genomic DNA

Eight oligonucleotides primers (10-mers) with G+C content ranging from 60-70% were eventually used to amplify genomic DNA. The sequences of the primers (5′ -3′) are represented in Table 1.

Table 1. Primer Sequences and their G+C Contents.

Code	Sequence 5′ to 3′	G+C %
1	TTC GAG CCA G	60
2	TGG ACC GGT G	70
3	AAA GCT GCG G	60
4	AAG CCT CGT C	60
5	TGC GTG CTT G	60
6	TTC CCC CCA G	70
7	CAC ACT CCA G	60
8	GTG ATC GCA G	60

Optimal results were obtained using 10-15 ng of nucleic acid template in 15 µl reaction volume. PCR buffer contained 10 mM Tris-HCl (pH9), 50mM KCl, 1.5mM $MgCl_2$, 15 pM primer, 2 mM of deoxynucleoside triphosphate and 1 unit of Taq DNA polymerase (0.2 µl). The reaction mixtures were overlaid with mineral oil (Sigma). The amplification reactions were carried out in a Biometra Thermal Cycler following an initial denaturation step at 96°C for 10 min. The reactions were subjected to 40 cycles of amplification at 96°C (30 sec), 35°C (30 sec) and 72 °C (45 sec) followed by a 5 min final extension at 72°C. Additionally, each set of reactions incorporated a negative control with the DNA template replaced with double distilled water.

The generated amplification products were resolved by electrophoresis on 1.4% (wt/vol) agarose gel in 1x TBE buffer (0.89M Tris. Base; 0.89 M boric acid pH (8.3); 2.5mM EDTA) for 3 hrs at 60V. A one hundred bp ladder (sigma) was loaded as a size marker. After electrophoresis, the gel was stained with ethidium bromide, visualized under UV trans-illuminator and photographed by a Polaroid CU5 camera. Pictures were scanned and the images were processed with the photoshop software.

2.5 Hybridization

Generally 15 crosses were made between males of the first strain (San Francisco Bay) and females of the second (Wadi El-Natrun), another 15 crosses were made between females of the first strain and males of the second. The experiment was carried out in the following way: material from each strain was raised separately as soon as the sex could be determined. When the egg sac was well filled, they were brought together with males from the other strain. Other individuals were crossed with the opposite sex from their own locality as controls. Crosses were inferred to be fertile when full/intact cysts or live nauplii were produced. The viability of the cysts was determined according to their ability to hatch (and give live nauplii) in standard conditions following deactivation of diapause (i.e. dehydration at 38 ± 1°C for at least 48 h, rehydration/dehydration cycles and/or hibernation at-30°C for at least 2 weeks). The viability of the nauplii was tested by raising them to sexually mature adults.

2.6 Data analysis:

One-way analysis of variance (ANOVA) was used to determine if there were significant differences between the means of biometric measurements among the three populations. XlMiner dendrogram was used to detect the relationships between individuals within each group. The results were processed with discriminant analysis using SPSS. The rough set data analysis was used to distinguish the variables for each population using Rosetta.

For RAPD each examined strain was scored for the presence or absence of every amplification product. Cluster analyses between DNA banding patterns were calculated and served as input values to create a dendrogram using unweighted pair group method with the arithmetic mean (UPGMA) by NTSYS program (Numerical Taxonomy System, Exeter Software).

3. Results

3.1 Morphometric analysis

The morphometric analysis is shown in table (2 and 3). The morphometric characteristic that most significantly contribute to the discrimination among the three groups were: the length of the 1st antenna, distance between compound eyes, width and shape of ovisacs, abdominal length and the length of furca. These five variables were highly statistically significant ($p \leq 0.001$). San Francisco Bay and El-Max strains do not differ statistically in cyst diameter, nauplius length, female length, third abdominal length and the number of setae, but they were highly statistically significant from Wadi El-Natrun population.

Table 2. Demographic Data of Various Morphometric Parameters of Cyst, Nauplii and Female *Artemia* (30 days old) for SFB, WN and MAX strains reared under laboratory conditions. (A) Diameter of hydrated cyst, (B) Length of newly hatched nauplii, (C) Total length, (D) % of

Abdomen length /Total length, (E) Width of the 3rd abdominal segment, (F) Length of the 1st Antenna, (G) Distance between compound eyes, (H) Width of ovisac, (I) Furca length and (J) Number of Setae/Furca. (Parameters A-J is mm except D is %).

		N	Mean± SD	Minimum	Maximum	P value
A	SFB	50	0.22±0.01	0.20	0.24	0.00**
	WN	50	0.19±0.014	0.14	0.23	
	MAX	50	0.23±0.01	0.22	0.25	
	Total	**150**	**0.22±0.02**	**0.14**	**0.25**	
B	SFB	50	0.51±0.02	0.48	0.54	0.00**
	WN	50	0.46±0.02	0.43	0.50	
	MAX	50	0.50±0.07	0.05	0.56	
	Total	**150**	**0.49±0.05**	**0.05**	**0.56**	
C	SFB	50	8.75±0.45	7.70	9.90	0.00**
	WN	50	5.48±0.41	4.50	6.40	
	MAX	50	8.87±0.38	8.00	9.40	
	Total	**150**	**7.70±1.63**	**4.50**	**9.90**	
D	SFB	50	43±0.03	38	57	0.00**
	WN	50	39±0.02	35	47	
	MAX	50	48±0.03	38	53	
	Total	**150**	**43±0.74**	**35**	**57**	
E	SFB	50	0.52±0.034	0.42	0.62	0.00**
	WN	50	0.46±0.024	0.36	0.55	
	MAX	50	0.51±0.03	0.42	0.58	
	Total	**150**	**0.49±0.05**	**0.36**	**0.62**	
F	SFB	50	0.77±0.05	0.62	0.85	0.00**
	WN	50	0.42±0.05	0.33	0.57	
	MAX	50	1.25±0.28	0.87	2.41	
	Total	**150**	**0.81±0.38**	**0.33**	**2.41**	
G	SFB	50	1.78±0.17	1.43	2.20	0.00**
	WN	50	0.86±0.06	0.73	0.97	
	MAX	50	1.37±0.08	1.12	1.53	
	Total	**150**	**1.34±0.39**	**0.73**	**2.20**	
H	SFB	50	1.37±0.12	1.10	1.56	0.00**
	WN	50	0.52±0.06	0.40	0.65	
	MAX	50	1.66±0.10	1.42	1.91	
	Total	**150**	**1.18±0.49**	**0.40**	**1.91**	
I	SFB	50	0.28±0.05	0.18	0.43	0.00**
	WN	50	0.14±0.03	0.10	0.21	
	MAX	50	0.44±0.05	0.32	0.56	
	Total	**150**	**0.29±0.13**	**0.10**	**0.56**	
J	SFB	50	15.84±1.67	12.00	19.00	0.00**
	WN	50	6.08±0.88	4.00	8.00	
	MAX	50	14.98±1.33	13.00	18.00	
	Total	**150**	**12.30±4.62**	**4.00**	**19.00**	

* sig. at 0.05, ** sig. at 0.001

Table 3. Discriminant Analysis of the Morphometric Parameters of Cyst, Nauplii and female *Artemia* individuals for SFB, WN and MAX populations reared under laboratory conditions; standardized coefficients for canonical variables, eigen values, cumulative percentage of variance and predicted classifications for each root are presented. For the abbreviations of the variables, see Table 2.

Classification Function Coefficients				Standardized Coefficient for Canonical Variables		
	SFB	WN	MAX		Root1	Root2
A	1887	1660	1939	A	0.16	0.04
B	183	196	170	B	-0.05	-0.07
C	59	35	60	C	0.58	-0.12
D	446	375	496	D	0.16	0.17
E	322	289	307	E	0.06	-0.12
F	25.7	22	37	F	0.10	0.28
G	134	74	105	G	0.28	-0.66
H	163	61	187	H	0.64	0.16
I	23	7	111	I	0.17	0.57
J	6	1	5.79	J	0.34	-0.19
(Constant)	-988	-499	-1048	Eigen values	69.75	6.38
				Cum. Perc.	91.6%	100%
Predicted Classifications						
SFB	100%					
WN	100%					
MAX	100%					
Total	100%					

Discriminant analysis based on the strain type as separator factor was performed (Figure 1). There was an absolute discrimination among (WN) and the other two strains (SFB and MAX), both also can be distinguished from each other. The total predictability of the model was 95.8%, the graph in Figure (1) was based on two roots and these two roots explained 100% of the total variation in the data collection (Table 2).

Concerning the morphology of brood pouch as shown in Figure (2) it was laterally rounded, heart shaped, without lateral lobes in El- Max females and with two protruded circles on the ventral side. Females from San Francisco Bay had also rounded brood pouch but with lateral lobes, while brood pouch were triangular with lateral lobes in Wadi El- Natrun strain. No structure differences were observed on the abdomen except for length and width (Figure 2).

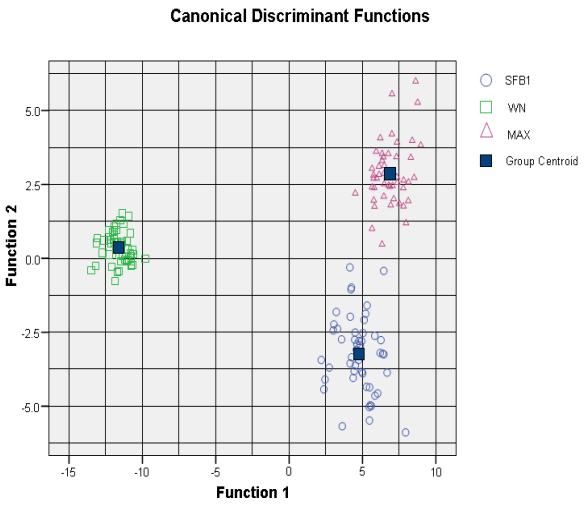

Figure 1. Scatter plot resulting from the discriminant analysis (canonical scores). When using strain origin San Francisco Bay (SFB); Wadi El Natrun (WN) and El-Max (MAX) as separating factor.

The morphology and length of furca showed clear differences according to the type of strain as shown in Figure (2), while no differences between males and females in the same strain were observed.

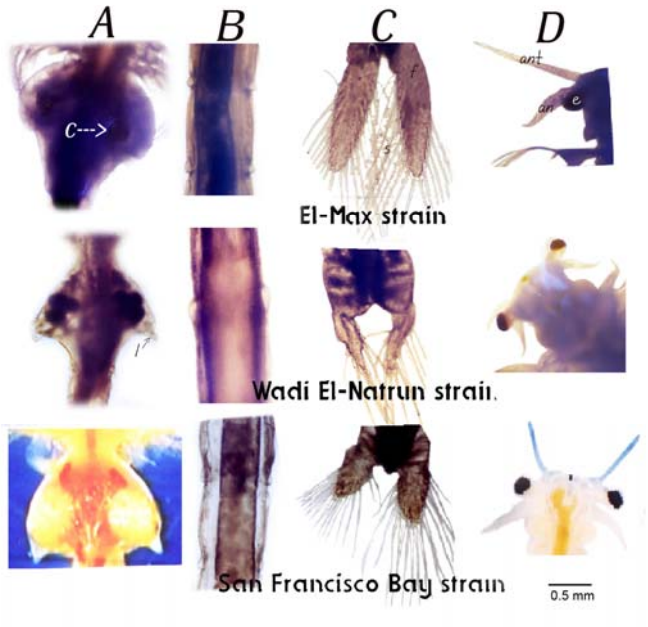

Figure 2. Representative light-graphs of female *Artemia* (total length 6mm) from El- Max, Wadi El- Natrun and San Francisco Bay strains. A: Ventral view of the brood pouch; B: Dorsal view of the abdomen; C: Last abdominal segment showing the furca.

The number of setae in each furca branch increased with the length of the animal and at the same length it was significant higher in El- Max and San Francisco Bay ($P \leq 0.001$) than Wadi El-Natrun strain.

3.2 RAPD profiles

Eight random primers were tested for fingerprinting of the three *Artemia* strains. Primer 8 gave no reproducibility while the other primers provided strongly amplified fragments. The fingerprints generated by the 7 primers revealed unique profiles for each strain. Seven primers were able to produce consistent amplification and yielded a total of 18, 14, 11, 13, 4, 10 and 8 fragments, respectively, ranging in size from 118 to 1353 bp figure (3). The greatest number of PCR fragments was found with primers 1, 2, 3, 4 and 5 (5-7 bands) while less fragments were obtained with primers 6 and 7 (1-3 bands). RAPD profiles showed that the greatest differences between strains were observed with primers 1 and 2.

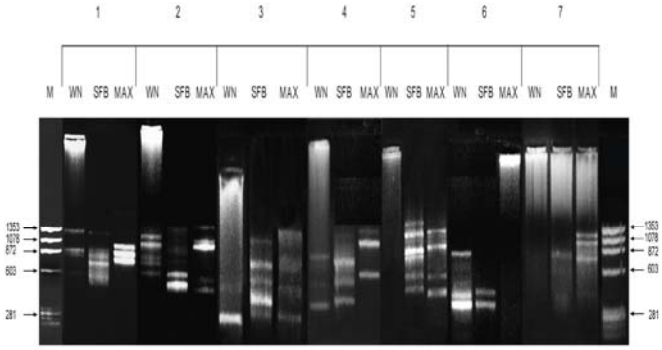

Figure 3. RAPD amplification products using primers from 1-7 for the three *Artemia* strains, Wad El- Natrun (WN), San Francisco Bay (SFB) and El- Max (MAX).

The similarities among species revealed certain relationships and differentiated them into two clusters (figure 4). The first cluster with primers 1, 2, 4 and 7 was between Wadi El-Natrun and San Francisco Bay strains, while the second cluster was El- Max strain. On the other hand, the first cluster with primers 3 and 6 was between Wadi El-Natrun and El- Max strains, while the second cluster was San Francisco Bay strain. The only cluster between El- Max and San Francisco Bay strains was obtained by primer 5.

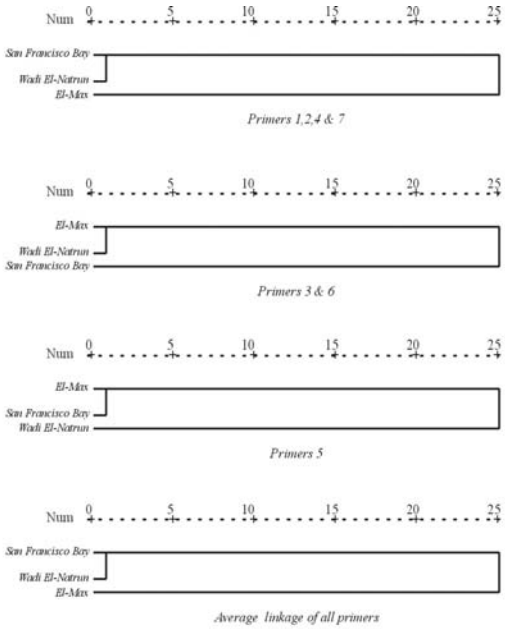

Figure 4. Dendrogram using Average linkage (between groups) Resclad Distance Cluster Combine .

The dendrogram calculated from all primers using average linkage between groups illustrated two clusters: the first between San Francisco Bay and Wadi El-Natrun strains while the second group was El- Max strain**.**

Accumulative proximity matrix calculated from the investigated primers showed 96% similarity between Wadi El-Natrun and San Francisco Bay and 33% similarity between Wadi El- Natrun and El-Max strains.

3.3 Hybridization

None of the hybridization crosses between Wadi El- Natrun and San Francisco Bay strain gave rise to an F1 generation, although 9 and 11 copulations respectively were observed from the two 15 crosses. They laid broods of transparent eggs (no nauplii) every 3 or 4 days. All attempts to hatch the eggs failed.

Control individuals crossed with the opposite sex from their own locality gave birth to a new generation freely, which developed normally.

4. DISCUSSION

The previous work on the morphology of *Artemia* (Gilchrist, 1960) has shown that *Artemia* individuals undergo morphological changes according to the environmental conditions and between males and females even when the animals were cultured in the same medium. The previous conclusion was cited by Amat (1980) after a complete morphological study on 22 different Mediterranean populations. He concluded that the variation in these characters observed among *Artemia* males and females from different populations allows one to classify the different main types of *Artemia*, but it is difficult to distinguish among populations of the same type. The same was observed when the strains under investigation were cultured under laboratory conditions and compared with those collected from the field. This may be due to the characteristic of the salterns that the populations inhabited. For example Wadi El-Natrun has a different ionic composition of the brine (alkaline hypersaline soda), also El- Max population are more euryhaline which has a very strong influence on the morphology of *Artemia* (El-Sherif 1989; and El-Bermawi, et al., 2004). Triantaphyllidis, et al, (1995) changed the discriminant parameter when compared between two populations according to the age and salinities, if low used the length of the first antenna and the width of the head for higher salinities also, marked differences at intrapopulation as well as interpopulation level.

Many studies frame the most discriminant variables as cyst volume, diameter of eyes; the distance between the eyes, width of the head; length of the first antenna; width of brood pouch, and length of furca (Hontoria and Amat, 1992; Torrentera and Dodson, 1995, Asem et al., 2007). Generally the cyst diameter of different produced batches of the same strain remains rather constant. Other biometrical characteristics such as cyst dry weight, instar 0-naupliar length, individual naupliar weight and energy content *etc.*, show a high correlation with the cyst diameter. As a consequence, biometrical parameters, in particular the cyst diameter, are good tools to characterize *Artemia* strains, and help to define the origin of unknown or even mixed cyst samples. The present study indicated slightly differences in cyst diameters and newly hatched nauplii between the San Francisco Bay and El-Max strains, although Zhenqiu et al. (1991) showed that parthenogenetic populations and their cyst size is larger than those of bisexual species. Hontoria (1990) studied 14 *Artemia Franciscana* populations and recorded a diameter ranging between 217 and 230µm. The herein size (200-240µm) were smaller when compared with those of the hydrated cyst from the commercially important Great Salt Lake populations, and the same as San Francisco and San Bablo Bay strains (Abdel Rahman, 1995). Wadi El-Natrun cysts had the lowest diameter when compared to El- Max and San Francisco Bay populations. These finding was in agreement with those presented by El-Sherif (1989), where Wadi El- Natrun cysts were smaller than *A. salina* and *A. franciscana* from San Francisco

Bay. The same was recorded with the newly hatched nauplii and adults (30 days old) of Wadi El- Natrun, they were smaller than the other two studied strains and this confirmed with the result of El-Sherif (1989) and El-Bermawi, et al. (2004) comparable to El- Max and Borg El- Arab strains. The previous may be due to the ionic composition in WN natural environment, that mostly different from that of the culturing medium. According to the results of El-Bermawi (2004) the best salinity for culturing *Artemia* strains from Egypt in order to discriminate individuals is $80gl^{-1}$.

Triantaphyllidis, et al, (1995) revealed that the length of the 1st antenna is the best characteristic for identification of parthenogenetic individuals. He found that the 1st antenna is significantly longer in parthenogenetic *Artemia* from Tanggue than in *A. franciscana*. The previous finding is compromised with the 1st antenna in El- Max strain, it was significantly longer than the other two bisexual strains. (Amat, 1980) showed the same, where 1st antennae in the San Francisco Bay *Artemia* are shorter than those from the Spain parthenogenetical strains.

Although Amat et al. (1995) and El-Bermawi, et al. (2004) recognized that the size of furca and the number of setae various considerably in wild populations, due to environmental conditions. They used these morphological variables as a systematic tool provided with well defined culture conditions. Amat et al. (1995) found that the furcal characters were the major factors for discriminating a group of Southern Spanish populations from the rest of the Spanish bisexual *Artemia*. The present work encourage this parameter because it was good to distinguish the three strains.

Many authors focused on the morphological data of the genitalia of arthropods, due to their taxonomical characters that are fairly constant within a given group and are usually given high taxonomical weight even in closely related species (Torrentera and Dodson, 1995 and Mayer, 2002). Torrentera and Dodson (1995) when studied populations of *Artemia* from Yucatan, concluded that, numerical and categorical characters of the female brood pouch are critical discriminating characters. Mayer (2002) emphasized that the female brood pouch morphology is the most useful morphological character when discriminate between two *Artemia* populations from Puerto Rico and one from the Dominican Republic. The general shape and structure of the brood pouch of the investigated populations were completely different and can be used to discriminate between them. Therefore, the probability that they were the same or related species is very low.

DNA is needed as cited by Mayer (2002) to supplement morphometric findings to evaluate the phylogenetic and taxonomic status of any population. Recently it has been demonstrated that polymorphisms in genomic fingerprints generated by arbitrarily primed polymerase chain reaction (PCR) can distinguish between strains in many organisms (Badaracco et al., 1995**)**. In the present study, this technique was used to estimate the phylogenetic relationships existing between three *Artemia* strains existing in El- Max and Wadi El- Natrun (Egypt) and San Francisco Bay (USA).

The RAPD patterns obtained using the random primers revealed differences in the intensities of some bands between *Artemia* isolates. However, one of the short comings of the objective analysis of RAPD profiles is that bands are scored as either present or absent. Consequently, there is no account between variations in the brightness of bands. In such case there is a possible loss of discriminatory power. Nevertheless, when comparing RAPD profile analysis to any of the morphological or hybridization methods of species discrimination, RAPD is always superior (Sun et al., 1999 and Camargo et al., 2002).

The clustering patterns obtained with the primers 1-7 corroborated that the populations in these clusters were not identical and genetic dissimilarities between them might exist. Other RAPD analyses showed a significant differentiation between populations belonging to *A. franciscana* (Badaracco et al., 1995). Camargo et al. (2002) analyzed 14 *Artemia* strains belonging to *A. franciscana* and A. *persimilis* and demonstrated genetic dissimilarities between them. Sun et al. (1999) used the same analysis to distinguish the four species of the genus *Artemia* (*A. franciscana, A. urmiana, A. sinica and A. parthenogenetica*) and cited significant differences between the four strains.

The cumulative relationship between the three strains in the present work showed two groups, one of which contained the two bisexual species and the other form the parthenogenetic population. Sun *et al*. (1999) come to the same conclusion when they emphasized significant differences between bisexual *Artemia* species and parthenogenetic populations. El- Max strain was demonstrated to be apart from the San Francisco Bay population and very distinct from it, which tempts to suggesting that El-Max strain didn't evolved from *A. franciscana*. Contradictory, Abreu-Grobois and Beardmore (1980) and Barigozzi (1989) revealed that parthenogenetic forms would be derived from bisexual genotypes and parthenogenetic populations from inland salt lakes could have followed an evolutionary path that was different from that of the coastal populations (Gao et al*.,* 1994).

Despite the genetic differences between the San Francisco Bay (*Artemia franciscana*) and El-Max strain, they were morphologically and morphometrically very similar (5 out of 10 biometric characters). The same was observed between *A. franciscana* and *A. persimilis*; the two species were described as being morphologically very similar in spite of the genetic differences between them (Browne and Bowen, 1991 and Gajardo et al., 1999).

The opposite was observed between Wadi El-Natrun and San Francisco Bay strain. Despite their genomic similarities, they were significantly different in other morphometric aspects. Abreu-Grobois (1987), Badaracoo et al. (1987) and Browne and Bowen (1991) thought that *Artemia franciscana* is closely related to the original group of species that evolved in the Mediterranean.

The herein results were further supported by the hybridization test, where there is impossibility of producing normal offspring by crossing. According to the biological species concept, this is a sufficient proof that they do not belong to one species. The study of Kuenen (1939) provides the first example of sexual isolation within *Artemia salina* between two bisexual forms. Gilchrist (1960) found sexual isolation between *Artemia* from California and *Artemia* from North Africa. Bowen (1965) found sexual isolation between California and Sardinia *Artemia*. Other researches (Pilla and Beardmore, 1994) showed that the production of laboratory hybrids between morphologically or genetically divergent allopatric populations appears to be a common phenomenon in some *Artemia* populations and other members of the order. Maeda-Martinez *et al.* (1992) showed that morphologically distinct species that have been separated for a long period of time are sexually compatible. For this reason, a number of authors maintain that reproductive isolation is not necessarily a key aspect of the Biological Species Concept (Templeton, 1989).

CONCLUSIONS

The results supported the strains distinction and the Egyptian strains were divergent from American strain (*Artemia franciscana).* There wasn't agreement between genetic divergence (detected by DNA markers) and the morphometric aspects. Reproductive isolation was in the same line with genetic divergence. Morphometric data could be used through discriminant analysis to study relatedness among *Artemia* populations.

Acknowledgements

The author would like to acknowledge Dr. Abd El-Monsef, M. M. E. for his helpful assistance in statistical analysis.

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Altitudinal variation in nutritive value of adult-juvenile foliage of *Celtis australis* L.: A promising fodder tree species of Central Himalaya, India

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Abstract: The aim of the study was to compare the nutrient composition of adult and juvenile foliages of *Celtis australis*, collected from different altitudes. Adult foliages were collected from four different altitudes for nutritional analysis and compared with the nutritive value of juvenile foliage (seedlings of different provenances raised under the similar climatic conditions in the experimental garden for one year and the foliage has been referred herein as juvenile). The data revealed that nutritive value of *Celtis* foliage was strongly influenced by altitudinal gradient. The dry matter content in adult and juvenile foliage exhibited significant inverse correlation ($P < 0.05$) with altitude whereas, phosphorus, potassium and calcium contents showed strong positive correlation ($P < 0.01$) with elevational range of foliage. Crude protein in adult foliage also showed strong positive correlation with altitude ($P < 0.01$). A significantly higher ($P < 0.01$) dry matter, ash, crude protein and starch was recorded in adult compared to juvenile foliage of *C. australis*. On average, high altitudinal populations exhibited comparatively higher nutritive values than those from low altitude. High altitudinal trees, therefore, should be selected for multiplication of *Celtis* for quality fodder production. [Journal of American Science 2010;6(2):108-112]. (ISSN: 1545-1003).

Key words: *Celtis australis*, altitude, nutritive value, adult- juvenile foliage

1. Introduction

The fodder trees provide nutritious feed to the livestock population of hill farmers. Even the landless labourers, keeping small herds of sheep and goats mostly depend on the top feed resources from trees growing near habitats. *Celtis australis* L. of family Ulmaceae is an indigenous multipurpose agroforestry tree-crop of Central Himalaya, India and grown mainly in agrisilviculture and silvipastoral agroforestry systems throughout the hills. It is the only agroforestry species that has wide range of ecological amplitude (extending from 500 to 2000 m asl) and provides an excellent feed during dry season when protein and nutrient deficiencies are likely to occur to the livestock population (Bhatt and Verma, 2002; Singh, 1982; Singh, 2004).

Thus, this broad–leaved genus play a vital role in socio-economic structure of hill people by supplying highly palatable, nutritious and tannin free green fodder particularly during peak periods (Makkar et al., 1993; Subba et al., 1994). However, season of harvesting (Bhandari et al., 1979; Pal et al., 1979) and source of collection, i.e., altitude (Morecroft et al., 1992b; Woodward, 1986) influence the nutritive values of tree foliage significantly. Keeping in view the importance of this potential agroforestry tree–crop in the rural economy, present study was designed to know the effect of altitude on nutrient composition of adult and juvenile foliages so as to screen the suitable provenances for mass afforestation in Central Himalaya, India.

2. Material and Methods

The study was conducted at H.N.B. Garhwal University Srinagar (Garhwal), Uttarakhand, India for assessing the nutritive value of Celtis foliage. Tree foliage was harvested from four different sites, ranging 550 to 1980 m altitude, 30^0 06' to 30^0 25'N latitude and 78^0 38' to $78^0$48'E longitude (Table 1).

Table 1. Geographical description of foliage collection sites of *Celtis australis*, Central Himalaya, India

Provenance	Altitude (m asl)	Latitude (N)	Longitude (E)
Srinagar	550	$30^0$13'	$78^0$48'
Agroda	1180	$30^0$06'	$78^0$47'
Kandikhal	1550	$30^0$20'40"	$78^0$38'05"
Badiyargaon	1980	$30^0$25'	$78^0$48'

From each selected site, more than half kg of fresh leaves of *C. australis* was collected from adult trees in the month of December from single branch of selected trees. To collect the juvenile foliage, seeds from four different altitudes were collected and sown in nursery beds in the experimental garden of Forestry Department (situated at $30^0$13' N latitude, 78^0 48' E longitude and 550m asl altitude). The juvenile foliage was harvested from one year old grown seedlings of *C. australis* and compared with nutritive value of adult foliage. Initially 2 kg of leaf sample was harvested from each of the population representing all the

seedlings. Bulk sample was mixed thoroughly and only half kg was finally collected for drying and further investigation.

The dried samples were grounded and sieved through a 1 mm mesh sieve for nutritional analysis. The dry matter (DM), crude protein (CP), crude fibre (CF) and Ash was estimated following the procedure of AOAC (1995). CF was estimated in defatted samples. The total phenolic (TP) was estimated using the method of Makkar et al. (1993). Calcium (Ca) was estimated as per the procedure of Underwood (1977) and the estimation of phosphorus (P) and potassium (K) was carried out as per the methods described by Okaebo et al. (1993). Similarly, soluble sugars (SS) and starch were determined by the method of Mc-Cready et al. (1950). Each parameter of nutrient composition (mean ± S.D.) was analyzed with four replicated samples of juvenile and adult foliages.

All the statistical analyses were performed using SPSS software package, version 10.0.1 (SPSS Inc., Chicago, USA). Variation in nutrient composition of the foliages was analyzed by ANOVA. The model included adult, juvenile and altitude as source of variation. Pearson's correlation analysis was performed to study the association between different experimental parameters.

3. Results

This study describes the effect of different provenances on nutrient composition of adult and juvenile foliage of *C. australis*. The results indicated significant variations in nutrient composition of adult and juvenile foliages. Further, altitude significantly influenced the nutrient composition of *Celtis* foliage. DM content of the adults and juvenile foliage has been given in Table 2. Foliage collected from the area with an altitude of 550 m asl exhibited significantly ($P < 0.05$) higher DM than those from higher altitude areas (1550 m asl). Significant ($P < 0.05$) inverse correlation between foliage DM content and altitude was recorded, which indicates that with increasing altitude, DM content declined in adult and juvenile foliages (Table 3).

Table 2. Altitudinal variations in nutritive value (Mean ± S.D.; n = 4) of adult and juvenile foliage of *C. australis*

Altitude (m asl)	Foliage	Dry matter (mg/g)	Crude protein (mg/g)	Crude fibre (mg/g)	Ash (mg/g)	Phosphorus (mg/g)	Potassium (mg/g)	Calcium (mg/g)	Soluble sugars (mg/g)	Starch (mg/g)	Phenolic (mg/g)
550	Adult	414.80 ±8.79	126.60 ±5.38	163.60 ±7.18	414.80 ±7.74	1.10 ±0.08	4.39 ±0.15	28.74 ±0.10	16.65 ±1.83	49.30 ±2.58	5.21 ±0.09
	Juvenile	288.05 ±7.39	96.90 ±3.71	141.00 ±4.08	134.00 ±6.06	0.94 ±0.06	4.62 ±0.14	21.99 ±0.11	20.74 ±2.94	65.17 ±5.50	3.18 ±0.05
1180	Adult	412.50 ±11.80	126.90 ±4.83	134.20 ±5.74	412.50 ±4.76	1.14 ±0.07	4.29 ±0.16	30.87 ±0.08	16.27 ±1.82	47.08 ±1.83	7.79 ±0.14
	Juvenile	272.00 ±5.59	105.80 ±6.06	145.00 ±6.06	126.00 ±4.08	1.06 ±0.05	5.27 ±0.10	24.27 ±0.07	17.70 ±0.97	52.95 ±3.16	6.58 ±0.08
1550	Adult	368.10 ±10.08	133.40 ±5.08	171.20 ±3.65	368.10 ±5.48	1.04 ±0.06	4.23 ±0.12	30.62 ±0.06	14.85 ±1.75	63.11 ±4.24	7.26 ±0.06
	Juvenile	266.00 ±11.13	96.90 ±4.08	154.50 ±4.43	124.00 ±3.58	1.03 ±0.04	5.75 ±0.11	25.12 ±0.09	18.83 ±1.12	53.81 ±2.58	3.23 ±0.06
1980	Adult	370.00 ±9.45	140.02 ±3.18	160.80 ±2.94	370.00 ±5.59	1.05 ±0.03	5.01 ±0.15	32.64 ±0.08	14.45 ±1.83	61.17 ±2.16	5.21 ±0.04
	Juvenile	276.00 ±10.03	91.10 ±1.41	157.50 ±6.78	138.00 ±4.94	1.12 ±0.10	5.12 ±0.14	25.87 ±0.11	16.87 ±1.14	75.45 ±5.59	4.20 ±0.05
"t" value (adult vs juvenile foliage)		13.74**	8.89**	4.37*	10.74**	0.14^{NS}	0.64^{NS}	2.36^{NS}	1.98^{NS}	13.63^{**}	1.16^{NS}
"r" value (adult vs juvenile foliage)		0.16^{NS}	-0.76**	0.12^{NS}	-0.98**	-0.66**	-0.26^{NS}	0.95**	0.65**	0.29^{NS}	0.84**

*Significant at $P < 0.05$, **significant at $P < 0.01$ and NS = Non-significant

Table 3. Correlation coefficient 'r' between altitude and nutritive values of adults and juvenile foliage of *C. australis*

Parameters	Adults foliage	Juvenile foliage
Dry matter	- 0.64*	-0.65*
Ash content	0.11^{NS}	0.12^{NS}
Phosphorus	0.74**	0.66**
Potassium	0.57*	0.59*
Calcium	0.90**	0.93**
Crude protein	0.91**	0.46^{NS}
Soluble sugars	- 0.94**	-0.85**
Starch	0.80**	0.30^{NS}
Crude fibre	$- 0.01^{NS}$	0.96**
Phenolics	0.37^{NS}	0.24^{NS}

* Significant at $P < 0.05$, ** Significant at $P < 0.01$ and NS- Non-significant

However, ash content did not exhibit any established trend with an altitude either in case of adult or juvenile foliages. On average, ash content in foliages of higher altitude population (1980 m asl) was significantly ($P < 0.05$) higher compared to foliages from other provenances. Similarly, CP content of foliages of 1980 m asl provenance was significantly ($P < 0.05$) higher than those of 550, 1180 and 1980 m altitudinal populations. There was significant ($P < 0.01$) positive correlation between CP content and altitude of the adult foliage. However, CP content of juvenile foliages did not exhibit significant relationship with altitude (Table 3). Data on CF also exhibited significant ($P < 0.05$) altitudinal variations and the foliages collected from 1980 m altitude showed significantly ($P < 0.05$) higher CF content compared to other altitudinal populations. There was significant ($P < 0.01$) positive correlation between CF and altitude of juvenile foliage, indicating increasing trend of CF with an increasing altitude (Table 3).

4. Discussion

The nutritive value of adult foliage of *Celtis* observed in the present study was well within the range as reported by Singh (1982), Verma et al. (1992), Negi and Todaria (1994) and Subba et al. (1994). Significant provenance variation in chemical contents of *Albizia lebbek* foliage has also been reported, which supports to the present findings (Kumar and Toky, 1994). In the present study, significant positive correlation between CP and altitude was recorded. Morecroft et al. (1992a) also reported that nitrogen concentration in plants increased with altitudinal gradient which supports the present findings and the variations in nitrogen content may partly be attributed to re-translocation of leaf nitrogen into branches before leaf fall and partly due to a dilution factor with expansion and maturity of the leaves (Khosla et al., 1992).

In general, CP content has been reported to be the most important nutrient (Negi, 1986). Higher level of crude protein in young leaves of *Celtis* was recorded which decreased with leaf maturation. A similar pattern of variation in protein content with the season was also reported by earlier workers in the foliage of *C. australis* (Wood et al., 1995; Subba et al., 1994) and *Grewia optiva* (Khosla et al., 1980). A detailed study on six fodder trees of the Central Himalaya, India also suggested that early successional fast growing tree species like *Celtis* has much greater content of protein in leaves (16.97%) than late successional slow growing species (Khosla et al., 1992).

Significant ($P < 0.05$) provenance variations have been noticed for P content among the foliages. There was significant ($P < 0.01$) positive correlation between P content and altitude of foliage. Likewise K in the foliage showed significant ($P < 0.05$) altitudinal variations. Therefore, significant ($P < 0.05$) positive correlation between K content and altitude of foliage. Ca contents in the foliage of high altitude populations was also significantly ($P < 0.05$) higher than those of low altitude provenances. Significant ($P < 0.01$) positive correlation between Ca content and altitude of adult and juvenile foliages was recorded (Table 3).

Very few studies are available on concentration of P, K and Ca of foliages along an altitudinal gradient. However, the high altitude species of *Alps* showed higher concentration of P (Korner, 1989), which supports to the present findings. Butola (2004) also reported significant seasonal variations in the concentration of minerals in the *Celtis* foliage.

Data on SS exhibited significant ($P < 0.05$) altitudinal variations. There was significant ($P < 0.01$) inverse correlation between SS content and elevational range of foliage, indicating decreasing trend of sugars with increasing altitude. Significant altitudinal variations for the starch content of adult and juvenile foliages were also recorded. There was significant ($P < 0.05$) positive correlation between starch content and altitude of foliage. TP contents also showed significant ($P < 0.05$) altitudinal variation between adult and juvenile foliages of different provenances. However, there was insignificant association between phenolic content and altitude of provenances among the adult and juvenile foliages (Table 2).

These variations in TP contents of adult and juvenile foliages of different provenances suggested that the level of secondary metabolites change with change in the altitude of plant origin. These findings are in conformity with earlier report of Khanduri and

Purohit (1981) in case of Himalayan *Berberis* spp. Mooney and Billings (1961) and Pekka et al. (2000) also reported that TP in foliage decreases with increasing altitude. Besides altitudinal variation, significant seasonal variations in chemical composition of *Celtis* foliage have been recorded and peak values of SS and TP have been observed during October-December (Butola, 2004).

So far no attempts have been made to compare the nutritive value of juvenile and adult foliage of *C. australis*. However, agronomic, biochemical and morphological parameters have been widely used in the evaluation of various promising agroforestry tree species including *Celtis* (Negi, 1986). From the present investigation, it is well understood that there is strong correlation between altitude and nutritive value of *Celtis*.

The present study suggests that altitude influenced significantly the chemical composition of *Celtis* foliage. Strong correlation was also recorded for chemical composition of adult and juvenile foliage. On average, high altitude foliage (Badiyargaon population-1980 m asl) exhibited comparatively higher values for CP, Ca and K whereas, the foliages of low altitude (550 m asl) revealed higher value for P, SS and DM content. Based on the present findings, we recommend that the high altitudinal populations could be selected for multiplication of *Celtis* for obtaining the nutritionally superior fodder.

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9/9/2009

Theoretical study of combustion efficiency in an Otto engine

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Abstract: Multi-irreversibilities, mainly resulting from the adiabatic processes, finite-time processes and heat transfer loss, are considered in the cycle model of an Otto heat engine. The relations between the power output and the compression ratio, between the thermal efficiency and the compression ratio, and the optimal relation between power output and the efficiency of the cycles are derived. The performance characteristic curves of the cycle are presented. Moreover, the effects of combustion efficiency on the cycle performance are analyzed. The results show that the effect of the combustion efficiency on the cycle performance is significant. The results obtained may provide a theoretical basis for both the optimal design and operation of real Otto heat engines. [Journal of American Science 2010;6(2):113-116]. (ISSN: 1545-1003).

Key words: combustion efficiency; Otto cycle; internal irreversibility; performance

1. Introduction

A study of gas cycles as the models of internal combustion engines is useful for illustrating some of the important parameters influencing engine performance. In the last two decades, by using finite time thermodynamics theory, many optimization studies based on various performance criteria have been carried out for endoreversible and irreversible heat engine models (Chen et al., 2008; Ge et al., 2008a; Ebrahimi, 2009a). Mozurkewich and Berry (1982) used mathematical techniques, developed in optimal-control theory, to reveal the optimal motions of the pistons in Otto cycle engines. Leff (1987) showed that some model engines (e.g., Otto, Diesel, Joule-Brayton, and Atkinson), operating reversibly without any loss at maximum work output per cycle, have efficiencies equal to, or well approximated by, the Novikov–Chambadal–Curzon–Ahlborn (NCCA) efficiency. Wu and Blank (1993) also optimized the endoreversible Otto cycle with respect to both net power output and mean effective pressure. Bera and Bandyopadhyay (1998) studied the effect of combustion on the thermoeconomic performances of Otto and Joule–Brayton engines. Gonzalez et al. (2000) derived the maximum irreversible work and efficiency of the Otto cycle by considering the irreversible adiabatic processes with the compression and expansion efficiencies. Fischer and Hoffman (2004) concluded that a quantitative simulation of an Otto-engine's behavior can be accurately achieved by a simple Novikov model with heat leaks. Chen et al. (2003, 2004) determined the characteristics of power and efficiency for Otto and Dual cycles with heat transfer and friction losses. Ozsoysal (2006) gave the valid ranges of the heat transfer loss parameters of the Otto and diesel cycles with consideration of the heat loss as a percentage of the fuel's energy. Hou (2007) compared the performances of air standard Atkinson and Otto cycles with heat transfer loss considerations. Ge et al. (2008a; 2008b; 2009) analyzed the performance of an air standard Otto, Diesel and dual cycles. In the irreversible cycle model, the non-linear relation between the specific heat of the working fluid and its temperature, the friction loss computed according to the mean velocity of the piston, the internal irreversibility described by using the compression and expansion efficiencies, and the heat transfer loss are considered.

As can be seen in the relevant literature, the investigation of the effect of combustion efficiency on performance of Otto cycle does not appear to have been published. Therefore, the objective of this study is to examine the effect of combustion efficiency on performance of air standard Otto cycle.

2. An air standard Otto cycle model

An air-standard Otto cycle model is shown in Fig. 1. Process $1 \to 2s$ is a reversible adiabatic compression, while process $1 \to 2$ is an irreversible adiabatic process that takes into account the internal irreversibility in the real compression process. The heat addition is an isochoric process $2 \to 3$. Process $3 \to 4s$ is a reversible adiabatic expansion, while $3 \to 4$ is an irreversible adiabatic process that takes into account the internal irreversibility in the real expansion process. The heat rejection is an isochoric process $4 \to 1$. The total reversible power output per second is

$$P_{otto} = Q_{23} - Q_{41} = \dot{m}_t c_v (T_3 - T_2) - \dot{m}_t c_v (T_4 - T_1) = \frac{R_{air} \dot{m}_t}{\gamma - 1}(T_1 - T_2 + T_3 - T_4) \quad (1)$$

where $\dot{m}_t$ is the mass flow rate of the air–fuel mixture, R_{air} is the gas constant, c_v is the specific heat at constant volume for the working fluid, T is the

absolute temperature and γ is the specific heat ratio, $\gamma = c_p / c_v$.

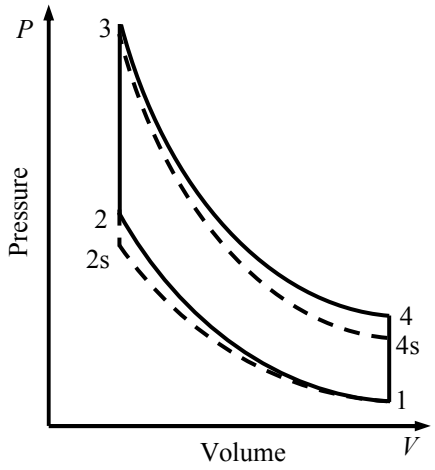

Figure1. $P-V$ diagram for the air standard Otto cycle

The compression ratio, r_c , is defined as:

$$r_c = V_1 / V_2 \tag{2}$$

where V is the volume of the gas in the cylinder.

For the processes $1 \to 2s$ and $3 \to 4s$, we have

$$T_{2s} = T_1 r_c^{\gamma-1} \tag{3}$$

and

$$T_{4s} = T_3 r_c^{1-\gamma} \tag{4}$$

For the two reversible adiabatic processes $1 \to 2s$ and $3 \to 4s$, the compression and expansion efficiencies can be defined as (Ge et al., 2008a):

$$\eta_c = (T_{2s} - T_1)/(T_2 - T_1) \tag{5}$$

and

$$\eta_e = (T_4 - T_3)/(T_{4s} - T_3) \tag{6}$$

When the total energy of the fuel is utilized, the maximum cycle temperature reaches undesirably high levels with regard to structural integrity. Hence, engine designers intend to restrict the maximum cycle temperature. The total energy of the fuel per second input into the engine can be given by:

$$Q_{fuel} = \eta_c \dot{m}_f Q_{LHV} \tag{7}$$

The heat loss through the cylinder wall is given in the following linear expression (Chen et al., 2008)

$$Q_{ht} = \dot{m}_t B(T_2 + T_3) \tag{8}$$

where B is constant.

Since the total energy of the delivered fuel Q_{fuel} is assumed to be the sum of the heat added to the working fluid Q_{in} and the heat leakage Q_{ht} .

$$Q_{in} = Q_{fuel} - Q_{ht} = \eta_c \dot{m}_f Q_{LHV} - \dot{m}_t B(T_2 + T_3) \tag{9}$$

The relation between $\dot{m}_f$ and $\dot{m}_t$ is defined as (Heywood, 1988):

$$\dot{m}_t = \dot{m}_f \left(1 + \frac{1}{(m_a / m_f)_s \phi} \right) \tag{10}$$

where ϕ is the equivalence ratio, m_a / m_f is the air–fuel ratio and the subscript s denotes stoichiometric conditions.

The thermal efficiency of the Otto cycle engine is expressed by

$$\eta_{th} = P_{otto} / Q_{in} \tag{11}$$

Where

$$Q_{in} = \frac{R_{air} \dot{m}_t}{\gamma - 1}(T_3 - T_2) \tag{12}$$

Notice that both power and efficiency are convex functions of the compression ratio.

When r_c , η_c , η_e and T_1 are given, T_{2s} can be obtained from Eq. (3), then, substituting T_{2s} into Eq. (5) yields T_2 . T_3 can be deduced by substituting Eq. (9) into Eq. (12). T_{4s} can be found from Eq. (4), and T_4 can be deduced by substituting T_{4s} into Eq. (6). Substituting T_1 , T_2 , T_3 and T_4 into Eqs. (1) and (11), respectively, the power output and thermal efficiency of the Otto cycle engine can be obtained. Therefore, the relations between the power output, the thermal efficiency and the compression ratio can be derived.

3. Numerical examples and discussions

As it can be concluded from Eqs. (1) and (18), the efficiency and the net power output of the Otto cycle are dependent on the combustion efficiency. In order to illustrate the effect of this parameter, the relations between the power output and the compression ratio, between the thermal efficiency and the compression ratio, and the optimal relation between power output and the efficiency of the cycles presented in Figs. 2–4. According to references (Chen et al. 2006; Ozsoysal, 2006; Ge et al., 2009; Ebrahimi, 2009b), the following parameters are used: $\eta_e = 0.97$, $\eta_c = 0.97$, $\dot{m}_f = 0.001 kg/s$, $\gamma = 1.4$, $B = 0.728 kJ/kg\,K$, $Q_{hv} = 45000 kJ/kg$, $T_1 = 300 K$, $\eta_c = 80 \to 100\%$, $r_c = 1 \to 100$, $(m_a / m_f)_s = 14.5$ and $\phi = 1$.

Figures 2–4 show the effects of the combustion efficiency on the power output and the thermal efficiency of the cycle with heat resistance and internal irreversibility. From these figures, it can be found that the combustion efficiency plays an important role on the power output and the thermal efficiency. They reflect the performance characteristics of an Otto cycle engine.

The variations of the power output with respect to the compression ratio and the combustion efficiency are indicated in Figure 2. One can see that the power output versus the compression ratio characteristic is parabolic

like curve. In other words, there is a maximum power output in the range of compression ratio. With increasing combustion efficiency, the maximum power output, the working range of the cycle and the compression ratio at the maximum power output increase. Therefore, it can be resulted that the effect of combustion efficiency on the power output of the cycle is related to compression ratio. It should be noted that the increase of the value of maximum power output with increasing combustion efficiency is due to the increase in the ratio of the heat added to the heat rejected. In this case, when combustion efficiency increases by about 20%, the maximum power output, the compression ratio at the maximum power output point and, the working range of the cycle increase by about 32%, 26.6% and 42.8% , respectively.

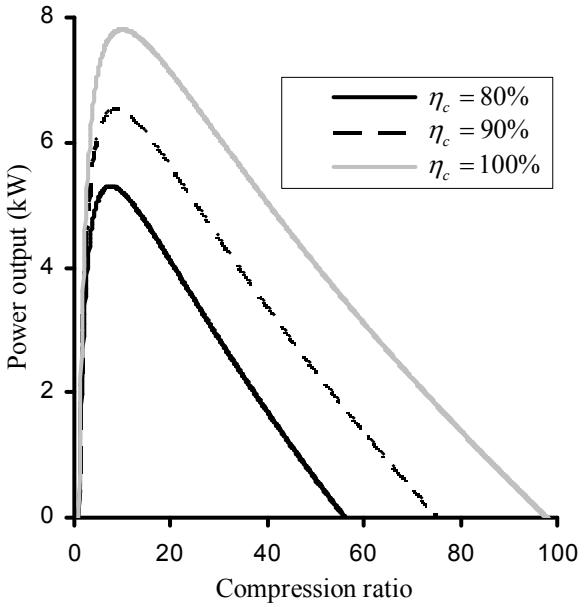

Figure 2. Effect of combustion efficiency on the variation of the power output with compression ratio

Figure 3 shows the effect of combustion efficiency on thermal efficiency with respect to the compression ratio. It can be seen that the thermal efficiency versus the compression ratio characteristic is parabolic like curve. In other word, the thermal efficiency increase with increasing compression ratio, reach their maximum values and then decrease with further increase in compression ratio. With increasing combustion efficiency, the maximum thermal efficiency and the compression ratio at the maximum thermal efficiency increase. Therefore, it can be resulted that the effect of combustion efficiency on the thermal efficiency of the cycle is related to compression ratio. It should be noted that the increase of the value of maximum thermal efficiency with increasing combustion efficiency is due to the increase in the ratio of the heat added to the heat rejected. Numerical calculation shows that when combustion efficiency increases by about 20%, the maximum thermal efficiency and the compression ratio at the maximum thermal efficiency increase 38% and 7.3%, respectively.

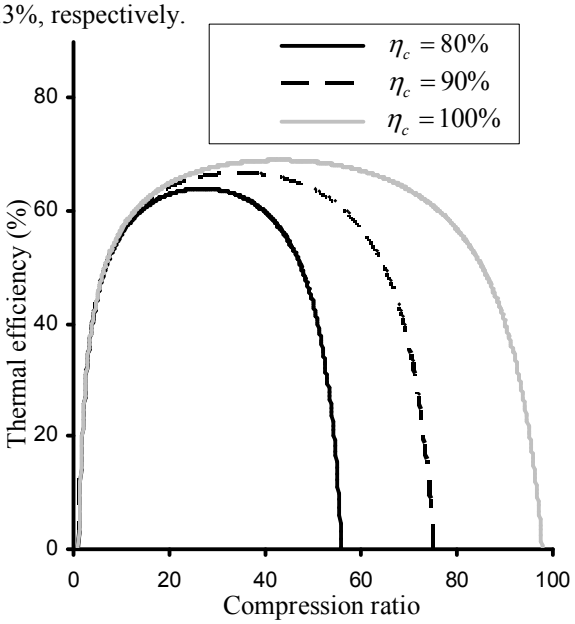

Figure 3. Effect of combustion efficiency on the variation of the thermal efficiency with compression ratio

Figure 4 shows the effects of the combustion efficiency on the power output versus the thermal efficiency characteristic. The power output versus thermal efficiency characteristics exhibit loop shaped. From the figure, it is found that the parameter combustion efficiency has a significant influence on the power output versus thermal efficiency characteristic. They show that the maximum power output point and the maximum efficiency point are very adjacent. When combustion efficiency increases, the efficiency at the maximum power output point, as well as the power output at the maximum efficiency point, will also increase. If combustion efficiency increases by about 20%, the optimal power output corresponding to maximum efficiency and the optimal thermal efficiency corresponding to maximum power output increase by about 30% and 8.4%, respectively.

According to the above analysis, it can be concluded that the effects of the combustion efficiency on the cycle performance are significant, and should be considered carefully in practical-cycle analysis and design.

4-Conclusion

In this paper, the effect of combustion efficiency on the performance of an Otto cycle during the finite time is investigated. The relations between net power output, efficiency, compression ratio, and the combustion

efficiency are derived. The maximum power output and the corresponding efficiency and the maximum efficiency and the corresponding power output are also calculated. The detailed effect analyses are shown by one numerical example. The results can provide significant guidance for the performance evaluation and improvement of real Otto engines.

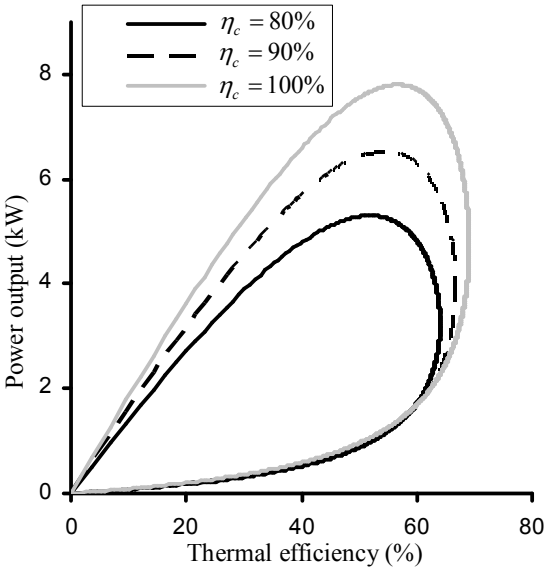

Figure 4. Effect of combustion efficiency on the variation of the power output with thermal efficiency

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9/9/2009

Nutrient Status and Economic Analysis of Soils in Oak and Pine Forests in Garhwal Himalaya

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Abstract: The soils of two forest types i.e., oak (*Quercus leucotrichophora* A. Camus) and pine (*Pinus roxburghii* Sargent) were analysed for physico-chemical properties and economic analysis. The collected soil samples from both the forests were analysed for texture, water holding capacity, pH, potassium, phosphorus and nitrogen. The results show that the higher percent of moisture and water holding capacity was in oak forest and lower in pine forest. The forest types indicate that the soil of oak forest was acidic and slightly acidic to pine forest. The average SOC in oak forest was 2.19% followed by 1.63% in pine. The nitrogen for oak and pine forests was 0.15 and 0.19% respectively. The available phosphorus in oak forest was higher (17.99 kg ha^{-1}) than in pine forest (16.88 kg ha^{-1}). The exchangeable potassium was 188.92 kg ha^{-1} in oak forest and 166.43 kg ha^{-1} in pine forest. The total nutrients generated by soils, as an ecosystem service in oak and pine forests were calculated for market costs. The total market cost of nutrients in oak was 1372.00 Rs ha^{-1} and in pine 1227.50 Rs ha^{-1}. The maximum contribution among the nutrients was of potassium followed by phosphorus and nitrogen in both the forests. The results of the paper conclude that soil is the principal source of ecosystem services which is generating number of other services. Oak forest are rich in nutrients than pine forest. Thus, oak forest should be preferred to protect, enhance their nutrients level for enhancing the forest ecosystem services. [Journal of American Science 2010;6(2):117-122]. (ISSN: 1545-1003).

Keywords: Soil, physico-chemical, oak, pine, nutrients status, economic analysis.

1. Introduction

Forest soils influenced the composition of forest stand and ground cover, rate of tree growth, vigour of natural reproduction and other silviculturally important factors (Bhatnagar, 1968). Physico-chemical characteristics of forest soils vary in space and time because variation in topography, climate, weathering processes, vegetation cover, microbial activities (Paudel and Sah, 2003) and several other biotic and abiotic factors. Vegetation also plays an important role in soil formation (Champan and Reiss, 1992). The yearly contribution of surface vegetation to soil, in the form of needles, leaves, cones, pollen, branches and twigs, gradually decomposes and becomes a part of the soil (Singh and Bhatnagar, 1997). The nutrient thus, returned in the soil, exerts a strong feed back on the ecosystem processes (Pastor et al., 1984). Plant tissues (above and below ground litter) are the main source of soil organic matter, which influences the physico-chemical characteristics of soil such as, texture, water holding capacity, pH and nutrients availability (Johnston, 1986). Nutrients supply varies widely among ecosystems (Binkly and Vitousek, 1989), resulting in differences in plant community structure and its production (Ruess and Innis, 1977).

Oak is a moderate sized to large evergreen tree occurs in the moist and cool aspects in the western Himalaya between at an altitudes of 800 to 2300 m asl. It is a principal species of the lower west Himalayan temperate forests (Luna, 2005). Pine is the most common resin producing species of India. It is a large evergreen conifer and a principal species of the Himalayan sub-tropical forests (Champion and Seth, 1968).

The nature of soil profile, pH and nutrient cycling between the soils and trees are the important dimensions to determine the site quality. The vegetation influences the physico-chemical properties of the soil to a great extent. It improves the soil structure, infiltration rate and WHC, hydraulic conductivity and aeration (Ilorkar and Totey, 2001; Kumar et al., 2004). With the help of available literature the present study was carried out with the hypothesis that; 1.How oak and pine forests soils differ in physiochemical properties. 2. How economically (Rs) the nutrient (NPK) varies with the local market cost between the forests.

2. Materials and Methods

2.1. Study site

Two dominant forest cover types i.e., oak (1600-2200 m asl) and pine (600-1200 m asl)), were selected in the District Tehri Garhwal of Uttarakhand (located between 30^0 18' 15.5" to 30^0 20' 40"N and 78^0 40' 36.1" to 78^0 37' 40.4" E). Each forest type was categorized on different altitude i.e., 1600-1800 m asl (site-I), 1800-2000 m asl (site-II) and 2000-2200 m asl (site-III) and pine forest; 600-800 m asl (site-I), 800-1000 m asl (site-II) and 1000-1200 m asl (site-

III) Table-1 for the study. The climate of the area is quite distinct in a year and represents three different seasons i.e., winter, summer and rainy. The mean maximum temperature ranges from 12.8^{0}C (December) to 32^{0}C (June) and mean minimum between 4^{0}C (December) to 16^{0}C (June). The mean relative humidity varies from 35% (May) to 92% (August).

Table 1. Site characteristics

Forest Types	Site	Altitude (m asl)
Quercus leuctrichophora	I (1)	1600-1800
	II (2)	1800-2000
	III (3)	2000-2200
Pinus roxburghii	I (1)	600-800
	II (2)	800-1000
	III (3)	1000-1200

2.2. Methods

The soil characteristics were analysed by collecting samples from three different depths i.e., 0-10, 10-20 and 20-30 from each site in both the forests. A total of 6 forest sites, three each in oak and pine forest type were selected and thus total 54 samples were collected. The moisture (%), water holding capacity (WHC) and texture of soil was determined as the methods described by Misra (1968). Soil pH (1:2.5 ratio of soil: water) was measured with dynamic digital pH meter. Soil organic carbon (SOC) was determined by partial oxidation method (Walkley and Black, 1934). Total nitrogen content determined using of the Kjeldal methods (Jackson, 1958) and phosphorus (P) and potassium (K) by flame photometer methods (Jackson, 1958). The nutrients status was compared among the sites and between the forests. The economic analysis of nutrients (NPK) was estimated per kilogram basis of current market value (Rs kg^{-1}), which was assessed from the local market in the form of nutrients sold in the market. Urea containing only (46%) of nitrogen, so the value (Rs) of urea was converted as per the % of nitrogen available in urea.

3. Results and Discussion

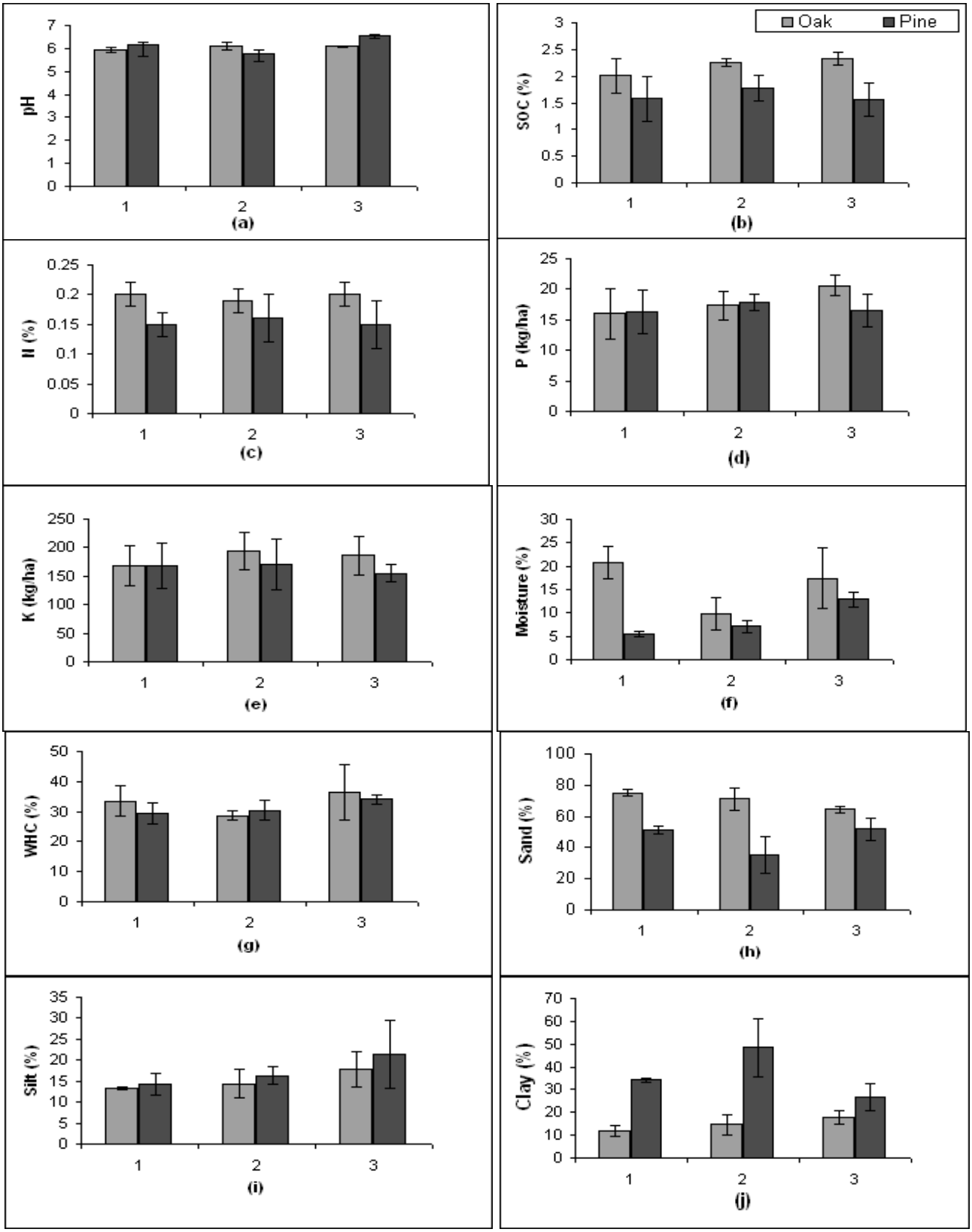
In oak forest**,** among the physical properties the moisture content ranged from 17.73 % to 24.50 %, 6.22 to 13.18 and 9.89 to 21.79 for site-I , site II and site III respectively. WHC on site II increased with increasing depths however, the trend was altered on site III where higher amount of moisture was in upper layer and decreased with depths, whereas on site I there was no fixed trend. The mean proportion ranged for sand, silt and clay in oak forest was 74.93 to 64.48, 17.82 to 13.28 and 11.77 to 17.67 respectively. The soil of oak forest was sandy loam. The pH values on all sites and depths ranged 5.80 to 6.27 which indicated the soil was acidic to slightly acidic in nature (Fig 1a). The SOC (%) ranged from 1.65 on site I to 2.43 on site III (Fig.1b). It was interesting to note that the SOC was reduced with increasing elevations. The ranged values of nitrogen (%) on all the sites were 0.18 to 0.23 (Fig.1c). Phosphorus 12.52 to 22.25 kg ha^{-1} (Fig.1d) and potassium 128.20 to 225.76 kg ha^{-1} (Fig.1e).

Similarly in the pine forest the moisture (%) on depths ranged from 4.70 to 6.0, 6.35 to 8.63 and 12.08 to 13.62 which have no definite trend in the depths but with the altitudes the mean moisture percent increases in order of 5.43 %, 7.11 and 12.88, for site I, site II and site III (Fig.1f) respectively. WHC also increased with increasing elevation. The average WHC on the site was 31.28 %. The average proportion of sand, silt and clay on all the sites and depths were 46.20, 17.35 and 36.42 % respectively. The soil was clay to sandy clayey loam. The pH values ranged 5.42 to 6.71 and average was 6.16. The average SOC on all sites and depths was 1.63 %. Similarly the average values of nitrogen, potassium, phosphorus were 0.15 %, 16.88 kg ha^{-1} and 164.22 kg ha^{-1} respectively.

Between the forests, *Q. leucotrichophora* was the dominant on all sites in oak forest. The associated reported species were *Rhododendron arboreum, Myrica esculenta, Lyonia ovalifolia, Prunus cerasoides Pyrus pashi* etc. The important noticed shrubs were *Pyracantha crenulata, Berberis asiatica, Rubus ellipticus Prinsepia utilis* etc. Similar association of species for oak dominated forests of Garhwal Himalaya was also reported by Bhandari et al. (2000) and Kumar et al. (2004).

Pinus roxburghii is one of the important timber and resin yielding species of Garhwal Himalaya. The people of this area used pine forest land for grazing and collect grasses for their cattle feed. Similar importance of pine forest also reported for Himachal Pradesh in India (Gupta and Dass 2007). In the pine dominated forest the main grasses were *Heteropogon contortus, Chrysopogon montanus, Apluda mutica, Themeda anathera, Lespideza gerardiana Micromeria biflora, Imperata cylinderica Cyperus* spp. Etc. Between oak and pine forests, the higher amount of moisture (Fig. 1f) was in oak forest due to dense and closed canopied forest compared to pine.

Oak forests were characteristically are moist (Saxena and Singh, 1980), fire free (Champion and Seth, 1968) and closed canopied (Saxena, 1979). Similar as moisture, WHC (Fig. 1g) was also higher in oak forest, because dense canopy of oak produced the higher amount of litter which influenced the texture of soil result in, higher water retention capacity.



Figures: (1a to 1j) represents the physico-chemical properties of soil in oak and pine forests for Site, 1, 2 & 3.

Among the chemical properties, soil of oak forest was acidic and pine slightly acidic in nature (Fig.1a). The acidic nature of soil is also reported by several other workers for oak dominated and oak-pine mixed forests of Garhwal Himalaya (Bhandari, *et al.*, 2000; Dhanai, *et al.*, 2000; Kumar, *et al.*, 2004). The average SOC (Fig. 1b) was higher in oak forest (2.19 %) followed by pine (1.63 %). The higher SOC in oak could be due to closed canopied forest result in higher inputs of litter which enriches SOC. The lower SOC in pine forest is good indicator of wide spacing of trees which provide low inputs of leaf litter to the soil. The ranged values of nitrogen for oak and pine forests were 0.15 to 0.19 % (Fig. 1c). The nitrogen values reported (0.10 to 0.20 %) for temperate forest of Garhwal Himalaya (Kumar *et al.*, 2004) were close to this study. Phosphorus (Fig. 1d) was also higher (17.99 kg ha^{-1}) compared to pine forest (16.88 kg ha^{-1}). Potassium (Fig. 1e) was 188.92 kg ha^{-1} in oak forest and 166.43 kg ha^{-1} in pine forest. The values of phosphorus and potassium in oak and pine forests were comparable as reported by Bhandari et al. (2000) as 14.40 to 21.60 kg ha^{-1} and Kumar et al. (2004) as 9.3 to 18.2 kg ha^{-1} for phosphorus. Bhandari et al. (2000) also reported potassium ranged of 170.8 to 295.4 kg ha^{-1} for Garhwal Himalayan oak forests. Kumar et al. (2006) studied soil on different aspects and reported range values of soil pH (6.33 to 6.47), SOC (0.47 to 0.68 %), phosphorus (9.67 to 10.67 kg ha^{-1}) and potassium (141.87 to 172.48 kg ha^{-1}).

The economic analysis of nutrients in term of money have been analysed with current available market value for the year 2007 for oak (Fig. 2a) and pine (Fig. 2b) soil nutrients. The available form of NPK in market was, urea, diammonium phosphate (DAP) and potash respectively, with market price of rupees 12.80 Rs Kg^{-1} (urea), 12.50 Rs Kg^{-1} (DAP) and 6.00 Rs Kg^{-1} (potash). The amount of nutrients in oak (Fig 3a) was 1.96 kg ha^{-1} (N), 17.99 kg/ha kg ha^{-1} (P) and 188.92 kg ha^{-1} (K) and estimated market cost for NPK for the available nutrients was 25.0 Rs ha^{-1}, 225.0 Rs ha^{-1} and 133.50 Rs ha^{-1} respectively. Similarly in pine (Fig. 3b) the available NPK nutrients were 1.53 kg ha^{-1}, 16.88 kg ha^{-1} and 166.00 kg ha^{-1} respectively and the market cost was rupees 19.50 Rs ha^{-1} (N), 212.00 Rs ha^{-1} (P) and 996.00 Rs ha^{-1} (K).

4. Conclusion

The results of the paper conclude that oak forests are rich in the nutrients availability than pine. Therefore, oak forests wherever present should be protected and enhanced its plantation in pine forest also to enrich soil nutrient supply.

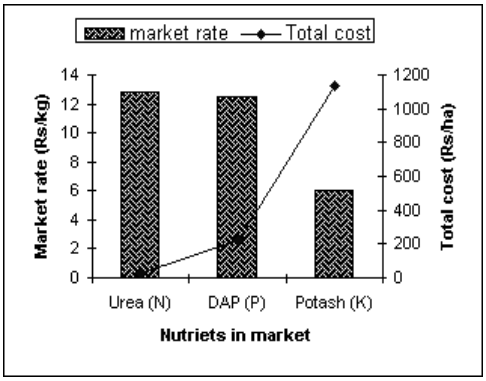


Figure: 2a

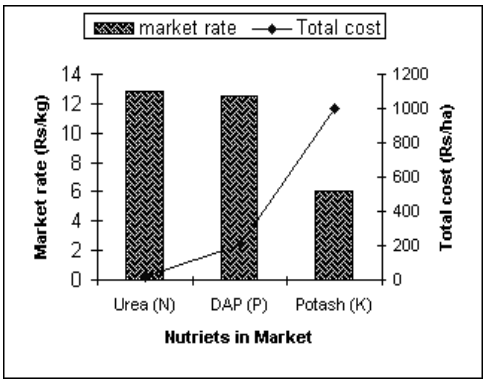


Figure.2b

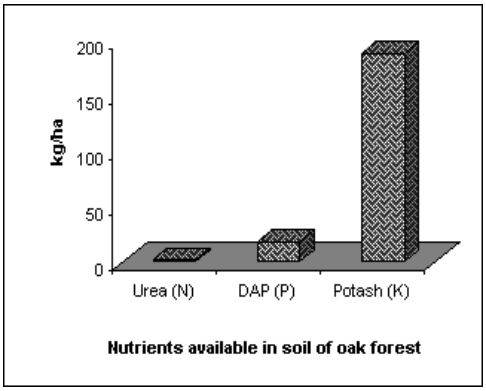


Figure.3a

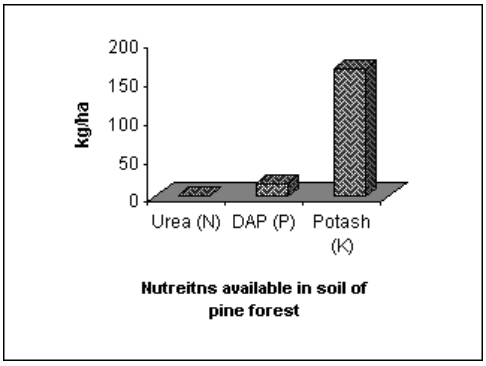


Figure.3b

Oak is the main source of basic requirement to the villagers in form of timber, litter and many other requirements. The excess lopping of forests and surface burning by fire in pine reduced considerable input of nutrients in the forest floor. Thus these nutrients services can be maintained/enhanced through proper management by reducing excess exploitation of forest litter especially for fodder, branch lopping and, surface burning.

5. Acknowledgement

Authors are thankful to Department of forestry HNB Garhwal University for providing laboratory facilities during the work.

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Haematological Profile of the African Lungfish, *Protopterus annectens* (Owen) of Anambra River, Nigeria

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Abstract: Haematological studies of the African lungfish, *Protopterus annectens* were carried out in order to establish a normal range of blood parameters which would serve as baseline data for assessment of the health status of the fish as well as reference point for future comparative surveys ..Blood parameters such as erythrocyte, leucocyte and thrombocyte counts, haemoglobin contents, Mean Corpuscular volume, Mean Corpuscular haemogbobin, Mean Corpuscular haemoglobin concentration, blood osmolality, pH, haematocrit, glucose, urea, uric acid, creatinine and ionic concentrations were determined in the various reproductive stages (fingerlings, juveniles, intermediates and adults) of *P. annectens.* Intraspecies haematological relationships in *P. annectens* indicated a high positive correlation between haematocrit and both erythrocyte counts and haemoglobin contents respectively in all sizes of *P. annectens;* with mean r –values of 0.860 and 0.843 ($p < 0.05$) for Hct/EC and Hct/Hb4 respectively. A number of factors which might influence haematological characteristics of *P. annectens* were discussed. [Journal of American Science 2010;6(2):123-130]. (ISSN: 1545-1003).

Key words: Haematology, Profile, African, Lungfish, Anambra River, Nigeria

1. Introduction

The African lungfish, *P. annectens* is a highly prized food fish in Nigeria (Otuogbai, 2001; Otuogbai and Ikhenoba, 2001). It is distributed in shallow parts of rivers and lakes of some West African countries ranging from Senegal to Cameroon where it contributes to a relatively high percentage of artisanal fisheries (Otuogbai, 2001; Otuogbai and Ikhenoba, 2001; Okafor 2004a). Intensive studies on the biology of *P. annectens* have just begun (Otuogbai, 2001; Otuogbai and Ikhenoba, 2001; Okafor and Chukwu, 2005a). However, only few studies have been carried out on the haematological characteristics of *P. annectens* (Okafor, 2004abcd; Okafor and Chukwu, 2005b).

The determination of haematological values of fishes are carried out for a variety of purposes: to establish a 'normal range' of blood parameters (Etim, *et al*., 1999), to investigate conditions that might lead to alterations of some of these values such as sampling methods, temperature, sex, maturity, disease condition or nutrition of the fish (Clarks *et al*., 1979; Barham *et al*., 1980) and to ascertain the effects of certain chemical pollutants (e.g. insecticide) and sublethal strength of some toxicants (such as heavy metals e.g. lead) on blood values (Mathiessen, 1981; Etim *et al*., 1999).

In the light of the above, it was considered worthwhile to undertake a study on some selected haematological parameters of various sizes of the African lungfish, *P. annectens* (fingerlings, juveniles, intermediates and large). This would form a baseline data for assessment of the health status of the fish as well as reference point for future comparative surveys.

2. Materials and Methods

Fish Samples

A total of 152 live specimens of the African lungfish, *P. annectens* comprising fingerlings (mean length 20.5cm ± 3.5, mean weight 50.5g ± 10.4), juveniles (mean length 32.5cm ± 6.0, mean weight 223.8g ± 15.3), intermediates (mean length 39.9cm ± 2.8; mean weight 380.2g ± 24.4) and large (mean length 48.7cm ± 3.5; mean weight 956.6g ± 32.6) were obtained from Anambra river at Otuocha in Anambra State, Nigeria. The fishes were transported to the Zoology laboratory of the University of Lagos, Lagos – Nigeria in plastic buckets (27 x 15cm) containing water got from Anambra river. In the laboratory they were acclimatized for three weeks during which they were provided daily with insect larvae, fish feed obtained from the Nigerian Institute of Oceanography and Marine Research (NIOMR) Victoria Island, Lagos as well as boiled rice and beans to avoid the possible effect of starvation on any of the haematological values.

Fish were examined for any sign of infection or disease condition (Obiekezie, 1988) and only those fishes considered to be healthy were used for the study.

Blood Collection

Blood was collected from the caudal blood vessels of the fishes using the method of Kori-Siakpere and Egor (1997).

Ethylene diamine tetracetic acid (EDTA) was the anti-coagulant employed, because unlike heparin, it did not cause the blood cells to shrink.

Blood Analysis

The Erythrocyte count (EC) was done in an Improved Neubauer haemocytometer following the method of Baker and Silverton (1982). The total Leucocyte count (TLC) was determined in the same Improved Neubauer haemocytometer (used for red cells) following the same method of Baker and Silverton (1982). The microhaematocrit method of Blaxhall and Darsley (1973) was employed in the determination of blood haematocrit. The haemoglobin content of blood samples was determined by cyanmethaemoglobin method (Wharton and McCarty, 1972; Blaxhall and Daisley, 1973). The Thrombocyte count (TC) was determined in an Improved Neubauer haemocytometer using a phase contrast microscope (Okafor and Chukwu, 2005b). The blood osmolality, ionic concentrations, and pH were determined using a Karl Kolb osmometer, flame photometer and pH metre respectively, following the method of Chukwu and Odiete, (1999). The blood urea, uric acid, creatinine and glucose levels were determined following the standard methods of Dyer 1965; Wharton and McCarty, 1972 and Brewer *et al*., 1974.

The haematological Indices: Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH) and Mean Cell Haemoglobin Concentration (MCHC) were calculated using the formula of Baker and Silverton (1982) given below:

$$\text{Mean Corpuscular Volume (MCV µm)} = \frac{\text{Haematocrit (\%) x 10}}{\text{Erythrocyte count (mm}^3\text{)}}$$

$$\text{Mean Corpuscular Haemoglobin (MCH pg)} = \frac{\text{Haematocrit (g\%) x 10}}{\text{Erythrocyte count (mm}^3\text{)}}$$

$$\text{Mean Corpuscular Haemoglobin Concentration (MCHC) \%} = \frac{\text{Haemoglobin (g\%) x 100}}{\text{Haematocrit (\%)}}$$

Statistical Analysis

Regression analyses were employed between the various parameters measured. The coefficient of regression (r) was checked for statistical significance by the student t-test at 0.05 level of significance (Zar, 1984).

3. Results

The haematological profile of *P. annectens* under normal conditions: erythrocyte, leucocyte and thrombocyte counts, haematocrit, haemoglobin contents, MCV, MCH, MCHC, pH, Osmolality, glucose, Urea, Uric acid, and Creatinine levels, Na^+ and K^+ concentrations are presented in Table 1.

The Erythrocyte, Leucocyte and Thrombocyte counts in the fingerlings ranged from 54,000 to 85,000mm^3, 1500 to 3700mm^3, and 7.8 to 15.0mm^3 respectively, while in the adult specimens they were 60,000 to 97,000 mm^3, 1400 to 1800mm^3 and 5.0 to 11.6mm^3 respectively (Table 1).

The mean blood levels of urea and uric acid in the fingerlings were 21 ± 2.6 and 0.2 ± 0.1 respectively, while in the adult specimens they were 45.1 ± 5.6 and 0.4 ± 0.2 respectively **(Table 1)**.

There is a high positive correlation between haematocrit and both erythrocyte counts and haemoglobin contents respectively in all sizes of *P. annectens;* with mean r –values of 0.860 and 0.843 ($p < 0.05$) for Hct/EC and Hct/Hb4 respectively **(Tables 2– 4)**.

High positive correlation was recorded between osmolality , urea and uric acid levels respectively in all sizes of *P. annectens* with mean r- values for Osmolality/urea, = 0.897, and Osmolality/uric acid, = 0.573 ($p < 0.05$) respectively **(Tables 2 – 4)**.

4. Discussion

The significance of fish haematology in disease aetiology of fishes cannot be over emphasized (Kori-Siakpere and Egor, 1997). It is also necessary to establish normal haematological characteristics of a particular species of fish which would serve as reference for future comparative studies.

Blaxhall and Daisley (1973) for instance, have reported the essence of using haematocrit to detect anaemic conditions in fishes. Several reported values for fish haematocrit fall between 20% and 35% and rarely do values above 50% been reported (Clarks *et al*., 1976; Etim *et al*., 1999). The mean haematocrit values for *P. annectens* of all sizes (fingerlings, juveniles, intermediates and large) fall within this range. That is 27.7%, 28.1%, 28.8% and 29.2% for fingerlings, juveniles, intermediates and large specimens of *P. annectens* respectively.

Das (1965) reported that both the haemoglobin contents and Erythrocyte counts tend to increase with length and age of the fish. In the present study, the haemoglobin contents and Erythrocyte counts of *P. annectens* were higher in the large and intermediate sized specimens than in the fingerlings and juveniles (Table 1). Preston (1960) also observed such similar findings in the Plaice, *Pleuronectes platessa*.

Table 1: The Normal Haematological Profile of *Protopterus annectens*

Size Group	Mean Total Length (cm)	Mean Body Weight (g)	Haematocrit (%)	Erythrocyte Count (mm^3)	Leucocyte Count (mm^3)	Thrombocyte Count (mm^3)	Haemoglobin contents (g%)	PH	Osmolality (mOsmol/l)	Glucose (mg/dl)	Urea (mg/dl)	Uric acid (mg/dl)	Creatinine (mg/dl)	Mean Corpuscular Volume (MCV) (µm)	Mean Corpuscular Haemoglobin (MCH) (pg)	Mean Corpuscular Haemoglobin Concentration (MCHC) (%)	Na+ (mg/l)	K+ (mg/l)
Fingerlings	20.5±3.5 (15.8-27.5)	50.5±10.4 (37.2-74.5)	27.7±1.9 (23.5-37.3)	60,000±5000 (54000-85,000)	2200±250 (1500-3700)	11.4±3.0 (7.8-15.0)	7.4±0.4 (7.1-8.7)	7.5±0.2 (7.2-7.8)	255±20.2 (230-320)	71±7.5 (60-95)	21±2.6 (18.0-27.0)	0.2±0.1 (0.1-0.3)	0.4±0.3 (0.2-0.8)	461.7±18.5 (346.8-501.5)	123.3±10.2 (98.5-168.2)	26.7±2.8 (23.1-32.3)	99.5±3.8 (95.2-108.6)	8.0±1.0 (7.8-9.5)
Juveniles	32.5±6.0 (24.5-39.0)	223.8±15.3 (80.0-250.0)	28.1±1.8 (24.1-38.2)	62,000±5000 (55,000-90,000)	20,00±220 (1400-2200)	9.3±2.9 (6.1-13.1)	7.4±0.4 (7.1-8.7)	7.5±0.2 (7.1-7.8)	249±18.8 (215-330)	68±8.5 (55.0-94.0)	27.4±3.4 (23.1-31.6)	0.3±0.2 (0.1-0.7)	0.4±0.3 (0.2-0.8)	453.2±17.6 (339.2-498.7)	119.4±9.6 (92.7-188.1)	26.3±2.4 (22.7-31.9)	99.6±6.2 (90.1-110.5)	8.2±1.3 (7.2-11.5)
Young Adults	39.9±2.8 (36.9-43.9)	380.2±24.4 (250-550)	28.8±2.1 24.4-33.1	64,000±5000 (55000-95000)	1750±150 (1400-2000)	9.2±2.8 (6.2-12.3)	7.5±0.4 (7.0-8.8)	7.5±0.2 (7.0-7.6)	241±20.6 (205-330)	67±12.0 (52-90)	29.6±5.1 (24.0-31.5)	0.3±0.2 (o.1-0.7)	o.8±0.2 (0.5-1.3)	450.0±16.7 (336.0-496.4)	117.2±8.8 (90.3-179.3)	26.0±2.2 (22.4-31.6)	100.4±4.6 (93.5-110.0)	8.6±1.1 (7.9-8.4)
Old adults	48.7±6.5 (43.0-60.9)	956.6±232.6 (550.0-1622.0)	29.2±2.2 (23.0-32.0)	69,000±5000 (60,000-97,000)	1700±160 (1400-1800)	8.3±3.2 (5.0-11.6)	7.5±0.4 (7.0-8.8)	7.5±0.2 (7.0-7.6)	239±21.1 (195-340)	65±8.8 (55-90)	45.1±5.6 (25.2-55.1)	0.4±0.2 (0.2-0.7)	0.8±0.4 (0.5-1.1)	423.2±16.2 (309.2-469.6)	108.7±8.4 (81.8-170.8)	25.7±1.7 (22.1-31.3)	100.2±4.8 (94.0-111.0)	8.4±0.9 (7.0-11.3)

Table 2: Intraspecies Haematological relationships in *Protopterus annectens* (p<0.05) (Finger lings)

	Total Length	Weight	EC	TLC	TC	Hct	Hb4	pH	Osmolality	MCV	MCH	MCHC	Glucose	Urea	Uric Acid	Creatinine	Na^+	K^+
Total Length																		
Weight	0,71																	
E C	0.75	0.61																
TLC	0.51	0.48	0,10															
TC	0.54	0.51	-0.38	0.15														
Hct	0.76	0.77	0.89	-0.10	-0.31													
Hb4	0.84	0.73	0.95	0.28	-0.09	0.83												
pH	0.09	-0.06	-0.07	-0.05	-0.08	-0.07	-0.10											
Osmolality	0.19	0.39	0.12	-0.09	0.10	0.05	-0.55	-0.50										
MCV	0.82	0.71	0.93	0.08	0.11	0.92	0. 78	-0.12	-0.21									
MCH	0.85	0.79	0.94	0.07	0.05	0.75	0.91	-0.11	-0.18	0.88								
MCHC	0.77	0.75	0.78	0.05	0.03	0.96	0.95	-0.08	-0.23	0.79	0.90							
Glucose	-0.63	0.22	0.18	0.14	0.11	0.17	0.20	0.06	0.55	0.09	0.08	0.10						
Urea	0.85	0.88	0.16	0.06	0.05	0.11	0.09	0.10	0.91	0.14	0.13	0.09	0.08					
Uric Acid	0.71	0.73	0.05	0.04	0.13	0.10	0.08	0.18	0.59	0.11	0.07	0.06	0.11	0.82				
Creatinine	0.58	0.56	0.03	0.04	0.06	0.09	0.08	0.11	0.49	0.20	0.16	0.09	0.10	0.68	0.66			
Na^+	-0.31	0.19	0.11	0.12	0.08	0.15	0.05	-0.68	0.53	0.09	0.08	0.11	0.06	0.33	0.28	0.19		
K^+	-0.23	0.18	0.16	0.15	0.05	0.10	0.09	-0.61	0.50	0.11	0.12	0.10	0.09	0.25	0.22	0.16	0.80	

EC = Erythrocyte count in million /mm^3
TLC = Total leucocyte count in thousand / mm^3
TC = Thrombocyte count in thousand / mm^3
Hct = Haematocrit (%)
Hb4 = Haemoglobin contents (g%)
MCV = Mean Corpuscular Volume (µm)
MCH = Mean Corpuscular Haemoglobin (g)
MCHC = Mean Corpuscular Haemoglobin Concentration (%)

urea in mg/dL
uric acid in mg/dL
Creatinine in mg/dL
Na^+ in mg/L
K^+ in mg/L
Glucose in mg/dL

Table 3: Intraspecies Haematological relationships in *Protopterus annectens* (at p<0.05) (juveniles)

	Total Length	Weight	EC	TLC	TC	Hct	Hb4	pH	Osmolality	MCV	MCH	MCHC	Glucose	Urea	Uric Acid	Creatinine	Na^+	K^+
Total Length																		
Weight	0,69																	
E C	0.71	0.63																
TLC	0.52	0.50	0,08															
TC	0.49	0.51	-0.37	0.13														
Hct	0.80	0.81	0.85	-0.06	-0.26													
Hb4	0.82	0.75	0.93	0.17	-0.09	0.84												
pH	0.07	-0.08	-0.09	-0.05	-0.08	-0.09	-0.09											
Osmolality	0.18	0.33	0.07	-0.10	0.09	0.07	-0.51	-0.53										
MCV	0.79	0.74	0.96	0.10	0.12	0.90	0. 78	-0.11	-0.20									
MCH	0.84	0.80	0.94	0.09	0.03	0.70	0.89	-0.08	-0.14	0.87								
MCHC	0.78	0.77	0.78	0.08	0.04	0.91	0.93	-0.06	-0.19	0.81	0.93							
Glucose	-0.58	0.21	0.15	0.18	0.09	0.12	0.16	0.05	0.55	0.09	0.09	0.09						
Urea	0.83	0.86	0.11	0.05	0.03	0.11	0.08	0.12	0.89	0.13	0.13	0.07	0.08					
Uric Acid	0.75	0.69	0.09	0.08	0.12	0.10	0.09	0.11	0.57	0.12	0.08	0.06	0.10	0.83				
Creatinine	0.55	0.56	0.05	0.09	0.06	0.09	0.10	0.10	0.50	0.18	0.19	0.08	0.09	0.69	0.68			
Na^+	-0.30	0.18	0.11	0.11	0.09	0.16	0.05	-0.67	0.59	0.10	0.12	0.09	0.07	0.38	0.30	0.15		
K^+	-0.29	0.20	0.15	0.15	0.07	0.09	0.10	-0.63	0.48	0.10	0.08	0.10	0.09	0.22	0.27	0.16	0.78	

EC = Erythrocyte count in million /mm^3
TLC = Total leucocyte count in thousand/mm^3
TC =Thrombocyte count in thousand / mm^3
Hct = Haematocrit (%)
Hb4 = Haemoglobin contents (g%)
MCV = Mean Corpuscular Volume (µm)
MCH = = Mean Corpuscular haemoglobin (pg)
MCHC = Mean Corpuscular haemoglobin Concentration (%)
Glucose in mg/dL
Urea in mg/dL
Uric acid in mg/dL
Creatinine in mg/dL
Na^+ in mg/L
K^+ in mg/L

Table 1: Intraspecies Haematological relationships in *Protopterus annectens* (at p<0.05) (adults)

	Total Length	Weight	EC	TLC	TC	Hct	Hb4	pH	Osmolality	MCV	MCH	MCHC	Glucose	Urea	Uric Acid	Creatinine	Na^+	K^+
Total Length																		
Weight	0,74																	
E C	0.64	0.66																
TLC	0.60	0.52	0,08															
TC	0.51	0.56	-0.41	0.20														
Hct	0.79	0.75	0.84	-0.10	-0.32													
Hb4	0.88	0.83	0.90	0.25	-0.10	0.86												
pH	0.10	-0.05	-0.07	-0.05	-0.08	-0.08	-0.09											
Osmolality	0.21	0.35	0.11	-0.09	0.09	0.08	-0.53	-0.54										
MCV	0.80	0.73	0.93	0.09	0.10	0.92	0. 77	-0.11	0.20									
MCH	0.84	0.78	0.96	0.08	0.06	0.76	0.88	-0.10	-0.16	0.90								
MCHC	0.79	0.73	0.81	0.06	0.03	0.94	0.93	-0.07	-0.22	0.76	0.86							
Glucose	-0.59	0.18	0.17	0.10	0.11	0.15	0.19	0.08	0.52	0.08	0.08	0.09						
Urea	0.88	0.88	0.14	0.05	0.05	0.09	0.08	0.11	0.89	0.11	0.11	0.10	0.07					
Uric Acid	0.75	0.75	0.08	0.04	0.11	0.16	0.09	0.17	0.56	0.10	0.08	0.06	0.10	0.85				
Creatinine	0.54	0.49	0.06	0.05	0.06	0.08	0.09	0.08	0.50	0.18	0.19	0.08	0.10	0.67	0.65			
Na^+	-0.28	0.17	0.10	0.10	0.08	0.11	0.05	-0.63	0.58	0.10	0.12	0.11	0.08	0.37	0.30	0.16		
K^+	-0.32	0.18	0.20	0.13	0.09	0.10	0.10	-0.68	0.57	0.10	0.11	0.10	0.06	0.21	0.27	0.20	0.89	

EC = Erythrocyte count in million /mm^3
TLC = Total leucocyte count in thousand/mm^3
TC =Thrombocyte count in thousand / mm^3
Hct = Haematocrit (%)
Hb4 = Haemoglobin contents (g%)
MCV = Mean Corpuscular Volume (µm)
MCH = = Mean Corpuscular haemoglobin (pg)
MCHC = Mean Corpuscular haemoglobin Concentration (%)
Glucose in mg/dL
Urea in mg/dL
Uric acid in mg/dL
Creatinine in mg/dL
Na^+ in mg/L
K^+ in mg/L

Eisler (1965) had suggested that there was a correlation between haemoglobin concentration and activity of fish. The more active fishes tend to have high haemoglobin values than the more sedentary ones. Consequently, *P. annectens* being a relatively quiet and sedentary species (Okafor, 2006) has a slightly lower haemoglobin concentration than other more active African teleosts such as *Clarias buthupogon* whose mean hemoglobin concentration is as high as 9.88g/dL (Kori-Siakpere and Egor, 1997).

The blood urea and uric acid levels of the fingerlings and juveniles were slightly lower than those of intermediate and adult specimens because these fingerlings depend less on ureotelism and uricotelism as means of nitrogenous excretion than the adults.

The wide range of blood Osmolality observed in *P. annectens* is an indication of high degree of tissue tolerance and this of great value when encountering the estuarine or brackish water environment.

Acknowledgements

We wish to acknowledge the technical assistance given to us by Mr Bayo Adeluyi and Mrs I.A. Aderenle, of Zoology Department, as well as Mr Isaac Arukwe of the Department of Biochemistry, all of the University of Lagos, Nigeria. We are also grateful to Mr. Eddy Onuoha of the Department of Veterinary Microbiology and Pathology of the University of Nigeria, Nsukka-Nigeria for his own contributions toward the success of the study.

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14/09/2009

Effects of gasoline-air equivalence ratio on performance of an Otto engine

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Abstract: The effects of equivalence ratio on the performance of an Otto cycle during the finite time are investigated. In the cycle model, the friction loss computed from the empirical correlation, the specific heat ratio of the working fluid supposed constant, the internal irreversibility described by using the compression and expansion efficiencies, and the heat transfer loss are considered. The relations between the power output and the compression ratio, and between the thermal efficiency and the compression ratio are derived. Moreover, the effects of equivalence ratio on the cycle performance are analyzed. The results show that the power output, the thermal efficiency, the optimal compression ratio corresponding to maximum power output point, the optimal compression ratio corresponding to maximum thermal efficiency point and the working range of the cycle increase and then decrease as the equivalence ratio increases. [Journal of American Science 2010;6(2):131-135]. (ISSN: 1545-1003).

Key words: equivalence ratio; Otto cycle; internal irreversibility; performance

1. Introduction

A study of gas cycles as the models of internal combustion engines is useful for illustrating some of the important parameters influencing engine performance. In the last two decades, by using finite time thermodynamics theory, many optimization studies based on various performance criteria have been carried out for endoreversible and irreversible heat engine models [Sahin et al., 2002, Parlak et al., 2004; ebrahimi, 2009a]. Leff (1987) showed that some model engines (e.g., Otto, Diesel, Joule-Brayton, and Atkinson), operating reversibly without any loss at maximum work output per cycle, have efficiencies equal to, or well approximated by, the Novikov–Chambadal–Curzon–Ahlborn (NCCA) efficiency. Orlov and Berry (1993) deduced the power and efficiency upper limits for internal-combustion engines. They derived the maximum work or power and the corresponding efficiency bounds. Bera and Bandyopadhyay (1998) studied the effect of combustion on the thermoeconomic performances of Otto and Joule–Brayton engines. Ust et al., (2005) performed an ecological performance analysis for an irreversible Dual cycle by employing the new thermo-ecological criterion as the objective function. Parlak et al., (2005) optimized the performance of irreversible Dual cycle, gave the experimental results, and compared the performance of Dual and Diesel cycles under the maximum power output. Chen et al., (2003) determined the characteristics of power and efficiency for Otto cycle with heat transfer and friction losses. Ozsoysal (2006) gave the valid ranges of the heat transfer loss parameters of the Otto and diesel cycles with consideration of the heat loss as a percentage of the fuel's energy. Parlak and Sahin (2006) defined the internal irreversibility by using entropy production and analyzed the effect of the internal irreversibility on the performance of the irreversible reciprocating heat engine cycle. Ge et al., (2008) analyzed the performance of an air standard Otto cycle. In the irreversible cycle model, the non-linear relation between the specific heat of the working fluid and its temperature, the friction loss computed according to the mean velocity of the piston, the internal irreversibility described by using the compression and expansion efficiencies, and the heat transfer loss are considered.

As can be seen in the relevant literature, the investigation of the effect of equivalence ratio on performance of Otto cycle does not appear to have been published. Therefore, the objective of this study is to examine the effect of the equivalence ratio on performance of air standard Otto cycle.

2. Otto cycle model

An air-standard Otto cycle model is shown in figure 1. Process $1 \to 2s$ is a reversible adiabatic compression, while process $1 \to 2$ is an irreversible adiabatic process that takes into account the internal irreversibility in the real compression process. The heat addition is an isochoric process $2 \to 3$. Process $3 \to 4s$ is a reversible adiabatic expansion, while $3 \to 4$ is an irreversible adiabatic process that takes into account the internal irreversibility in the real expansion process. The heat rejection is an isochoric process $4 \to 1$. Assuming constant specific heats, the heat added to the working fluid and the heat rejected by the working fluid are defined as follows from the first law of thermodynamics (Heywood, 1988):

$$Q_{in} = \dot{m}_t c_v \left(T_3 - T_2\right) \quad (1)$$

and

$$Q_{out} = \dot{m}_t c_v \left(T_4 - T_1\right) \quad (2)$$

Therefore, the power output is

$$P_{otto} = Q_{in} - Q_{out} - p_{fri} = \dot{m}_t c_v \left(T_3 - T_2\right) - \dot{m}_t c_v \left(T_4 - T_1\right) - p_{fri} = \frac{R_{air}\dot{m}_t}{\gamma - 1}\left(T_1 - T_2 + T_3 - T_4\right) - p_{fri} \quad (3)$$

where $\dot{m}_t$ is the mass flow rate of the air–fuel mixture, R_{air} is the gas constant, c_v is the specific heat at constant volume for the working fluid, T is the absolute temperature, p_{fri} is the friction power and γ is the specific heat ratio, $\gamma = c_p / c_v$.

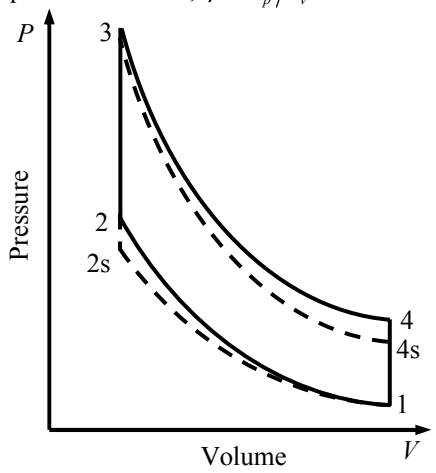

Figure 1. $P-V$ diagram for the air standard Otto cycle

The compression ratio, r_c , is defined as:

$$r_c = V_1 / V_2 \quad (4)$$

where V is the volume of the gas in the cylinder.

For the processes $1 \to 2s$ and $3 \to 4s$, we have

$$T_{2s} = T_1 r_c^{\gamma - 1} \quad (5)$$

and

$$T_{4s} = T_3 r_c^{1-\gamma} \quad (6)$$

For the two reversible adiabatic processes $1 \to 2s$ and $3 \to 4s$, the compression and expansion efficiencies can be defined as (Chen, 2004;Ebrahimi, 2009c):

$$\eta_c = \left(T_{2s} - T_1\right)/\left(T_2 - T_1\right) \quad (7)$$

and

$$\eta_e = \left(T_4 - T_3\right)/\left(T_{4s} - T_3\right) \quad (8)$$

Substituting equation (5) into equation (7) yields:

$$T_2 = \frac{T_1\left(r_c^{\gamma-1} + \eta_c - 1\right)}{\eta_c} \quad (9)$$

When the total energy of the fuel is utilized, the maximum cycle temperature reaches undesirably high levels with regard to structural integrity. Hence, engine designers intend to restrict the maximum cycle temperature. The total energy of the fuel per second input into the engine can be given by: (Heywood, 1988)

$$Q_{fuel} = \eta_{com}\dot{m}_f Q_{LHV} \quad (10)$$

The heat loss through the cylinder wall is given in the following linear expression (Chen et al., 2008)

$$Q_{ht} = \dot{m}_t B\left(T_2 + T_3\right) \quad (11)$$

where B is constant.

Since the total energy of the delivered fuel Q_{fuel} is assumed to be the sum of the heat added to the working fluid Q_{in} and the heat leakage Q_{ht} ,

$$Q_{in} = Q_{fuel} - Q_{ht} = \eta_{com}\dot{m}_f Q_{LHV} - \dot{m}_t B\left(T_2 + T_3\right) \quad (12)$$

The relations between $\dot{m}_a$ and $\dot{m}_f$, between $\dot{m}_a$ and $\dot{m}_t$ are defined as (Heywood, 1988):

$$\dot{m}_f = \frac{\dot{m}_a \phi}{\left(m_a / m_f\right)_s} \quad (13)$$

and

$$\dot{m}_t = \dot{m}_a\left(1 + \frac{\phi}{\left(m_a / m_f\right)_s}\right) \quad (14)$$

where ϕ is the equivalence ratio, m_a / m_f is the air–fuel ratio and the subscript s denotes stoichiometric conditions.

Combining equations (1) and (12) gives:

$$T_3 = \frac{\left(\eta_c \eta_{com} Q_{LHV}\right)/\left(\phi\left(m_a/m_f\right)_s\right) - T_1\left(r_c^{\gamma-1} + \eta_c - 1\right)\left(B + c_v\right)}{\eta_c\left(B + c_v\right)} \quad (15)$$

Substituting equations (15) and (6) into equation (8) yields:

$$T_4 = \left[\frac{\left(\eta_c \eta_{com} Q_{LHV}\right)/\left(\phi\left(m_a/m_f\right)_s\right) - T_1\left(r_c^{\gamma-1} + \eta_c - 1\right)\left(B + c_v\right)}{\eta_c\left(B + c_v\right)}\right]\left(r_c^{\gamma-1} + 1 - \eta_e\right) \quad (16)$$

The combustion efficiency, η_{com} , of a gasoline type fuel, such as octane, can be expressed in terms of equivalence ratio factor from measured data as (Abd Alla, 2002):

$$\eta_{com} = \eta_{com\,\max}\left(-1.6082 + 4.6509/\phi - 2.0764/\phi^2\right) \quad (17)$$

where the maximum possible value of the combustion efficiency, $\eta_{com\,\max}$, is typically 0.9 in a spark ignition engine using a gasoline fuel. The range of effective ϕ values spans normal spark ignition combustion, i.e., from about 0.83 to about 1.33.

The data of total motored friction mean effective pressure for several four stroke cycle, four cylinder spark ignition engines between 845 and 2000 cm^3 displacement, at wide open throttle, as a function of engine speed (Abd Alla, 2002) are well correlated by an equation of the form:

$$fmep = 97 + 0.9N + 0.18N^2 \quad (18)$$

where N is in revolutions per second. The unit of $fmep$ is kpa .

Therefore, the lost power due to friction is

$$p_{fri} = \frac{fmep V_d N}{2} = V_d N\left(45.5 + 0.45N + 0.09N^2\right) \quad (19)$$

Therefore, the net actual power output of the Otto cycle engine can be written as:

$$P_{otto} = \frac{R_{air}\dot{m}_a\left[\left(m_a/m_f\right)_s + \phi\right]}{\eta_c(\gamma-1)\left(m_a/m_f\right)_s}\left[T_1\left(1-r_c^{\gamma-1}\right)+\right.$$

$$\left.\left[\frac{\left(\eta_c\eta_{com}Q_{LHV}\right)/\left(\phi\left(m_a/m_f\right)_s\right) - T_1\left(r_c^{\gamma-1}+\eta_c-1\right)(B+c_v)}{B+c_v}\right]\left(\eta_e - r_c^{\gamma-1}\right)\right] - \quad (20)$$

$$V_d N\left(45.5 + 0.45N + 0.09N^2\right)$$

The thermal efficiency of the Otto cycle engine is expressed by

$$\eta_{th} = P_{otto}/Q_{in} = \frac{1}{\eta_c\left(T_3 - T_2\right)}\left[T_1\left(1-r_c^{\gamma-1}\right)+\right.$$

$$\left.\left[\frac{\left(\eta_c\eta_{com}Q_{LHV}\right)/\left(\phi\left(m_a/m_f\right)_s\right) - T_1\left(r_c^{\gamma-1}+\eta_c-1\right)(B+c_v)}{B+c_v}\right]\left(\eta_e - r_c^{\gamma-1}\right)\right] - \quad (21)$$

$$V_d N(45.5 + 0.45N + 0.09N^2)/\left(T_3 - T_2\right)$$

Notice that both power and efficiency are convex functions of the compression ratio.

3. Numerical examples and discussions

As it can be concluded from Eqs. (20) and (21), the power output and the thermal efficiency of the Otto cycle are dependent on the equivalence ratio. In order to illustrate the effect of this parameter, the relations between the power output and the compression ratio, between the thermal efficiency and the compression ratio, and the optimal relation between power output and the efficiency of the cycles presented in figures 2–4. According to references (Ebrahimi, 2009b; Chen et al., 2008; Ge et al., 2008) , the following parameters are used: $\eta_e = 0.97$, $\eta_c = 0.97$, $Q_{hv} = 44000\,kJ/kg$, $T_1 = 300\,K$, $N = 3000\,rpm$, $V_d = 366.5\,cm^3$, $\gamma = 1.4$, $\phi = 0.9 \to 1.3$, $r_c = 1 \to 100$, $\left(m_a/m_f\right)_s = 14.5$, $\dot{m}_a = 0.0146\,kg/s$ and $B = 0.57\,kJ/kg\,K$.

Figures 2-3 show the effect of the equivalence ratio on the cycle performance with heat resistance, internal irreversibility and friction losses. From these figures, it can be found that the equivalence ratio plays important roles on the performance of the Otto engine. It is clearly seen that the effects of equivalence ratio on the performance of the cycle is related to compression ratio. They reflect the performance characteristics of a real irreversible Otto cycle engine. The power output versus compression ratio characteristic and the thermal efficiency versus compression ratio characteristic are approximately parabolic like curves. In other word, the power output and the thermal efficiency increase with increasing compression ratio, attain their maximum values and then decrease with further increases in compression ratio. It should be noted that the heat added and the heat rejected by the working fluid first increase and then start to decrease as the equivalence ratio increases (see Eqs. (2) and (3)). Figures 2 and 3 show that the power output and the thermal efficiency increase with increasing equivalence ratio up to about $\phi = 1.1$ where they reach their peak value. This can be attributed to the fact that the ratio of the heat added by the working fluid to the heat rejected by the working fluid increase with the increasing equivalence ratio. With further increase in equivalence ratio, the power output and the thermal efficiency start to decline as the equivalence ratio increases. It can be attributed to the decrease in the ratio of the heat added by the working fluid to the heat rejected by the working fluid. This result is consistent with the experimental results in the internal combustion engine (Mercier, 2006). The results also revealed that the optimal compression ratio corresponding to maximum power output point, the optimal compression ratio corresponding to maximum thermal efficiency point and the working range of the cycle increase and then decrease as the equivalence ratio increases. Numerical calculation shows that for any same compression ratio, the smallest power output and the smallest thermal efficiency are for $\phi = 0.9$ and the

largest power output and the largest thermal efficiency are for $\phi = 1.1$ when the equivalence ratio increases from $\phi = 0.9$ to $\phi = 1.3$.

According to above analysis, it can be found that the effects of the equivalence ratio on the cycle performance are obvious, and they should be considered in practice cycle analysis in order to make the cycle model be more close to practice.

4-Conclusion

In this paper, the effects of equivalence ratio on the performance of an Otto cycle during the finite time are investigated. The results show that the power output, the thermal efficiency, the optimal compression ratio corresponding to maximum power output point, the optimal compression ratio corresponding to maximum thermal efficiency point, the working range of the cycle, the power output at maximum thermal efficiency and the

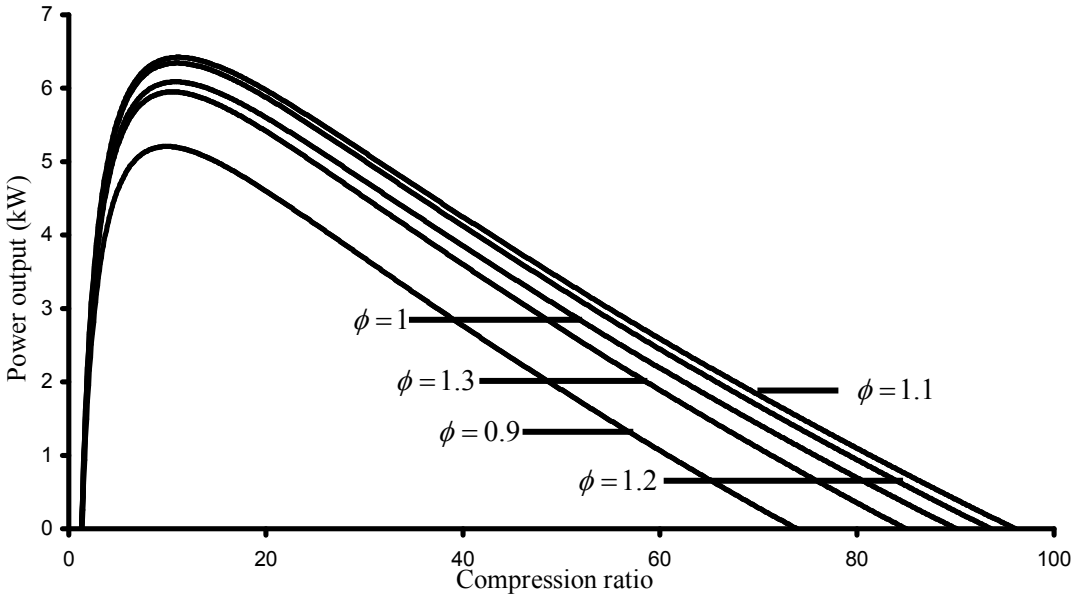

Figure 2. Effect of combustion efficiency on the variation of the power output with compression ratio

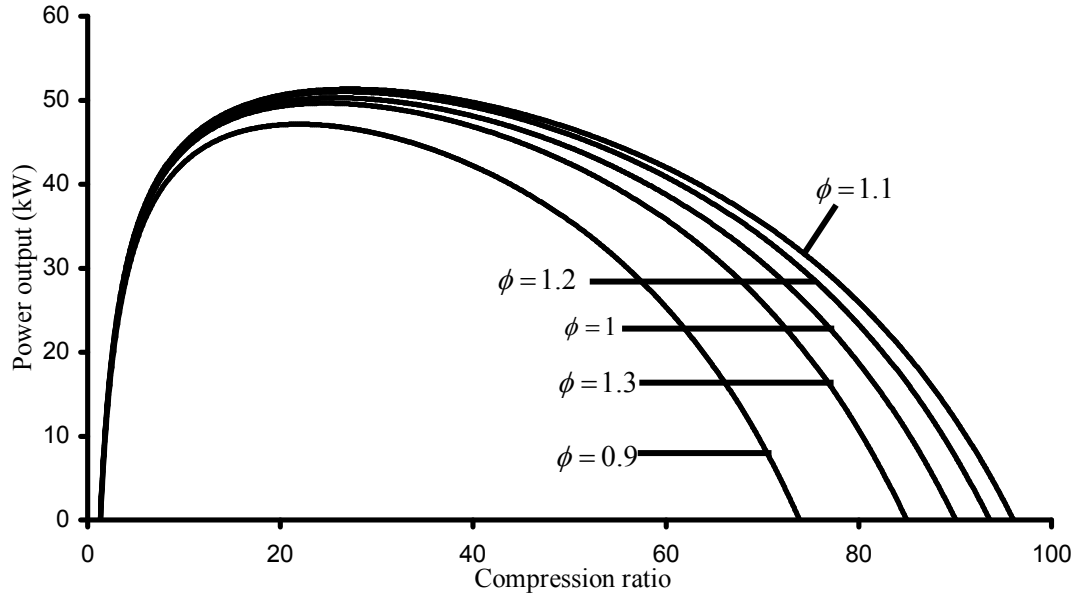

Figure 3. Effect of combustion efficiency on the variation of the thermal efficiency with compression ratio

thermal efficiency at maximum power output increase and then decrease as the equivalence ratio increases. The results of this investigation are of importance when considering the designs of actual Otto engines.

Acknowledgement

The author would like to thank the Shahrekord University for the financial support.

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6/8/2009

Barriers of Community Capacity Building in Types of Tourism Activities

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Abstract: This paper investigates barriers of community capacity building in tourism development base on types of tourism activities. This study was run in local communities of Shiraz, Iran. Questionnaire was used to collect data from community leaders. The focus group discussion also performed to collection data from community residents who were engaged in tourism activates. One way Anova was used to examine the difference barriers of community capacity base on types of tourism activities. According to the survey, results showed barriers of community capacity building in tourism development in handicraft activities higher than other types of tourism activity. [Journal of American Science 2010;6(2);136-142] (ISSN: 1545-1003).

Keywords: community capacity building, tourism activities, local communities, handicraft

1. Introduction

Tourism is a multi sector, and as a means of economic and social cultural exchange, it has many aspects and types (Mowforth & Munt, 2003). Because of its various forms, tourism researchers have been incapable of reaching either a conceptual or operational unity over a consensus definition (Mill & Morrison, 2002; Mills, 2005; Wall & Mathieson, 2006). Mill & Morrison (2002) and Wall & Mathieson (2006) noted how the discipline of studying tourism struggled with establishing a global definition of tourism. This aim of this study was to determine the barriers of community capacity building for tourism development base on types of tourism activities. In this study, community capacity building is tested as a dependent variable having a direct effect on tourism development. Hence understanding barriers of community capacity in terms of types of tourism activities can help to local communities for future planning to achieve sustainable tourism development.

2. Literature Review

Harrill & Potts (2003, p. 233) believed that "tourism is an invisible industry, encompassing transportation, loading, and entertainment. Unfortunately, tourism is also invisible to many planners, so tourism development is often left to private developers and leisure service providers". Tourism research has also recently come to be a favourite research subject in community development researches (Galston & Baehler, 1995). Ivanovic (2009) states that various types of tourism activities are an important element capable of considerably increasing tourism expenditure and the length of tourists' stay in communities (Ivanovic, 2009). Despite the potential for community capacity building in tourism development, barriers do exist and need to be addressed in tourism development planning. community capacity building in tourism development often faced barriers (Moscardo, 2008). Barriers to community capacity building in tourism development have hardly been debated by scholars of tourism (Moscardo, 2008).

Understanding barriers of community capacity building base on types of tourism activities is important when a community is getting organized for involvement in tourism activates. This understanding can help individuals, community and organizations more effectively impact the tourism policy-making process. Further, it is important for government to understand that communities also face barriers that can hinder its progress in responding and recognizing the priorities of local communities in Shiraz. Overcoming the barriers to tourism development presents a challenge to both communities and government, and will serve to facilitate the policy making process. There are several literatures that directly deal with the

barriers of tourism development through local communities particularly in third world countries.

i. **Power: Socio-political traditions:** The biggest barriers in local communities in the face of tourism development are the strong views of power-wielding governments that still exist in many third world countries. This form of government customarily nearly always precludes grassroots participation in tourism development (Sharma, 2004).

ii. **Information accessibility:** One of the primary barriers for local business in less developed countries is marketing difficulties. Limited access to advertising outlets, reservation system and adequate transportation services also contribute to lack of ability in some local business (Sharma, 2004).

iii. **Lack of awareness:** Lack of understanding by residents about tourism impacts prevents many people from becoming involved in tourism decision making and in the benefits of tourism (Sharma, 2004).

iv. **Economic problems:** Insufficient public funding is another limitation to local communities for achieving tourism development. Financial barriers at lower levels of administration increase dependence on national government. As a result the involvement of local people in tourism decision making can hardly be achieved (Sharma, 2004).

v. **Lack of cooperation:** It is argued that a great deal of collaborative effort is necessary for success in tourism development. Despite this apparent need, few places have achieved high level of cooperation in this regard (Sharma, 2004).

This study also outlines some of the more common barriers and challenges as perceived by Steven & Jennifer (2002) in local communities. The important barriers to community capacity building are referred to below.

i. **Lack of understanding of policy process:** Understanding the policy making process can help individuals and community organizations to decide whether they will become involved in trying to develop or change a policy and if, so, how to best go about it (Steven & Jennifer, 2002).

ii. **Lack of community resources:** In order for local communities to play an active role in the policy making, it is important for community residents to have access to resources. These resources include adequate funding, government training programs, education and volunteers to support community development. Many local communities tend to lack most of these resources. Having inadequate resources negatively impacts on the community's ability to effectively influence and develop tourism policy. Atkisson et al. (2003) believed tourism development at the community level has a number of limitations such as lack of resources, inadequate communication and planning.

iii. **Reliance on volunteers:** Access to financial resources, which is necessary to address problems of a local community. As a consequence, a lack of resources and tourism experts from local communities results in a depletion of potential future community leaders (Steven & Jennifer, 2002).

iv. **Policy timeline restrictions:** Often the policy timeline can create difficulties for communities looking forward to impacting policies pertaining to a particular issue.

v. **Lack of access to information:** Community citizen have indicated that they feel there is a lack of access to tourism information. Local communities have also reported that the information that is available on government programs is difficult to obtain and interpret.

Ebbesen et al. (2004) identified the most common barriers to building community capacity including:

i. Lack of clearly defined goals and outcome to be achieved for the community development.
ii. Lack of leadership to unite, motivate and take action in community.
iii. Limited public support or community voice to contribute to the change effort.
iv. Lack of funding and commitment, perceived to be related to competing priorities for policy attention and resource investment in community.
v. Lack of political will to develop capacity in communities.
vi. Inability of resource mobilization to quickly capitalize on opportunities.

Hunt (2005) also reviews an uptake of the notion of community capacity building in local communities. She strongly believed that any community capacity building activity in local communities must acknowledge and address the many barriers to that community capacity building. She outlines in broad terms, the following constraints:

i. A lack of community participation in policy development
ii. Lack of knowledge and awareness
iii. Power imbalance between local communities and government
iv. Lack of financial resources

The results of a survey by the Social Policy Unit of the Western Australian Government have shown the barriers of community capacity building. These

barriers include lack of knowledge, skills, funding limits, lack of abilities of individuals and groups to participate and lack of community development practitioners (Social Policy Unit, 2004). According to Cronin (2003), Hunt (2005) and McGinty (2003) there exist the following barriers in community capacity building in local communities:

i. Lack of recognition of local authority and power as a component of community development.
ii. Inadequate focus on human resource development at the community level
iii. Lack of information to facilitate informed decisions
iv. Lack of effective and strong government institutions
v. Dependency on government and bureaucracy to meet needs
vi. Lack of capacity to solve problems and manage individual and community matters
vii. Lack of authority for local communities to control important matters (Cronin, 2003).

In terms of barriers of community capacity building in local communities, Kleiner et al. (2004) also refers to limited resources (e.g., funding, expertise, time) and competition between communities and residents to regionalism, community organizations conflict, attracting participant interest and time constraints as the commonly cited problem in implementation of community capacity building in local communities.

Bushell & Eagles (2007, p. 154) states tourism as a phenomenon of affluent contemporary societies is a particularly difficult concept in local communities in developing countries to grasp. In this sense tourism development may be more difficult than other activities. Shortcomings are similar to those local communities, but a few factors tend to be more pronounced among local communities:

i. Lack of formal education or illiteracy
ii. Lack of foreign language skills
iii. Different ways of dealing with hygiene, litter, maintenance of infrastructure and buildings
iv. Limited knowledge of food preparation for foreigners, including catering to dietary, nutritional and culinary tastes
v. Lack of decision making and planning skills concerning the possible consequences of tourism, coupled with limited ability to control tourism development, unpredictable political climates, and long-term funding uncertainty (Bushell & Eagles, 2007, p. 154).

Attempts to measure barriers of community capacity building in types of tourism activities raise concerns about the relationship between dimensions of community capacity building and tourism development processes.

3. Research methodology

The data for this study were collected from community leaders and local residents which engaged in tourism activities. Community leaders was identified as a key factor in developing tourism in local communities (Aref & Ma'rof, 2009a; Moscardo, 2008). According to Eyler et al. (1999), Thompson et al. (2000), and Von et al. (1992) the leaders are able to speak for the community because of their knowledge and their roles in the community. The primary and major data collection is based on questionnaires. Focus group discussion (FGD) also was used to collection data from local residents that were engaged in tourism activities. According to Riley (1996) the majority of tourism research has relied on structure surveys and quantification" (Riley, 1996, p. 22). The items in the questionnaire for this survey were measured using Likert scale (Aref et al., 2009). The Likert scale is most commonly used in tourism marketing research (Grover & Vriens, 2006). Dong-Wan & William (2002) and Maddox (1985) recommended the use of a Likert scale in tourism research due to its high validity. Descriptive Analysis, and one way Anova were used to interpret the data in this study. Descriptive statistics usually include means, standard deviations, and frequencies (Anderson, MacLellan-Wright, & Barber, 2007). One-way Anova also is an appropriate statistics tool for comparing two or more independent groups on the central tendency (Morgan et al., 2001). In this study, it was used to compare the sample means for each independent group. When Anova test results indicated that the independent groups were significantly different, Post Hoc tests (Tukey HSD test) were performed. According to Morgan et al. (2001) Tukey HSD is a common Post Hoc test to use when the variances are equal (Aref & Ma'rof, 2009b). Statistical package for social sciences (SPSS 17) was used to process and analyze the quantitative data. The pre-testing of instrument was carried out prior to the actual data collection to examine the appropriateness and reliability of the instrument. Hence 32 convenient samples were chosen to conduct the pre-testing. The results indicated the sufficiently and factor ability of statements. It also showed satisfactory internal consistency of the manifest items measuring level of community capacity building. In order to determine the reliability of the instrument, the Cronbach Alpha was tested on each dimension of community capacity building. According to Garson (2009), the dimensions should have a Cronbach alpha of at least .70 to establish reliability of the constructs. Base on the reliability alpha values in this study the instruments has reliability with

Cronbach's alpha values (between .0.74 and .93)(Aref et al., 2009).

4. Results and Discussions

Respondents in survey of the study were community leaders. Out of 175 questionnaires distributed among the community leaders in whole Shiraz. The respondents illustrated handicraft activities with 34.90%, nature 10.3%, cultural activities 41.7%, business activities 10.9% and medical services 2.3% (Table 1). As earlier it illustrated Shiraz has many cultural tourism attraction and so it known as a cultural tourism destination and recently it be medical tourism destination. According to Table 1 most of local communities in Shiraz have activates around the cultural activities and this because of many cultural attraction in Shiraz.

Table 1: Frequency of Types of Tourism Activities (N=175)

Tourism status	Category	Frequency	Percent
	Handicrafts	61	34.9%
	Nature	18	10.3%
Types of tourism activities	Culture	73	41.7%
	Business	19	10.9%
	Medical service	4	2.3 %
	Total	175	100%

Table 2 shows barriers of community capacity building according to types of tourism activities in the community. The result show that the barriers of community capacity building in communities that tourism activity is base on handicraft (Mean= 136.93) is higher than other types of tourism activity. According to this table medical service has fewer barriers compare to other communities activities.

Table 2: Means and Standard Deviations of Barriers of Community Capacity Building to Types of Tourism Activities

	N	M	SD	SE
Handicrafts	61	136.93	17.527	2.224
Nature	18	130.94	16.882	3.979
Cultural	73	122.86	19.286	2.257
Business	19	131.89	20.864	4.787
Medical services	4	118.25	14.863	7.432
Total	174	129.47	19.445	1.470

A one-way Anova was used to test for preference differences barriers of community capacity building in among different types of tourism activities. Preferences for barriers of community capacity building differed significantly across the types of tourism, F (4, 170) = 5.255, p = .001. According to table 3 the F ratio with a F-probability value less than .05 It is significant, suggesting that the type of tourism activity significantly influences barriers of community capacity building in tourism development $F(4,170)=5.255$, $p<.05$. According to Table 3 there were significant differences between barriers of community capacity building and types of tourism activities at the $p < .05$ level ($F = 5.255$, $p = .001$).

Table 3: One Way Anova of Barriers of Community Capacity Building According to Types of Tourism Activities

	SS	*df*	*MS*	*F*	*P*
Between Groups	7239.783	4	180946	5.255	.001
Within Groups	58549.852	170	344.411		
Total	65789.634	174			

Post Hoc tests were performed to examine where the difference existed in the types of tourism activities. Due to the unequal group sizes among the types of tourism activities, the Games Howell modification of Tukey's HSD Post Hoc test was used. The analysis revealed handicraft activates was more likely to bring some barriers for community capacity building in tourism development. Post Hoc tests (Tukey) result indicates that there is a significant difference between the different types of tourism activities. Results show a significant difference between handicraft and culture at .000. However there is no significant difference between handicraft with nature, business and medical services. Results indicated nature doesn't significant difference with other its groups. It also illustrated culture has significant difference with handicraft at .000. Post Hoc Test also indicates that there are no significant differences between business activities and medical services with their groups.

Table 4: Post Hoc Testes (Tukey) of Barriers of Community Capacity Building According to Types of Tourism Activities

		Mean Difference	SE	Sig.
Handicraft	Nature	5.990	4.978	.749
	Culture	14.071*	3.219	.000
	Business	5.040	4.876	.839
	Medical Services	18.684	9.579	.295
Nature	Handicraft	-5.990	4.978	.749
	Culture	8.081	4.884	.465
	Business	-.950	6.104	1.000
	Medical Services	12.694	10.258	.729
Culture	Handicraft	-14.071*	3.219	.000
	Nature	-8.081	4.884	.465
	Business	-9.032	4.780	.327
	Medical Services	4.613	9.530	.989
Business	Handicraft	-5.040	4.876	.839
	Nature	.950	6.104	1.000
	Culture	9.032	4.780	.327
	Medical Services	13.645	10.209	.669
Medical Services	Handicraft	-18.684	9.579	.295
	Nature	-12.694	10.258	.729
	Culture	-4.613	9.530	.989
	Business	-13.645	10.209	.669

Handicraft activities, as a traditional industry still found in most local communities in Shiraz; But the findings show handicraft activities has most weakness and lack of community capacity building in tourism development.

Through FGD it was also realized that the people engaged in handicraft productions like to change their activities. They said the government didn't support them about marketing their production, they referred to some problems. They said before the Islamic revolution their activities was important but toady they cannot develop their activities. However local communities of Shiraz has many potential for develop this types activities of tourism but the local people were apathy for continue this activity. The local people are unable to protect their traditional production and government also is neglecting to protect these activities and keep them for local people activates (Ivanovic, 2009). Through FGD majority of participants in communities with handicraft activities stated that government is neglecting to support handicraft traditional and provide marketing in this traditional industry. Local communities engaged in this activity also have little awareness of tourism and little control or access on tourism (Butler & Hinch, 2007). The result also showed cultural activities has fewer barriers in terms of tourism development. This findings is consist with Butler & Hinch (2007) that they believed, However there are diversity of tourism activities in Iran, but cultural tourism activates is very important to Iranian tourism activities (Butler & Hinch, 2007). They also believed however there is a lack of data on characteristic and volume tourism: but most domestic tourism is generated in cultural and pilgrimage site such as Shiraz (Butler & Hinch, 2007).

5. Conclusion

This paper investigated barriers of community capacity building for tourism development according to types of tourism activities. To test the difference, One-way Anova was performed. To test differences between barriers of community capacity building based on types of tourism activates, One-way Anova was performed. The result shows that the barriers of community capacity building in communities that tourism activity is based on handicraft (M= 136.93) is higher than other types of tourism activity. According to the results, medical services have fewer barriers in comparison to other tourism activities. One-way Anova showed barriers of community capacity building is significantly different according to the type of tourism activity F (4,170) =5.255, p<.05. In support of these findings FGD was performed. The findings of this study have both theoretical and applied implications in the tourism industry. It is expected that the findings of this study could be utilized by the community leaders and tourism developers for future follow-up studies and reassessment of community capacity building for tourism development in their communities.

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15/September/ 2009

Effect of Extracts of *Hymenocardia acida* Tul (Hymenocardiaceae) on Rats

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Abstract: The aqueous and methanol leaf extracts of *Hymenocardia acida* Tul. (Hymenocardiaceae) were evaluated for their effect on superoxide dismutase (SOD) catalase (CAT); and Ca^{2+} concentrations in rats. The extracts were orally administered at a dose of 200mg^{-kg} daily for 7 days. Results showed elevated activity of SOD ($p<0.05$) while CAT activity was depressed ($p<0.05$) in the treated rats. Effects on enzymes' activities suggest that the extracts induced SOD activity while inhibiting CAT activity, indicating an altered oxidative status in the animals. Ca^{2+} concentrations were higher ($p<0.05$) in the treated rats which suggests an effect on Ca^{2+} metabolism. Correlation between activities of SOD/CAT and Ca^{2+} concentration were r = 0.055 and r = -0.787 for SOD; r = 0.533 and r = -0.908 for catalase. Study reveals that pharmacological action credited to *H. acida* is due to effect on enzymatic antioxidants and Ca^{2+} metabolism. [Journal of American Science 2010;6(2);143-146] (ISSN: 1545-1003).

Keywords: *H. acida*, superoxide dismutase, catalase, calcium.

1. Introduction

Oxidative stress and its related biological damage have been proposed to be involved in the development and maintenance of rheumatoid arthritis in animal and human models, cardiovascular diseases, diabetes and viral infections (Darlington and Stone, 2001 ; Repetto and Llesuy, 2002). Consequently, the use of medicinal plants exhibiting antioxidative activity in the treatment and management of diseases has been on the increase in recent times (Pourmorad *et al*., 2006). In living organisms the first line of defence against free radicals is the oxidative stress enzyme superoxide dismutase (SOD). Superoxide dismutase (EC 1.15.1.1) catalyses the dismutation of superoxide anions converting them to hydrogen peroxides. The toxic hydrogen peroxide in turn, is converted to molecular oxygen and water by catalase (EC 1.11.1.6) or glutathione peroxidase (EC 1.11.1.9) (Aksoy *et al*., 2004).

Furthermore, many medicinal plants also contain different proportions of micro nutrients (Okwu and Josiah 2006). One of such micro nutrient is Ca^{2+} which is the most common mineral in the body. The physiological functions of Ca^{2+} which include its roles as major structural element (particularly in bone formation), in cell signalling, and as cofactor for enzymes are vital to an organism's survival (Gross, 2005). Ca^{2+} in many organisms including humans may become deficient with advancing age and this negative calcium balance appear to be associated with several conditions including osteoporosis (Fujita *et al*., 2000). Thus, studies are focusing on the role of micro nutrients in the pathogenesis and management of different diseases (Okochi and Okpuzor, 2005).

Hymenocardia acida Tul (Hymenocardiaceae), widespread in tropical Africa is a small tree of about 6 m high. Ethnomedical investigation of *H. acida* reveals a variety of medicinal uses in tropical African countries. In Senegal and Ivory Coast, an infusion or decoction of its leaves is used for the treatment of chest complaints, small pox, in baths and draughts as a febrifuge, and is taken as snuff for headaches or applied topically for rheumatic pains and toothaches (Sofidiya *et al*, 2009). The bark and leaves are used together in various ways in Nigeria for abdominal and menstrual pains and as poultices on abscesses and tumours. The powdered leaves of the plant are used for the treatment arthritis (Burkhill, 1994). Our previous study on *H. acida* showed that it possesses free radical scavenging activity and strong reducing power *in vitro* (Sofidiya *et al*., 2006). Antioxidative screening of this plant revealed the presence of flavonols, flavonoids, phenols, proanthocyanidins, steroids and triterpenoids (Sofidiya *et al*., 2009). However, despite the extensive use of *H. acida* in the treatment of many diseases in traditional medicine, the *in vivo* basis for its pharmacological activity has not been evaluated.

This is the objective of this work which is to investigate the antioxidative property of the leaves *in vivo*, in order to ascertain the mode of the pharmacological action of the plant. Furthermore, in view of the role of Ca^{2+} in biological processes, the study aims at determining the relationship between the antioxidative property of the plant and Ca^{2+}

concentration in treated animal.

2. Materials and methods

Plant material

The leaves of *H. acida* were collected in January 2004 at Olokemeji reserves in Ogun State, Nigeria and were authenticated at the Forestry Research Institute of Nigeria (FRIN), Ibadan. Voucher specimen (FHI 38672) was prepared and deposited at the herbaria of both the Institute and at the Pharmacognosy Department, University of Lagos

Extraction

The leaves were air dried at room temperature for 21 days, pulverized and a portion (850 g) of the powdered material was extracted with 7.5 L of water on a shaker at room temperature overnight. The extract was filtered through Whatman No.1 filter paper and the filtrate concentrated in a lyophilizer. The residue after aqueous extraction was further extracted with methanol (3 L) and filtered. The filtrate was evaporated to dryness under reduced pressure. The extracts were stored at 4^{o}C until required.

Preparation of extracts solutions

The extracts solutions were prepared by dissolving 0.4 g of the extract in 10 ml of 5% Tween 20, to give an effective concentration of 40 mg mL^{-1}. The formula: Dosage mg^{-1} kg)/1000 x Wt of animal (g)/concentration (mg mL^{-1}) was used to calculate the volume of the extract solution to be administered to each animal. The extracts solutions were prepared fresh daily before administration.

Animal source

Eighteen Wistar rats used for the experiment were purchased from the rat colony at Department of Veterinary Parasitology and Entomology University of Nigeria, Nsukka. The Ethical committee of the University of Lagos approved the use of these animals for experimental purposes. They were housed in standard rat cages and were fed with commercial livestock feed and water *ad libitum*.

Animal treatment

The rats weighing between 200-250 g were sorted into 3 groups of 6 rats each (2 tests and one control). The extracts solutions [1 mL (200 mg^{-1} kg)] were administered orally to the test groups for 7 days. The control group received 1ml of 5% Tween 20 only. The animals were fasted overnight, sacrificed and blood was collected. The blood was centrifuged at 1500 rpm for 5 min; and serum was separated for enzymes assay and Ca^{2+} levels determination.

Enzyme assays

Chemicals

Hydrogen peroxide (H_2O_2), Epinephrine ($C_9H_{13}O_3N$) and Tween 20 were purchased from Sigma-Aldrich, Germany. Kit for calcium determination was from BDH (Poole, UK). All other chemicals used, including solvents, were of analytical grade.

Determination of SOD activity

The method of Sun and Zigma (1978) was adopted. The reaction mixture (3 ml) contained 2.95 ml 0.05 M sodium carbonate buffer pH 10.2, 0.02 ml of serum and 0.03 ml of epinephrine in 0.005 N HCL was used to initiate the reaction. The reference cuvette contained 2.95 ml buffer, 0.03 ml of substrate (epinephrine) and 0.02 ml of water. Enzyme activity was calculated by measuring the change in absorbance at 480 nm for 5 min.

Determination of Catalase activity

Serum catalase activity was determined according to the method of Beers and Sizer as described by Usoh *et al.,* (2005) by measuring the decrease in absorbance at 240nm due to the decomposition of H_2O_2 in a UV recording spectrophotometer. The reaction mixture (3 ml) contained 0.1 ml of serum in phosphate buffer (50 mM, pH 7.0) and 2.9 ml of 30 mM H_2O_2 in phosphate buffer pH 7.0. An extinction coefficient for H_2O_2 at 240 nm of 40.0 $M^{-1}cm^{-1}$ (Aebi 1984) was used for the calculation. The specific activity of catalase was expressed as moles of H_2O_2 reduced per minute per mg protein.

Determination of Ca^{2+} concentration

Calcium concentration in $mmolL^{-1}$ was estimated by the method of Biggs and Moorehead as described by Yakubu *et al.* (2007)

Statistical Analysis

Data were reported ±SEM of 6 measurements and were subjected to one-analysis of variance and significance of the difference between groups was by student's *t*-test ($p<0.05$). Test of correlation between groups was by Pearson correlation test.

3. Results

SOD activity

Results, summarised in Table 1, show a significant increase ($p<0.05$) in serum activity of SOD in the rats treated with aqueous and methanol extracts of *H. acida* as compared to the untreated rats. This increase was more significant ($p<0.05$) in the methanolic extract than the aqueous extract.

Catalase activity

Catalase activity was significantly lower ($p<0.05$) in rats treated with both extracts (Table 1). However, this depressed activity was more significant in the methanol extract than the aqueous extract.

A linear positive correlation (r = 0.9751) existed between SOD and catalase activities in the control rats. There was positive correlation (r = 0.533) between SOD and catalase activities in the methanol extract-treated rats. However, in the aqueous extract, SOD and catalase activities had negative correlation (r = -0.9083).

Table 1. SOD/Catalase Activities and Calcium concentrations in *H. Acida*-Treated Rats

Group	SOD (units/g Protein $x10^{-3}$)	Catalase (moles of H_2O_2 degraded/min $x10^{-2}$)	Calcium (mmol/L)
Control	2.35 ±0.16	28.0±0.03	1.91±0.23
MeOH	3.79±0.21*	0.2±0.0001*	2.75±0.31
H_2O	4.03±0.42*	4.0±0.03*	3.33±0.06*

*Significant at $p<0.05$

Ca^{2+} concentration

Serum calcium concentration was higher ($p<0.05$) in the *H. acida* aqueous extract-treated rats, while there was no significant difference between Ca^{2+}concentration in methanol extract-treated and the untreated rats (Table 1).

There was a relationship between Ca^{2+} and the enzymes (Table 2). The untreated rats showed positive correlation between Ca^{2+} concentration, SOD and catalase activities. In methanol extract, there was minimal correlation (r = 0.055) between Ca^{2+} and SOD activity, while there was a positive correlation (r = 0.533) between Ca^{2+} and catalase activity. However, in the aqueous extract, there was a strong negative correlation between Ca^{2+} levels and the enzymes' activities.

Table 2. Correlation between SOD/Catalase Activities and Calcium Concentration in Untreated and *H. acida*-treated Rats

		Extracts	
Parameters	Untreated (r value)	*H. acida* methanol (r value)	*H.acida* water (r value)
SOD/Ca^{2+}	0.673	0.055	-0.787
Catalase/Ca^{2+}	0.957	0.533	-0.9083

4. Discussion

Plants are generally believed to be rich in a wide variety of secondary metabolites such as alkaloids, flavonoids, terpenoids and saponins. Of these metabolites, plant antioxidants such as the numerous phenolic compounds have received increased attention as useful nutraceutical in management of diseases (Wan and Diaz-Sanchez, 2007). For this reason, research has focused on evaluating the antioxidant properties of plants used in ethnomedicine, in order to relate these properties to their mode of action.

The different effects demonstrated by *H. acida* leaf extract on SOD, catalase and Ca^{2+} concentration appear to be directly related to the types and proportions of compounds extractable by the two solvents – H_2O and methanol. Our studies showed an elevated SOD activity which was might be as a result of the induction of the synthesis of the enzyme. Earlier, the *in vitro* studies of *H. acida* aqueous and methanol extract reported a significant proportion of phenolic compounds, which accounted for its antioxidative activity (Sofidiya *et al*., 2006). Thus, we believe that the induction of SOD is probably due the presence of the phenolic compounds in the extract. This agrees with Yeh and Yen (2006), who reported that four different phenolic acids induced antioxidant enzymes SOD, catalase and gluthathione peroxidase.

Moreover, the depressed activity of catalase in our study suggests an inhibitory effect of H_2O_2 which accumulated due to elevated activity of SOD. H_2O_2 even though a natural substrate of catalase, acts as an inhibitor of the enzyme at elevated levels (Aksoy *et al*., 2004).

The relationship between SOD and catalase is buttressed in aqueous extract-treated rats which demonstrated that about 90% of the decline in the activity of catalase was due to the activity of SOD. This is supported by studies that in the presence of H_2O_2, SOD acts as a pro-oxidant (Bast *et al.*, 1991). This created oxidative stress in the animals which agrees with Maduka and Okoye (2002), who reported an elevated activity of SOD and inhibition of catalase activity in the red cells and the liver by stem bark of *Sacoglotis gabonensis* Baill Urb. (Humiriaceae), a Nigerian beverage additive. In view of the important role oxidative stress plays in resolution of inflammation in mammals, our results suggest the mode of the pharmacological action of *H. acida.*

A significant correlation was observed between SOD/catalase and Ca^{2+} concentration which suggest that a relationship exist between them. This was apparent in the aqueous extract-treated rats which exhibited higher Ca^{2+} concentration. This group showed that 78 and 90% of the activity of SOD and catalase respectively was due to the increase in Ca^{2+} concentration. These results are in agreement with previous findings that there is a relationship between

Ca^{2+} and antioxidative enzyme (Brown *et al*., 2003). Oxidative stress created in the rats is believed to affect calcium channels in mammals (Hool and Corry, 2007). Furthermore, H_2O_2 is reported to interact with cell signalling pathway by way of modification of key thiol groups on proteins that possess regulatory function (Hool and Corry, 2007).

This study reports that *H. acida* extract exerts its pharmacological activity in rats, by interaction with antioxidant enzymes, reactive oxygen species and extra cellular calcium. This supports the use of this plant for the treatment of rheumatoid arthritis in traditional medicine practice in Nigeria.

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14/09/2009

Redundancy and Reliability of Air to Air Missile Fuze Electronics

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Abstract: Achieving a high level of reliability is of utmost importance in military applications. A given military grade part is extremely more expensive than its commercial counterpart. This great price difference is mainly due to the differences in design, manufacturing and the quality of parts used in commercial versus military products. Moreover, design of military grade products is much more difficult than commercial or industrial grade products mainly due to the fact that extremely difficult operating environments are expected for military products for which they must be designed, tested and qualified. The achievement of a high level of reliability in military products is also partly due to especial design considerations such as derating of parts, use of high reliability parts, and designing in reliability by the use of redundancy. In this paper, the analysis and design of military products and the ways to increase their reliability are addressed. The specific characteristics of military grade products, the various approaches to designing in reliability and the importance of redundancy especially in military systems are discussed. In this study, the failure rate and mean time to failure of air to air missile fuze electronics that incorporates redundancy are calculated based on MIL-HDBK-217F. [Journal of American Science 2010;6(2):147-154]. (ISSN: 1545-1003).

Key words: Reliability, redundancy, MTTR, MTTF, availability, maintainability

1. Introduction

Reliability requirements for military products and systems are arising due to harsher battle environments as a result of globalization and the appearance of newer global threats. Manufacturers of military products who can design in reliability and are able to manage the reliability growth of their products have a significant competitive advantage over their competitors. Reliability of a given product is seriously affected by the design process.

Reliability improvement or growth is one of the main objectives in any system development effort, especially in sensitive medical equipment, aerospace and military applications. One may cite Braem et al. [1] for example, who model probabilistic connectivity in multi-hop body sensor networks in order to determine ways to improve reliability. Their results for two reliability improvements are given: randomization of the schemes and repeating the schemes received from a parent node. Todinov [2] addressed the issue of reliability improvement in a product using a comparative method for improving the resistance to failure initiated by flaws. The advantage of their proposed method for improving the resistance to failure initiated by flaws is that it does not rely on a Monte Carlo simulation and does not depend on knowledge of the distribution of the flaws and the material properties.

However, the designers must design a product that not only meets its mission's functional requirements, but is also able to perform well under a variety of extremely difficult operating conditions. Even the conditions of storage, transportation before deployment and environmental conditions during deployment must all be included in the design of the product. The design process usually starts with a feasibility study. Usually an initial prototype is designed and built with only 10 to 30 percent the final expected reliability of the product. Engineers and technicians sometimes use an iterative design/test/modify/redesign cycle to improve a product and its reliability. An initial reliability estimate may be performed at the design stage based on a part count analysis of the product to get an idea about the generic MTTF of the product. However, achieving the desired reliability in practice is a great challenge.

Tian et al. [3] presented an approach for joint reliability-redundancy optimization of multi-state series-parallel systems which not only determined the optimal redundancy level for each parallel subsystem, but also aims at finding the optimal values for the variables that affect the component state distributions in each subsystem.

Another form of redundancy in design that may be used to improve reliability is N-modular redundant architecture. Flammini et al. [4] presented a combined failure model for voting architectures based on Bayesian networks and a maintenance model based on continuous time Markov chains in order to analyze the

impact of imperfect maintenance on the system safety in safety-critical control systems based on N-modular redundant architectures, using majority voters on the outputs of independent computation units.

Dai and Levitin [5] proposed an algorithm to optimize level of service reliability by utilizing redundancy in execution units in a grid computing system in which the resource management system (RMS) divides service tasks into execution blocks (EB), and sends these blocks to different resources.

2. Basic measures of reliability

Reliability is usually defined as the probability of successful operation of a mission under predefined operating conditions and for a specified mission time. There are many different measures used to measure reliability as presented below.

2.1. Failure Rate and MTTF

The most basic measure of reliability is the failure rate that indicates the average number of failures per unit time as follows:

$$\lambda(t) = \lim_{\Delta t \to 0} \frac{1}{\Delta t} P[System\ Down\ \ in\ (t, t+\Delta t) \mid System\ Up\ at\ \ t)] \quad (1)$$

In cases where the failure rate is constant, we have

$$\lambda(t) = \lambda \quad (2)$$

Reliability is found from the failure rate function as follows:

$$\mathrm{R(t)} = e^{-\int \lambda(t).dt} \quad (3)$$

For constant failure rate, the reliability is

$$\mathrm{R(t)} = e^{-\int \lambda dt} = e^{-\lambda t} \quad (4)$$

The next measure of reliability is the mean time to failure, or the expectation of the stochastic variable T_U that defines the uptime of the system.

$$MTTF = E[T_U] = \int_0^\infty t f_U(t)dt = \int_0^\infty R(t)dt \quad (5)$$

For a system with exponential probability density function we have:

$$MTTF = E[T_U] = \int_0^\infty t f_U(t)dt = \int_0^\infty e^{-\lambda t}dt = \frac{1}{\lambda} \quad (6)$$

One should not consider MTTF as the normal life time of a system, since the system reliability decreases drastically when that much of the life of the system has elapsed. The reliability at the time equal to MTTF is found to be:

$$R(t = MTTF) = R(\frac{1}{\lambda}) = e^{-\lambda(\frac{1}{\lambda})} = e^{-1} = 0.3678 \quad (7)$$

Table 1 shows typical MTTF values for several components and systems.

TABLE I
MTTF FOR SEVERAL COMPONENTS OR SYSTEMS

Part or system	MTTF (Hours)
Resistor	2500000
Cable	950000
Battery	250000
Electric Motor	100000
Generator	12000
Television	10000-50000
Antenna	20000
Laser	20000
Relay	500000
Magnetron	10000
Radar	600

2.1 Mean Time to Repair (MTTR)

The next important measure affecting a military system's reliability is its maintainability indicated by mean time to repair as follows:

$$MTTR = E[T_D] = \int_0^\infty t f_D(t)dt \quad (8)$$

If the assumption of exponential behavior of the time to repair is made, that is:

$$f_D(t) = \mu e^{-\mu t} \quad (9)$$

then the mean time to repair would be:

$$MTTR = E[T_D] = \int_0^\infty t f_D(t)dt = \int_0^\infty e^{-\mu t}dt = \frac{1}{\mu} \quad (10)$$

Table 2 shows the typical values of MTTR at various maintenance levels.

TABLE 2
TYPICAL VALUES OF MTTR AT THE VARIOUS MAINTENACE LEVELS

Maintenance Level	*MTTR*
Basic	0.5-1 Hours
Intermediate	0.5-3 Hours
Advanced	0.5-4 Hours

The failure rate and MTTR for several products are shown in Table 3.

TABLE 3
THE FAILURE RATE AND MEAN TIME TO REPAIR FOR SEVERAL PRODUCTS ADOPTED FROM DAVIDSON [6]

Product	Failures per year	Mean time to repair (Hours)
Electric heater	0.02	72
Small electric motor	0.03	4
Large electric motors	0.12	148
Pressure vessels	0.001	72
Centrifugal pumps	2.6	24
Oil pumps	0.5	8
High voltage transformers	0.003	24
Steam turbines	0.6	70

2.2 Mean time between failures (MTBF)

Another reliability index used in repairable systems is the mean time between failures as:

$$MTBF = MTTF + MTTR \quad (11)$$

This index shows the average time between successive failures or repairs. Table 4 indicates typical MTBF values for computers and related equipment.

TABLE 4
MTBF FOR COMMERCIAL COMPUTER EQUIPMENT

Equipment	MTBF (Hours)
Personal Computer	5000-50000
Monochrome Display	20000-30000
Color Display	5000-30000
Hard Drive	30000-90000
Floppy Drive	20000-40000
Tape Drive	7500-12000
Compact Disk Drive	30000-60000
DVD Drive	75000-125000
Keyboard	30000-60000
Dot Matrix Printer	2000-4000
Plotter	30000-40000
Modem	20000-30000
Router	50000-500000
Power Supply	20000-40000

However, military equipments are usually much more sophisticated. Although a lot of effort is exerted to achieve high reliability levels using part derating, redundancy, use of high quality parts and extensive part screening and environmental testing, the mean time between failures for many such military systems is much less than that of commercial or industrial products. Estimated values of the mean time between failures for several military systems are shown in Table 5. A look at the numbers in these tables clarifies the importance of reliability in military systems.

TABLE 5
TYPICAL VALUES OF MTBF FOR SEVERAL MILITARY SYSTEMS

Product	MTBF (Hours)
Ground Fixed Radar	100-200
Tactical Ground Mobile Radar	50-100
Fixed Phase Array Radar	5-10
A Fighter Plane Fire Control Radar	50-200
Airplane Detection Radar	200-2000
Airplane Seek Radar	300-500
Airplane Navigation Radar	300-4500
F-20 Mission Computer	2400
F-14 Fighter Plane	6
F16 APG-66 Radar	150
F16 APG-68 Radar	250
F22 APG-77 Radar	450
Cockpit Honeywell 4x4inch Multifunction Display	7000
MIG-29 Fighter Plane	7.3
Infrared Sensor for B-52	127
ICBM VLF Communications	2738

2.3 Availability

It can be seen from Tables 4 and 5 that the MTBF for military products is much less than that for non-military parts. Another measure of reliability for repairable systems is availability which takes into account both MTTF and MTTR as follows:

$$Availability = \frac{MTBF}{MTBF + MTTR} \quad (12)$$

Some typical values of MTTF, MTTR and availability for naval military systems are shown in Table 6.

With such low mean time to failure values in military systems, the need to attain high reliability is fulfilled by designing in modularity, and employing techniques to reduce mean time to repair so that the overall availability is high. For example, the expected availability of naval military system should be very high since once a naval vessels goes on a mission, it has no access to ground facilities. This can be seen from the data shown in the table.

3. Factors affecting MTTR

The mean time to repair may be improved by considering the various factors that affect it. This is possible through proper consideration of the operational limitations of military forces deploying the equipment under study. One may cite the following factors:

1- Hours of operation
2- Limitations on equipment's use due to maintenance
3- Mobility requirements of the product
4- The system's need for an operator or lack of such need
5- System's dependability

TABLE 6
MTTF, MTTR AND AVAILABILITY OF SEVERAL NAVAL MILITARY SYSTEMS [7]

System	MTTF (Hours)	MTTR(Hours)	Availability
SWS Submarine Workstation	3500	0.5	0.999857
HLDS Submarine Horizontal Large Screen Display	1500	0.5	0.999666
MicroPUFFS Submarine Sonar	3600	0.5	0.999861
ORION Danish Coastal Radar	3700	0.6	0.999837
SPS-40D Shipboard Radar	252	0.75	0.997032
DRBV Shipboard Radar	2180	0.25	0.999885
MteQ C-band Surface Search Radar	600	0.75	0.998751
W-160 Shipboard FCS	600	0.5	0.999167
AAR-50 Thermal imaging Navigation Set for F/A-18	410	0.3	0.999268
MK 116 Mod7 Fire Control System	875	1	0.998858
AVP Naval Color Dispaly	3000	0.25	0.999916
SPA-25 Raw-Video Radar Repeater	4000	0.33	0.999917
CWS Two-Poisition Command Workstation	3000	0.5	0.999833
AAS-36 Infrared Detecting Set	300	0.5	0.998336
21HS Hull Sonar	1100	1	0.999091

6- System's response time
7- System's operational environment
8- The expertise and level of education of the maintenance personnel for the system
9- The qualifications of the personnel who accompany the system when deployed
10- Testing, fault diagnosis and fault location facilities embedded in the system or accompanying it when dispatched on a mission
11- The hierarchy and design of the various levels of maintenance for the system
12- Use of commonly used components or new designs in the system
13- The degree of maintainability of the system

4. The role of logistics on system availability

The down time of a system should end with the repair of the failed parts and the system should be returned to operational conditions. The downtime may be elongated in military systems due to logistics problems such as inability to provide replacement parts. Therefore, the availability of military systems should be defined as follows:

$$A_O = \frac{MTTF}{MTTF + MDT} \tag{13}$$

The average down time of the system is affected by the mean time to repair as well as the mean time the system is down due to logistics as:

$$MDT = MTTR + MLDT \tag{14}$$

Thus military equipment's availability is:

$$A_o = \frac{MTTF}{MTTF + MTTR + MLDT} \tag{15}$$

2.4 Intrinsic Availability of Military Systems

If we consider ideal logistics conditions and assume

$$MLDT = 0 \tag{16}$$

Then the intrinsic system availability that is the highest possible level of system reliability is:

$$Ao = \frac{MTTF}{MTTF + MTTR} \tag{17}$$

Therefore, the factors that can affect the availability of military products by reducing $MLDT$ and are somewhat controllable by the military forces are as follows:

1- Time to travel for the technical personnel to diagnose and repair the fault
2- Availability of spare parts
3- The time required to obtain the spare part
4- Proper choice of spare parts

5. Redundancy and reliability

It is well known by reliability engineers that system topology affects reliability. For example, in a series system shown in Figure 1 all the parts must function for the system to function. If we assume that we have n parts making up a system each with failure rate λ_i, then the overall failure rate of the system will be

$$\lambda_S = \sum_{i=1}^{n} \lambda_i(t) \quad (18)$$

And the reliability of a series system may be computed from

$$R_S(t) = \prod_{i=1}^{n} R_i(t) \quad (19)$$

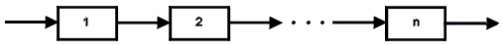

Fig. 1. The reliability block diagram of a simple series system consisting of n components

One of the best approaches to increase the reliability of a military system is the incorporation of redundancy in its topology. This may be in the form of parallel redundancy, r out of n redundancy, or standby redundancy. In a parallel system only one part needs to function for the system to operate as shown in Figure 2.

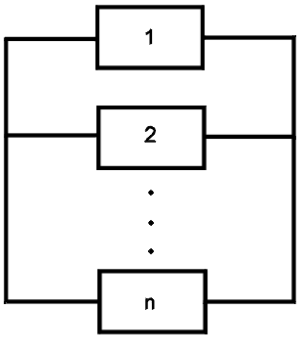

Fig. 2. The reliability block diagram of a fully parallel redundant system consisting of n components

The equivalent part for n redundant parts in parallel is computed as:

$$R_P(t) = 1 - \prod_{i=1}^{n} (1 - R_i(t)) \quad (20)$$

However, in a parallel system in which we enjoy redundancy, the functioning of only one part suffices for the system to operate. In such a system, for example, ten parts employed in parallel each with a reliability of only 0.75 would yield a system with reliability of 0.999999. While having a part with reliability of 0.75 may be normal, obtaining a part with reliability of 0.999999 is either extremely difficult, or improbable if not impossible. This indicates the strength of the use of redundancy to achieve a high level of reliability.

Of course, there are a variety of forms of redundancy in practice. We may have active or standby redundancy. In active redundancy, either a human operator, or some switching elements are used to switch in the redundant device when needed. Although this switching element should have a very high reliability to be effective, this type of redundancy has the benefit of not stressing the standby device when not needed.

The third form of redundancy in design is in voting or r out of n systems in which r components must work for the system to work. This is a topology somewhere in between the series and the parallel configurations both in terms of reliability and cost.

6. Reliability issues in military systems

The reliability of military systems depends on several issues that are not usually considered in industrial or commercial products.

1- Military systems demand high performance specifications usually not required from industrial or commercial products.

2- Designers of military systems usually encounter situations in which they must present the complete system design at once, while designers of other products usually benefit from trial and error and/or perfection of their design through several consecutive brands of a product.

3- Military products are expected to operate under extremely harsh situations which are very difficult to simulate for testing in the laboratory, while commercial or industrial products have well defined operating conditions.

4- Military products should be able to withstand many different environmental stresses such as extreme temperatures, thermal cycling, vibration, mechanical shock, humidity, corrosion, electromagnetic interference, radiation, etc.

5- Some of the maintenance/repair of military systems is done in unsafe conditions and under stress. This poses the personnel to more human errors.

6- Military systems are usually extremely more expensive than industrial or commercial products since there is a need for ruggedness and high reliability.

7- The low sales volume of military parts and goods naturally makes them much more expensive to manufacture.

8- The mission profile for military products including storage, transportation and deployment is usually much more complicated than industrial or commercial products.

9- Naval equipment require higher MTBF since they are deployed in long term naval missions during which there is no access to land-based logistic facilities.

The reliability issues involved in military systems can be easily seen by analyzing what was considered in projects such as the Minuteman ICBM. Initiated

around half a century ago and going into an alert-ready status in 1962 as the Minuteman I, the Minuteman III program is the only remaining US Air Force ICBM system today. These underground missiles that are said to be able to deliver nuclear warheads against any target around the globe in less than an hour are supposedly the most threatening weapon of the U.S. Air Force. The Air Force's 500 Minuteman III missiles are located at Malmstrom AFB, Montana holding 200 missiles; Minot AFB, North Dakota holding 150; and F. E. Warren AFB, Wyoming holding another 150 missiles [8]. ICBMs are stored in launch facilities that are unmanned, hardened, and underground structures. A separate missile alert facility serves as the center of assigned security patrol areas. It is the staging point for security forces deployed to the missile complex, and serves as an area away from the main base where maintenance personnel can remain overnight. One missile alert facility controls ten launch facilities making up a flight with five flights making up a squadron. F. E. Warren Air force base has three Minuteman III missile squadrons. Each squadron is responsible for 50 of the ICBMs. Even though this is one of the oldest military systems that still exists, reliability issues are a major concern due to its scope and importance.

Rigorous part control programs were implemented from the very beginning. The computer and memory units were designed with no on/off switches, indicators or electromechanical devices - due to the high failure rate of such devices - except for card and chassis connectors. Strict part screening for especial electrical and environmental screen followed by powered burn in was employed. Extensive and strict use of part derating was implemented in the Minuteman project. All stress factors such as voltage, current, power and temperature were strictly monitored for every part to ensure the part derating policy.

The Minuteman Weapon System Control AN/UYK computer used NDRO plated wire instead of core memory to achieve shorter access time and a lower susceptibility to radiation effects. It had an MTBF of over 25000 hours. The launch control facility system computers that ran continuously for over two decades without a single failure showed no failures. This indicates a case of built-in reliability. The UYK was used in the underground launch control facility and in each silo. The Propulsion Replacement Program (PRP), Guidance Replacement Program (GRP), and Safety Enhanced Reentry Vehicle (SERV) Programs were designed to sustain the Minuteman III ICBM to 2020 and reinforced security measures were put into effect after the 9/11 to extend its life to 2030.

7. Redundancy in military systems

Redundancy is widely used along with other measures in the design of military systems to attain the high levels of reliability desired. Redundancy is used in various ways to increase the reliability of the Minuteman III system. Redundancy is not only used in the hardware design, but it is also implemented in its operation to prevent a nuclear holocaust. For example, it takes more than one man to gain access to the silo or initiate the missile launch. Two men each using both hands must be present to interact with the missile system. The two men have to initiate the procedures within one second of each other. Else, the process will not go through and has to be repeated.

There are various other redundancy measures in effect in both data fusion and decision making systems to increase the reliability. The reliability issues involved in the use of computers in the command and control systems of nuclear weapons were addressed by Borning [9]. The Oct. 5, 1960 warning of a massive missile attack on the United States from the Soviet Union with a certainty of 0.99 was found to be due to spotting of the rising of the moon by BMEWS radars in Thule, Greenland. The June 3, 1980 false alarm in the display system of the Strategic Air Command (SAC) at Offutt Air Force Base indicating that two submarine-launched ballistic missiles were heading towards the United States was pursued by several actions that raised the severity level of the situation. However, this was actually rooted in the failure of a 74175 integrated circuit chip in a Data Digital communications multiplexer computer.

It was the built in redundancy in the system that prevented a nuclear war from happening. The Threat Assessment Conference was convened among the top deputy officers at SAC, NORAD and NMCC as a formal decision making process in the alert state. It was confirmed that there were no indications of an attack on the displays at NORAD, and the indications on the displays at SAC and NMCC did not match each other and were not logical. It was this form of redundancy built into the system – having three systems at SAC, NORAD and NMCC assess the same potential threat – that helped evade a nuclear war.

8. The reliability of missile fuze electronics

The reliability issues discussed are presented in a case study of the electronics of the fuze of surface to air missiles. This is a very important part of any missile and an increased reliability is usually attained by implementing redundancy in design. An example fuze is illustrated in Figure 3. The electronics for this

is shown in Figure 4 and is usually attached at the top of the fuze as could be seen from Figure 3.

Fig. 3. A sample missile fuze adopted from Cope [10].

Fig. 4. The electronic board of the sample missile fuze adopted from Cope [10].

One possibility for improved reliability is redundancy in design. The electronic subsystems making up the electronics of a fuze are analyzed in detail as shown in Figure 5. The equations presented above for the reliability of series and parallel systems are used to calculate the failure rate and the mean time to failure for the fuze based on MIL-HDBK-217F [11] and the results are shown in Table 7.

Given the failure rate and mean time to failure for the fuze electronics, we can estimate its reliability based on (4). Another possibility to improve reliability is the integration of parts into more reliable devices. However, this was not an obligation in this research contract.

9. Conclusions

In this paper, the issues involved in the reliability of military systems were reviewed and the various measures of reliability of military systems were reviewed. The various means of improving the reliability of military systems were presented. The importance of redundancy as a means to improve the reliability of military systems was stressed both in hardware and decision making processes in military systems. The failure rate and mean time to failure of an electronic fuze that incorporates redundancy were calculated based on MIL-HDBK-217F.

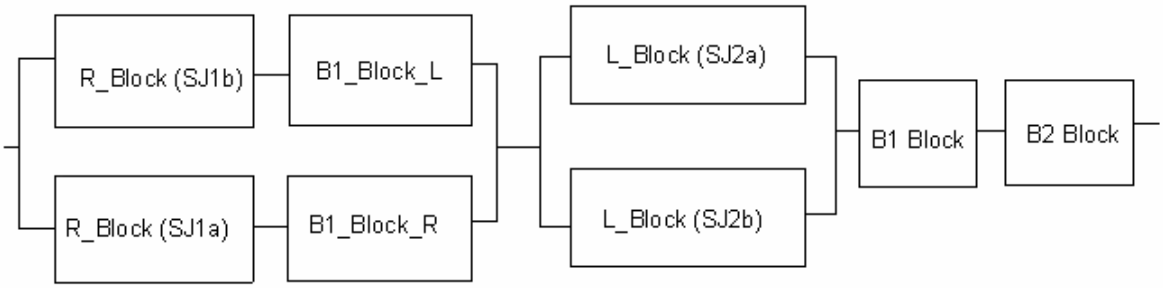

Fig. 5. The reliability block diagram of fuze electronics

Table 7 – Failure rate and mean time to failure calculations for the fuze with redundancy

No.	Module Title	λ_{ML} (FPMH)	λ_{MF} (FPMH)	$MTTF_{ML}$ (HRS)	$MTTF_{MF}$ (HRS)
1	(R_BLOCK(SJ1a)ANDB1_Block_R)OR (R_BLOCK(SJ1b)ANDB1_Block_L)	32.2476	7.2943	31010.05966	137093.3469
2	(L_Block (Sj2a))OR(L_Block(SJ2b))	19.4254	4.3357	51478.99142	23064.2641
3	B1 Block	1.2143	0.2366	823519.7233	422654.688
4	B2 Block	21.9237	9.0469	45612.73873	110535.1004
TOTAL ESTIMATED MTTF:		74.811	20.9135	13367.01822	47816.00402

Acknowledgements

This work was supported by the Grant 3064 (1388/3/30) Project of the Vice Chancellor of Research and Technology of the Ferdowsi University of Mashhad, and a military grant from the Office of Applied Research of the Ferdowsi University of Mashhad.

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Tourism Development in Local Communities: As a Community Development Approach

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Abstract: This article illustrates the role of local communities for tourism development. This study also attempts to highlight the role of tourism local development. This article looks at how local communities can develop tourism in local area. The concepts of community and community development have been important for local tourism development. The implication of this study arises from the fact that there has been little research carried out on interaction between communities and local tourism. Theoretically, the findings of this study enrich the knowledge concerning local tourism industry [Journal of American Science 2010;6(2):155-161]. (ISSN: 1545-1003).

Keywords: local communities, tourism development, community development

1. Introduction

Community is one component for understanding community development for tourism development but is also important to appreciate how community affects local tourism development. Local communities have a key role in tourism development as they are crucial in providing a good environmental condition for tourists. Local communities are a basic element of modern tourism development. They are the focal point for the supply of accommodation, catering, information, transport, facilities and services for tourism development (Godfrey & Clarke, 2000). The term community can have a specific geographic meaning with a clearly defined spatial boundary and area and also refers to groups of people with a common interest (Chapman & Kirk, 2001). According to Bradshaw (2008, p. 6) Community as defined has historically shared boundaries one's geography of residence. For the purpose of this study, community is defined as a group of individuals living or working within the same geographic area with some shared cultures or common interests. This geographical definition of community is essential to understand how community development is linked to the ability of a community to improve tourism development.

The role of the local community in influencing the tourism development activities are becoming clearer (Hall et al., 2005). McIntyre, et al. (1993, p. 50) states that local communities must organize themselves at all levels to play a more effective role in development, and interact with government and role-players at all levels. They must be able to identify potential tourism resources and attractions within their communities and support responsible tourism and community development. They should be eager participants in tourism decision making with respect to major tourism development for communities. Kepe (2004, p. 45) states that local communities should play a proactive role to ensure positive benefits from tourism. Local communities should work closely with Non-governmental Organizations (NGOs) to educate others in the community concerning tourism development projects.

2. Local communities

There is numerous definition of "community". In understanding the meaning of community development, the study needs first to be clear about the term of "community" itself. The definition of community is highly problematic and there are many definitions (Tesoriero & Lfe, 2006). For most

tourism purposes, the concept of community often hinged upon a common location. However, it has also been used to refer to groups that are not geographically determined but share common characteristics or interests. For the assessing the level of tourism development, a community can be any existing or potential network of individuals, groups and organizations that share or have the potential to share common concerns, interest and goals (Bush et al., 2002). According to Dalton et al. (2001) notion of community tend to falls within two major classifications. One a territorial conception of community based on geographic location and the other, relational conception of community based on social network relationships.

Ivanovic (2009, p. 14) states that "Sociology use two approaches in defining community. First, it regards community as a territorial concept, and second, it regards community as a relational concept". As a territorial concept, a community can be defined and delineated on a map. A community has a name, borders, landmarks, types of people and recognizable symbols. Community as a rational concept represents people who are tied together by communication, friendship and association (Ivanovic, 2009). The term community is most commonly defined as residents contained by geographical boundaries, local zoning, or politics; the ethnicity of its residents or the resources or industry established in the area (Chaskin et al.,2001; Mancini et al., 2003). The local community play a fundamental role in the lives of its members by promoting their physical, social, psychological, and spiritual well-being (Mancini et al., 2003). The operational definition of "community" (Chaskin et al.,2001) is a geographical area that assumes a commonality of circumstances and identity among its people and contains functional units for the delivery of goods and services. In contrast, a "community" refers to a group of people who are associated in some way. However the most common definition of community is based on geographic location (Mahoney et al., 2007).

The origins of the modern notion of community are generally traced back to the late 18th century. This was a time of growing industrialization and urbanization. One of the most important writers on the topic was Ferdinand Tonnies, who summarized this form of thought in 1887 in his book *Gemeinschaft* and *Gesellschaft.* The term Gemeinschaft refers to a community that is characterised by associations based on mutual aid and trust. Gesellschaft refers to society, characterized by associations based on individual self-interest (Goodwin, 2003). Hence the historical discussion of community begins with Tonnies work on Gemeinschaft and Gesellschaft (Ricketts & Phipps, 2008; Wood & Judikis, 2002). Tonnies represents these two perspectives of community as a shift from Gemeinschaft towards that of Gesellschaft. Gemeinschaft can be described in three dimensions, through kinship, locality and mind, and actions are considered in the context of some common purpose or goal. Gemeinschaft is characterized by a strong identification with community, emotionalism, traditionalism and holistic conceptions to other members of the community (Ricketts & Phipps, 2008). When reviewing research literature on community development and tourism development, it is necessary to understand the definition of community as it was used in research. One must understand the concept of community in order to understand the purpose of community development. Therefore, this section of the literature review offers definitions of community and discusses the needs for community development by illustrating the nature of problems in local communities. Hillery (1955) suggested that there were at least ninety four different definitions of community. He presented the general definitions of community: community consists of persons in social and cultural interaction within geographic area and having one or more additional common ties. Mattessich & Monsey (2004, p. 56) defined community as a "people who live within a geographically defined area and who have social and psychological ties with each other and with the place where they live". This definition was used in study for definition of community as the main concept for tourism development. Fellin (2001) also described local communities as social systems, including families, groups, organizations. He noted that community is a social unit based on a common place, interest, identification, or some combination of these characteristics. Dalton et al. (2001) also states community is a meaningful entity that represents resources of empowerment (Dalton et al., 2001).

According to Telfer & Shrpley (2008) there is a wide range of perspectives that can be taken on local communities in the context of tourism development. Local communities may be considered as the main attractions to community skill and knowledge while for others the community is simply the setting where tourism occurs. And for others still, a community may, in fact, stand in the way of other potential tourism development. Local communities are increasingly being drawn into tourism not only from the demand side, as tourists actively seek out new destinations and communities to experience, but also from the supply side, as communities are becoming aware of the potential of the products they can offer to tourists and the economic gains that can be made (Telfer & Sharpley, 2008, p. 115).

3. Community Development

The concept of community development is explored in terms of participation, empowerment and community capacity as they related to tourism development (Singh, Timothy, & Dowling, 2003). Community development can be seen as building social capital for collective benefits. It uses skill and knowledge and strategy in their practice (Gilchrist, 2004). Community development aims to increase citizens' participation in their community. In community development, emphasis is placed on community as a social system, bounded by geographical location or common interest (Talbot & Verrinder, 2005). Community development is linked to community capacity building through a shared focus of building capacity to a collective participatory force (Williams, 2004). According to Frank & Smith (1999) community development is the planned evaluation of all aspects of community well-being. Community development is undertaken to strengthen or build community relationship and strengthen structures that have become fragmented (Yan, 2004). According to Gilchrist (2004) community development helps local community residents to identify unmet needs. It seeks to build capacity by improving skill and knowledge for individuals and the community as a whole (Gilchrist, 2004). Community development is viewed as the best way to build the capacity of community residents to engage with each other and find solutions to issues that affect their community. Community development holds potential to build community cohesion by facilitating a community's capacity to engage connections between individuals, organizations and groups (Chaskin et al., 2001). Helping a community to build its capacity for development is a primary goal of community development (Ife, 2002). Community development is a process that allows community residents to come together to plan, generate solutions and take action developing the evolution of social, economic, environmental and cultural aspects of community (Hackett, 2004). Community development emphasizes the importance of participation as a means of strengthening local communities (Kuponiyi, 2008). Increased community capacity building is a result of successful community development (Hackett, 2004). Hence, the process of tourism development in local communities is the process of community development. Community development builds peoples' skills for community issue. Hence it is vital to the survival of local communities (Talbot & Verrinder, 2005). The figure (1) illustrates components of community development in local communities.

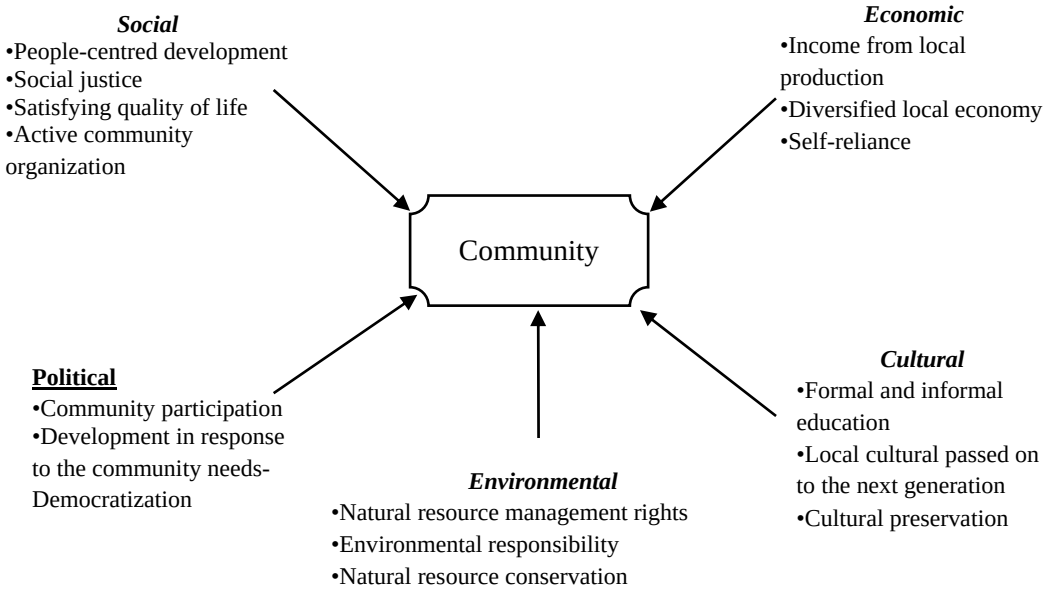

Figure 1. Five Aspects of Community Development. Adapted from Suansri (2004)

4. Tourism and Community Development

Tourism is increasingly seen as a key community tool, with the recognition of its economic contribution in bolstering stagnating economies and its ability to unify local community residents (Fennell, 2003). At community levels, tourism offered opportunities for direct, indirect, and induced employment and income, spurring regional and local economic development (Aref, 2010; Coccossis, 2004). According to Godfrey & Clarke (2000) tourism development is an ongoing process. It is no economic panacea, and is best suited as a supplement to a local community for achieving development (Godfrey & Clarke, 2000). Bushell & Eagles (2007) says tourism plays a role in facilitating community development through business mentoring and educational opportunities that contribute to local communities in increasing skill and knowledge in local communities and local residents as well as improving the community's economic level. The process of tourism development is important as an important tool in community development. Hence many local communities have turned to tourism development to provide economic, social, cultural and overall development of the community. Allen, et al., (1993) suggested that tourism is increasingly being viewed as an important component community development. However, while there is appreciation of tourism as a development tool, there is little understanding of tourism development in the literature. In recent years as local communities have realized the developmental promise of tourism, there has been also a growth in research on tourism and its contribution to community development. Tourism holds promise for local community development as illustrated in the studies, but how can tourism be developed? This study attempted to answers this question through community capacity building. Tourism has grown as a topic of research in the field of community development and community development researchers have increasingly investigated tourism and its potential (Flora et al., 1992). However, there is no research on how a certain community developed tourism when it decided to become a tourist destination. Before tourism can be used as a developmental tool in a community, it has to be developed. However, there is a little literature that explains the process development of tourism through local communities. That gap in the tourism research was apparent and the gap will be to be attempted to be filled by this study. The following figure shows the contribution of tourism in community development.

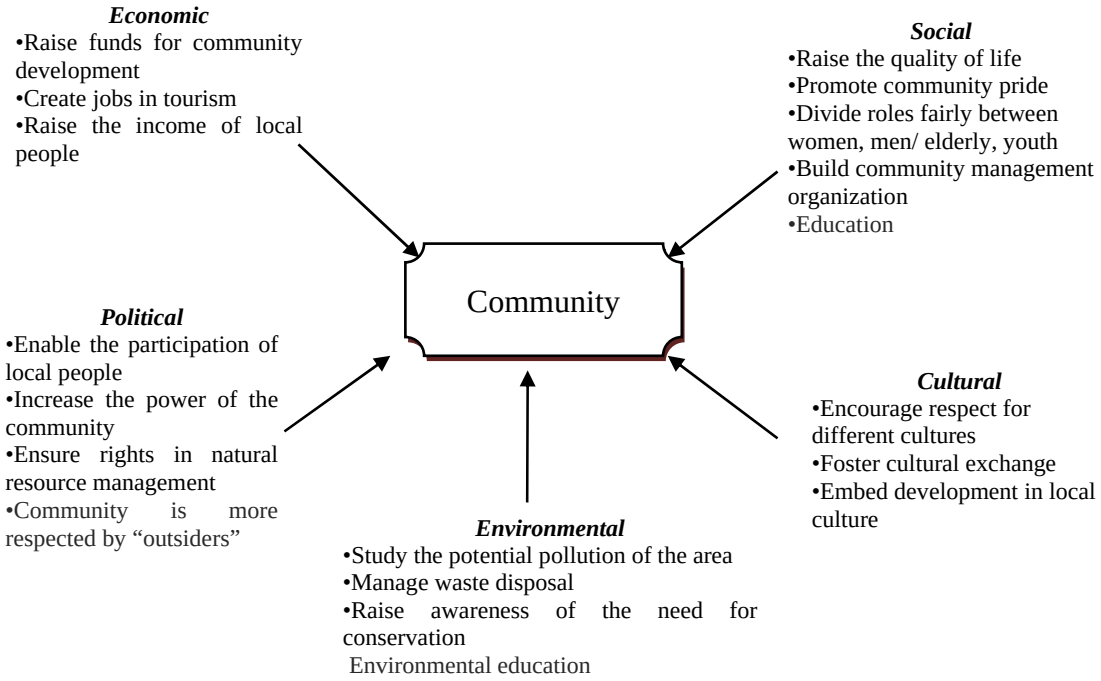

Figure 2: Contribution of Tourism in Community. Adapted from Strasdas (2005) & Suansri (2004)

5. Community Development for Tourism Development

The development of tourism in local communities is often an illustration of a community taking advantage of resources within community, which is an example of self-help approach to community development. The most prevalent approaches are: the self-help approaches to community development which is a strategy of community development in tourism development (Christenson, 1989). The technical assistance approach to community development is based on technical information and expertise for improving the tourism in local communities. However, this approach has a downside and it can limit community capacity building. This is because governments use the technical approach to develop tourism and this can disempowering local community and create dependency (Cavaye, 2000). Some writers referred to technical assistance as a key element in building community capacity and increase skill (Rural Voices for Conservation Coalition, 2007). Zody (1980) agrees that technical assistance solves short-term problems, it can establish dependency relationship that becomes part of the problem. Brown (1980) argues technical assistance does not address a real community's capacity building. According to Cavaye (2000), however the support of the government through a technical assistance can be limit building capacity. Yet at the same time, government can also develop partnerships that foster community capacity building for tourism development. Thus in third world countries particularly, without the government support, community capacity cannot be achieved. The conflict approach stresses the equal distribution of resource in community and usually focuses on those with limited power. The idea of the conflict approach is to get people together to change a community (Christenson, 1989). In this study, this approach has referred to decentralization in tourism organization and so it can refer to community participation in tourism development. In summary, community development literature is relevant to this study as it provides the rational and theoretical background for tourism development.

6. Conclusion

This paper takes a closer look at tourism based in local areas and their associated communities. Local communities are a main reason for tourists to travel, to experience the way of life and material products of different communities. Local communities also shape the 'natural' landscapes, which many tourists consume. Communities are, of course, also the source of tourists; tourists are drawn from particular places and social contexts which in themselves will help shape the context of the tourist's experience in the host community (Richards & Hall, 2000). Consequently, tourism can positively promote a community to potential investors and residents as well as visitors. This paper showed a brief conception of community and its involvement in the tourism development (Beeton, 2006). The main importance approaches that suggested in this study were self-help approaches for community development through tourism development. Hence, this study can be motivation for futures investigate in local communities base tourism development.

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Date submission: 21/ 9/ 2009

The Study of Persian Gulf Cuttlefish (Sepia pharaonis) Chromosome Via Incubation of Blood Cells

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Abstract: Nowadays it is recognized that cuttlefish have extensive function in different basis. Despite this, there is some information about biology of cuttlefish. Due to this fact that no chromosomal study on *Sepia pharaonis* in Iran and even all over the world, has been dene, they just consider the chromosomes numbers in *Sepia pharaonis* in Persian Gulf (Bahracan region). Bahracan is one of the important fishing ground in eastern part of Khuzestan province. In this area fishermen hunt aquatic animals with trawl and gargoor. In this project blood cell Incubation was used. Chromosomes preparations of the Cuttlefish *Sepia pharaonis* were studied using conventional Gimsa staining. The numbers of diploid chromosomes (2N) of *Sepia pharaonis* were 48 and most of the metaphase plackes were in a range of 42 to 56. [Journal of American Science 2010;6(2):162-164]. (ISSN: 1545-1003)].

Key words: Cuttlefishes, Sepia pharaonis, Cytogenetics, Persian Gulf

1. Introduction

A subclass of Coleoidea includes two subdivisions which Neocoleoidea is one of them (Nishinguchi, 2007). It contains Octopuses, Squids and Cuttlefishes. Neocoleoid is characterized by either, reduction and internalization of the shell or complete loss of it (Nishinguchi, 2007) so, as a result of it, a little information about origin and its relatives is available (Nishinguchi, 2007).

The shelled Cephalopods which originally belong to period of cenozoid (Khromov, 1998), such as all present forms of Squids and Cuttlefishes, have a vast distribution such as, regions of Indo-Pacific, along the coast line of the African coast to the Red Sea, Arabian Sea and China Sea (Meriem, 2001). In the above mentioned waters, the main distribution appears in the less than 50 m. depth.

Sepiidae family which belongs to order of Sepioidea (Roper, 2005), has significant value to commercial and industrial fisheries. Generally, due to the food crises which may end to a big disaster (Verbeke, 2005), sooner or lather is beter to be studied. More so that we would able to get benefit of it, in a large amount, in human consumption, all over the world.

To the fact that the recent molecular studies, have shown a high level of differences between phylogenetics of Coleoid Cephalopods (Strugnell, 2007), the produced results are conflicting and to extend more confusing.

By taking in to account, the different geographical areas and observation of the fact of adaptation, encourage us to focus on the study of phylogenetics of Sepia pharaonis in Bahracan, which is a part of Persian Gulf. In this respect, the numbsr of chromosomes of Sepia pharaonis was determined and then it was compared with other species.

Chromosomal changes, particularly polyploidy, have played a significant role in the evolution of plants, and most higher plants are recent polyploids (DeWit, 1980). Although polyploidy is relatively rare in animals, chromosomal changes are increasingly recognized as an important force in animal evolution. The extent of chromosomal changes and their roles in speciation are poorly understood in many animal taxa, including marine cephalopods. Chromosomal studies may provide a unique perspective on the evolution of marine cephalopods.

2. Material and Methods

The species of Sepia pharaonis, were collected from Bahracan regions which is part of Persian Gulf and is located in 49˚30´ E to 49˚55´ E; 30˚15´ N to 29˚ 50´ N. In this area fishermen hunt aquatic animals with trawl and gargoor.

The collected specimens were identified accordingly Silas, 1985; Aoyama and Nguyan, 1989 and Graham, 1994.

At the sea, blood samples were taken from 10 specimens that were chosen randomly from different catches of the area. Blood, spesificly, obtained from the central heart and branchial heart (figure1), and it resuspend in RPMI 1640. Cell division was arrested at the metaphases, using colchicin solution at the concentration of 0.1 cc. cells were incubated with cold 0.075 M Kcl solution for 20 minutes, prior to fixing in a fresh solution of acetic acid / methanol (1:3) for 10 minutes. Cell suspention which was dropped on the slides, was air dried and stained with 5% of Gimsa solution for about 15-20 minutes. The slides were observed by light microscope (Olympus, Japan), equipped with camera. Metaphase chromosomes were examined at 1000X magnification.

Then they were photographed and counted. Representative metaphases were printed on high contrast papers.

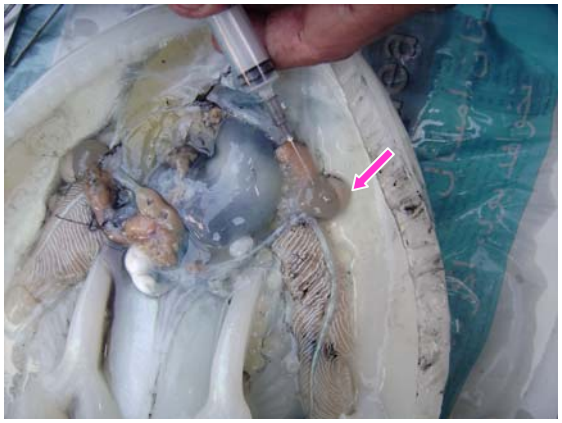

Figure 1. blood taken from branchial heart of *Sepia pharaonis*

3. Results

The obtained results showed that the numbers of diploid chromosomes (2N) of Sepia pharaonis were clearly 48 (figure2) and most of the metaphases plackes were in a range of 42 to 56. From the point of view of morphology, the chromosomes were different kinds such as submetacentric, telocentric and acrocentric. In adition, micro chromosomes were observed in all the pelackes.

In 2005, Karyological studies were made by Yue Mian and Yutaka on the embryos of seven cephalopods using chopping method. Two sepiids (Sepia esculenta and Sepia lycidas) and three loliginids (Sepioteuthis lessoniana, Heterololigo bleekeri and Photololigo edulis) were all 2n=92. Their karyotypes and total length of chromosomes were slightly different from each other. Two octopuses (Octopus ocel-latus and O. vulgaris) were both 2n=60. Their karyotypes and total length of chromosomes were, however, remarkably different from each other.

Nakamura, 1985, showed that chromosomes of cephalopoda species have high diploid numbers, 2N= 52 and 56.

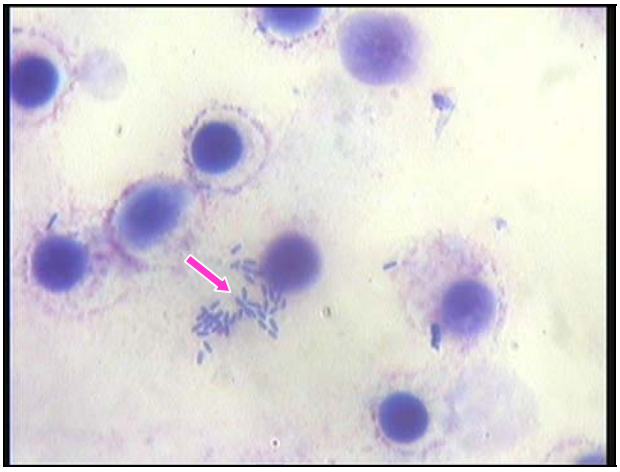

Figure 2. metaphases pelackes in *Sepia pharaonis*

4. Discussions

Phylogenetic studies based on nuclear and mitochondrial gene sequences have helped clarify cephalopod taxonomy. 18S rDNA sequences are available in a large range of taxa including cephalopods. The chromosomes number of cephalopods (52-112) are the highest among Mollusca (28-32) and their progression appears non-random. The number of chromosomes and the proportion of large chromosomes are higher in Decabrachia than in Octopoda. Thus, both number and morphology appear to change radically during evolution.

According to Nakamura, 1985, the range of the numbers of diploid (2N) chromosomes in Bivalves is 14 to 48, in Polyplacophora is 12 to 26 and in Cephalopoda is 52 to 56. in thus respect, it is clear that among the rest of the above mentioned invertebrates, Cephalopods has the highest number of chromosomes, although, Nutilus has the lowest number of chromosomes than other Cephalopods which is said, it is probably a matter of its ancestral (Bonnaud, 2003).

There is not published information on the chromosomal morphology of Cephalopoda. Inaba (2007) showed that Octopus vulgaris and Octopus variabilis have 2N = 56 chromosomes.

Cytogenetic data are used in taxonomoi analyses. Gene sequences, chromosome number and morphology can all be used as phylogenetic indicators, conservatism of

chromosomes number being reported for many mollusc groups.

In the present study, species of Sepia pharaonis has number 2N = 48 chromosomes. Also they are, submetacentric, telocentric and acrocentric. Moreover, in all the plackes microchromosomes were observed.

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19/9/2009

Effect of processing methods on chemical and consumer acceptability of kenaf and corchorus vegetables

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Abstract: Kenaf leaves are rich in nutrients with satisfactory protein digestibility. *Corchorus olitorious (Ewedu)* popularly consumed in West Africa is also known to be rich in nutrients. There is however little information about the cooking properties and utilization of kenaf leaves in human diet. The effect of processing methods on chemical and consumer acceptability of Kenaf and *Corchorus* vegetables were investigated. Freshly harvested kenaf leaves (Ife-ken 400, Cuba 108 and Ife-ken 100) and *Corchorus Olitorious* (*C. Olitorius*) wre blanched and cooked, cooked and dry and cooked were subjected to chemical analysis such as (Protein, fat ,crude fibre, ash, moisture and vitamin C). Sensory evaluation was by a ten member panel randomly selected from male and female adults. Cooked *C.Olitorius* was significantly higher in crude fibre (1.67%), ash (3.36%) and vitamin C (27.13). Cooked Ife ken 400 was higher in crude protein (1.70%), Crude fat (0.48%), crude fibre (1.54%), ash (3.36%) and vitamin C(21.32) when it was compared with other treated kenaf leaf samples. Cooked vegetables were higher in compositional attributes than blanched and cooked vegetables and dry and cooked vegetables. Dry and cooked *C.Olitorius* was significantly higher in colour (7.7), taste (7.4) and mouth feel (7.1). There was no significant difference in flavour of processed vegetable samples. Cooked *C.Olitorius* was higher in overall acceptability (7.1). In general processing methods did not adversely alter the quality of the processed leafy vegetables and processed kenaf leaves compared favourably well with *C.Olitorius* in compositional and sensory attributes. [Journal of American Science 2010;6(2):165-170]. (ISSN:1545-1003).

Keywords: kenaf, cooked, processing , Corchorus olitorious, sensory

Introduction

Leafy vegetables play crucial roles in alleviating hunger and food security and that is why they are very important in the diet of many people. Apart from the variety which they add to the menu. They are valuable sources of nutrients where they contribute substantially to protein, mineral, vitamins, fiber and other nutrients which are usually in short supply in daily diets (Solanke and Awonorin, 2002). In addition to their high concentration of micronutrients, vegetables provide little dietary energy, making them valuable in energy limited diets. The fibre content has been reported to have beneficial effects on blood cholesterol and aids in the prevention of large bowel diseases, while in diabetic subjects, they improve glucose tolerance. They also add flavour, variety, taste, colour and aesthetic appeal to what would otherwise be a monotonous diet. They are in abundance shortly after the rainy season but become scarce during the dry season during which cultivated types are used.

Kenaf (*Hibiscus cannabinus L*) is a warm season annual herbaceous plant closely related to cotton (*Gossypium hirsutum*) and okra (*Abelmoschus esculentus*).Its leaves are low in calories and rich in protein and essential oils such as (E)-phytol (28.16%), (Z)-phytol (8.02%), n-nonanal (5.70%), benzene acetaldehyde (4.39%), (E)-2-hexenal (3.10%), and 5-methylfurfural (3.00%) when compared to other leafy vegetables. The leaves are also rich in calcium and phosphorus and have appreciable amounts of Vitamin C. The seeds are rich in essential fatty acids and calories. (Kobaisy *et al.*, 2001)

Corchorus Olitorius is a very popular vegetable in West Africa. The young shoot tips can be eaten raw or cooked and it contains high levels of protein and vitamin C

Leafy vegetables are sometimes processed by blanching which is an important pre-processing heat –treatment of vegetable destined for freezing, canning or dehydration. They are also cooked or dried depending on the mode of utilization.(Shittu and Ogunmoyela 2001).

There is however little information about the cooking properties and utilization of kenaf leaves in human diet. Therefore, the need for detail study on the contribution and suitability of kenaf leaf to human diet.

This work is therefore aimed at evaluating the effect of processing methods on chemical composition and consumer acceptability of new and exotic varieties of kenaf and *corchorus* leaves.

Materials and Methods

Raw materials

Freshly harvested kenaf leaves (Ife ken 400, cuba 108 and Ife ken 100) and corchorus leaves were obtained from the experimental farm of the Institute of Agricultural Research and Training (I. A. R. & T.), Moor Plantation, Ibadan Nigeria. The fresh samples were blanched and cooked, dry and cooked and cooked.

Blanching and cooking process

The freshly harvested vegetable leaves (100gm) were thoroughly cleaned in water to removed extraneous matter before soaking in 200mls of hot water for 30 seconds after which they chopped and cooked for 10minutes. A pinch of salt was added to taste

Drying and cooking process

The freshly harvested vegetable leaves (100gm) were thoroughly cleaned in water to removed extraneous matter. They were then chopped and dried for 24hours at $55^{O}C$ before cooking in water for 10mins. A pinch of salt was added to taste

Cooking process

The freshly harvested vegetable leaves(100gm) were thoroughly cleaned in water to removed extraneous matter. They were then chopped before cooking in water for 10mins. A pinch of salt was added to taste

Chemical analysis

Determination of Crude Protein

The micro-Kjeldahl method for protein determination is employed for protein determination. This is based on three principles:

Digestion: $RNH_2 + 2H_2SO_4 \longrightarrow (NH_4)_2 + SO_4 + CO_2 + H_2O$

Distillation: $(NH_4)_2\ SO_4 + 2NaOH \longrightarrow (NH_3 + H_2O + Na_2SO_4$

Absorption: $3NH_3 + H_3BO_3 \longrightarrow (NH_4)_3\ BO_3$

Titration: $(NH_4)_3\ BO_3 + HCl \longrightarrow H_3BO_3 + 3NH_4Cl$

Procedure

The sample (0.5g) was weighed into the micro-Kjeldahl flask. To this were added 1 Kjeldahl catalyst tablet and 10ml of conc. H_2SO_4. These were set in the appropriate hole of the digestion block heaters in a fume cupboard. The digestion was left on for 4 hours after which a clear colourless solution was left in the tube. The digest was carefully transferred into 100ml volumetric flask, thoroughly rinsing the digestion tube with distilled water and the volume of the flask made up to the mark with distilled water. 5ml portion of the digest was then pipetted to Kjeldahl apparatus and 5ml of 40% ($^{w}/_{v}$) NaOH added.

The mixture was then steam distilled and the liberated ammonia collected into a 50ml conical flask containing 10ml of 2% boric acid plus mixed indicator solution. The green colour lsolution was then titrated against 0.01 NHCl solution. At the end point, the green colour turns to wine colour, which indicates that, all the nitrogen trapped as ammonium borate have been removed as ammonium chloride. The percentage nitrogen was calculated by using the formula:

% N = Titre value x atomic mass of nitrogen x normality of HCl used x 4

The crude protein is determined by multiplying percentage nitrogen by a constant factor of 6.25 (AOAC, 1990).

Crude Fat Determination

The sample (1g) was weighed into fat free extraction thimble and plug lightly with cotton wool. The thimble was placed in the extractor and fitted up with reflux condenser and a 250ml soxhlet flask which has been previously dried in the oven, cooled in the dessicator and weighed. The soxhlet flask is then filled to ¾ of it volume with petroleum either (b.pt. 40 – 60°C) and the soxhlet flask extractor plus condenser set was placed on the heater. The heater was put on for six hours with constant running water from the tap for condensation of ether vapour. The set is constantly watched for ether leaks and the heat sources is adjusted appropriately for the either to bril gently. The ether is left to siphon over several times at least 10 – 12 times until it is short of siphoning. It is after this is noticed that any ether content of the extractor is carefully drained into the ether stock bottle. The thimble-containing sample is then removed and dried on a clock glass on the bench top. The extractor flask with condenser is replaced and the distillation continues until the flask is practically dried. The flask which now contains the fat or oil is detached, its exterior cleaned and dried to a constant weight in the oven (AOAC,

1990). If the initial weight of dry soxhlet flask is Wo and the final weight of oven dried flask + oil/fat is W_1, percentage fat/oil is obtained by the formula:

$$\frac{W_1 - Wo}{\text{Weight of sample taken}} \times \frac{100}{1}$$

Crude Fibre Determination

The sample (2g) was accurately weighed into the fibre flask and 100ml of $0.25NH_2SO_4$ added. The mixture was heated under reflux for 1 hour with the heating mantle. The hot mixture was filtered through a fibre sieve cloth. The filterate obtained was thrown off and the residue was returned to the fibre flask to which 100ml of (0.31NNaOH) was added and heated under reflex for another 1 hour.

The mixture was filtered through a fibre sieve cloth and 10ml of acetone added to dissolve any organic constituent. The residue was washed with about 50ml hot water twice on the sieve cloth before it was finally transferred into the crucible. The crucible and the residue was oven-dried at 105°C overnight to drive off moisture. The oven-dried crucible containing the residue was cooled in a dessicator and later weighed to obtain the weight W_1. The crucible with weight W_1 was transferred to the muffle furnace for ashing at 550°C for 4 hours. The crucible containing white or grey ash (free of carbonaceous material) was cooled in the dessicator and weighed to obtain W_2. The difference $W_1 - W_2$ gives the weight of fibre (AOAC, 1990). The percentage fibre was obtained by the formula:

$$\% \text{ Fibre} = \frac{W_1 - W_2}{\text{Weight of sample}} \times \frac{100}{1}$$

Determination of Ash

The sample (2g) was weighed into a porcelain crucible. This was transferred into the muffle furnace set at 550°C and left for about 4 hours. About this time it had turned to white ash. The crucible and its content were cooled to about 100°C in air, then room temperature in a desiccator and weighed (AOAC, 1990).

The percentage ash was calculated from the formula below:

$$\% \text{ Ash content} = \frac{\text{Weight of ash}}{\text{Original weight of sample}} \times \frac{100}{1}$$

Moisture content Determination

The sample (2g) was weighed into a previously weighed crucible. The crucible plus sample taken was then transferred into the oven set at 100C to dry to a constant weight for 24 hours overnight. At the end of the 24 hours, the crucible plus sample was removed from the oven and transferred to desiccator, cooled for ten minutes and weighed (AOAC, 1990).

If the weight of empty crucible is Wo

Weight of crucible plus sample is W1

Weight of crucible plus oven dried sample W3

$$(\% \text{ Moisture}) = \frac{W_1 - W_3}{W_1 - W_0} \times 100$$

Determination of Vitamin C:

Ascorbic acid was determined using the procedure described by Kirk and Sawyer (1991). Standard indophenol's solution was prepared by dissolving 0.05g 2,6-dichloro Indophenol in water diluted to 100ml and filtered. To standardize, 0.053g of ascorbic acid was dissolved in 90ml of 20% metaphosphoric acid and diluted with water to 100ml. 10ml of this solution was pipette into a small conical flask and titrated with indophenol's solution until a faint pink colour persists for 15seconds. 2ml of the extracted juice from the calyces was pipette into a conical flask and 5ml of 20% metaphosphoric acid (as stabilizing agent) was added and made up to 10ml mark with water. It was titrated with the indophenols solution a faint pink colour persists for 15seconds. The vitamin content in the calyces was calculated

$$\text{Vitamin C in mg/100g} = \frac{\text{Titre value} \times 0.212 \times 100}{\text{Wt of sample}}$$

Sensory evaluation

Sensory evaluation of vegetable samples were on the basis of colour, taste, flavour mouth feel and overall acceptability using ten membered untrained male and female adults that are familiar with the product in question. They were independently evaluated using the difference technique described by Larmond (1977). The nine-point hedonic scale was used to determine the preference of panelist. Ratings were from (1-9). One corresponding with extreme dislike and nine with extreme likeness.

Data generated were subjected to statistical analysis using Duncan Multiple range test (Duncan, 1955)

Results and discussion

Table 1 depicts the effect of different processing methods on chemical composition of kenaf and corchorus leaves. In blanched and cooked vegetables, Corchorus vegetables was significantly higher than other blanched and cooked kenaf vegetables in protein, fat, crude fibre, ash and vitamin C although blanched and cooked Ife-ken 400 was significantly higher than other blanched and cooked kenaf based vegetables in proximate compositional attributes. The differences observed may be due to varietal influence (Richard *et al.,* 2007, Oboh 2005, Ado 1993)

In cooked vegetables, it was also seen that cooked corchorus leaves was higher in proximate parameters with cooked Ife-ken 400 being significantly higher than other cooked kenaf vegetables in protein, fat, crude fibre, ash, and vitamin C. There was no significant difference in the moisture content of cooked vegetable samples at $p<0.05$. Cooking is popularly known to decrease the nutrient attributes of foods (Oladumoye *et a.,l* 2005, Oteng-Gyang and Machi 1987)

In dry and cooked vegetables, dry and cooked Corchorus leaves was higher in protein, fat, crude fibre and vitamin C. There was no significant difference in the ash contents of dry and cooked corchorus and cuba (108) kenaf leaves. The moisture content of all dry and cooked vegetables were not significantly different from each other. This finding agreed with the report of Oshodi (1992) about variability in the compositional attributes of some dried vegetables.

In general kenaf cooked leafy vegetables were higher in compositional attributes than blanched and cooked vegetables and dry and cooked vegetables. Processed kenaf vegetables compared favourably well with processed corchorus vegetables.

Table 1. Effect of processing methods on chemical composition of Kenaf and corchorus leaves.

	Protein (%)	Fat (%)	Fibre (%)	Ash (%)	Moisture (%)	Vitamin C Mg/100g
Blanched/Cooked						
C.Olitorius	1.82^{a}	0.47^{c}	1.55^{b}	3.27^{c}	85.78^{a}	26.31^{b}
Ife-ken (400)	1.63^{d}	0.43^{d}	1.46^{c}	2.96^{f}	87.35^{a}	18.23^{d}
Cuba (108)	1.22^{h}	0.21^{h}	1.22^{g}	2.33^{k}	89.58^{a}	13.19^{f}
Ife-ken (100)	1.14^{i}	0.24^{g}	1.25^{f}	2.47^{j}	89.25^{a}	9.83^{i}
Cooked						
C.Olitorius	1.93^{a}	0.62^{a}	1.67^{a}	3.51^{a}	88.35^{a}	27.13^{a}
Ife-ken (400)	1.70^{c}	0.48^{c}	1.54^{b}	3.36^{b}	88.70^{a}	21.32^{c}
Cuba (108)	1.53^{e}	0.43^{d}	1.35^{e}	3.22^{d}	88.74^{a}	18.23^{d}
Ife-ken (100)	1.29^{g}	0.29^{f}	1.24^{f}	3.16^{e}	89.04^{a}	14.65^{e}
Dry and cooked						
C.Olitorius	1.72^{b}	0.52^{b}	1.47^{c}	2.83^{g}	87.57^{a}	12.75^{g}
Ife-ken (400)	1.47^{e}	0.37^{e}	1.24^{f}	2.64^{h}	87.74^{a}	9.33^{j}
Cuba (108)	1.51^{f}	0.45^{d}	1.40^{d}	2.80^{g}	86.99^{a}	11.53^{h}
Ife-ken (100)	1.30^{g}	0.28^{f}	1.16^{h}	2.54^{i}	88.55^{a}	8.46^{k}

Means in the same column followed by the same letter are not significantly different from each other at $P<0.05$

Table 2 describes the effect of different processing methods on sensory properties of kenaf and corchorus leaves.

The colour of dry and cooked corchorus olitorius was significantly higher than other processed vegetables. Dry and cooked Ife-ken (400) and cuba (108) kenaf vegetables were not significantly different from cooked Ife-ken (400) and cooked cuba (108). This indicates that drying process did not mar their colour. It was also observed that blanched and cooked cuba (108) and blanched and cooked Ife-ken (100) were not significantly different from cooked cuba (108) and cooked Ife-ken (100). Blanching did not adversely affect the colour of the vegetables. This finding agreed with the report of (Nantawan and Weibiao 2009, Onayemi and Badifu 1989). The taste of dry and cooked corchorus olitorius was significantly higher than other treated vegetables at $p<0.05$. However, the taste of dry and cooked Ife-ken 400, dry and cooked cuba (108), cooked Ife-ken (400), blanched and cooked cuba (108) and blanched and

cooked Ife-ken (1000 were not significantly different from each other. This is an indication of the fact that the different processing methods did not adversely affect their taste. Hudson and Janice (2004) reported the similar trend with dehydrated cowpea leaves.

The flavour of all processed vegetables were not significantly different from each other at $p<0.05$. Processing methods did not adversely affect the flavour of the vegetables (Hudson and Janice 2004).

Dry and cooked corchorus olitorius was also significantly higher in mouthfeel at $p<0.05$. Dry and cooked Ife-ken (400), dry and cooked cuba (108) and cooked Ife-ken (400) were not significantly different from each other at $p<0.05$.

Blanched and cooked cuba (108), blanched and cooked Ife-ken (100), cooked cuba (108) and dry and cooked Ife-ken (100) are all significantly lower than other treated vegetables in mouth feel but are not significantly different from each other.

General acceptability scores showed that cooked *corchorius olitorius* was higher and all blanched and cooked vegetables with dry and cooked vegetables were not significantly different from each other at $p<0.05$. Cooked kenaf vegetable (108) was significantly lower than others.

It is therefore of noteworthy that acceptable sensory scores were given to processed kenaf leaves and none was rejected.

Table 2. Effect of processing methods on sensory properties of Kenaf and corchorus leaves.

	Colour	Taste	Flavour	Mouth feel	General acceptability
Blanched/Cooked					
C.Olitorius	7.00^{abc}	6.50^{abc}	6.60^{a}	6.20^{abc}	6.10^{ab}
Ife-ken (400)	6.20^{bcd}	5.30^{c}	5.90^{a}	5.70^{abc}	5.70^{ab}
Cuba (108)	5.80^{cd}	5.50^{bc}	5.40^{a}	5.00^{c}	5.80^{ab}
Ife-ken (100)	5.80^{cd}	5.50^{bc}	5.30^{a}	5.10^{c}	5.60^{ab}
Cooked					
C.Olitorius	7.50^{ab}	7.00^{ab}	6.70^{a}	6.90^{ab}	7.10^{a}
Ife-ken (400)	5.90^{cd}	5.60^{bc}	5.90^{a}	5.6^{bc}	5.50^{ab}
Cuba (108)	5.90^{cd}	5.20^{c}	5.90^{a}	5.30^{c}	5.20^{b}
Ife-ken (100)	6.10^{cd}	6.10^{abc}	6.40^{a}	6.30^{abc}	6.20^{ab}
Dry and cooked					
C.Olitorius	7.7^{a}	7.4^{a}	6.60^{a}	7.10^{a}	6.70^{ab}
Ife-ken (400)	5.60^{cd}	5.60^{bc}	6.00^{a}	5.40^{bc}	5.80^{ab}
Cuba (108)	5.80^{cd}	5.70^{bc}	6.00^{a}	5.50^{bc}	5.70^{ab}
Ife-ken (100)	5.40^{d}	5.30^{c}	5.40^{a}	5.00^{c}	5.50^{ab}

Means in the same column followed by the same letter are not significantly different from each other at $P<0.05$.

Conclusion

Cooked leafy vegetable samples were higher in compositional attributes than blanched and cooked vegetables and dry and cooked vegetables. Also Ife-ken (400) was significantly higher than other processed kenaf vegetables in protein, crude fat, crude fibre and vitamin C.

Acceptable sensory scores were given to processed kenaf leaves and none was rejected.

In general processing methods did not adversely alter the quality of the processed leafy vegetables. Processed kenaf leaves from Ife-ken (400), Cuba (108) and Ife-ken (100) compared favourably well with corchorus olitorius in compositional and sensory attributes and can be used as an alternative to *corchorus olitorius.*

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9/25/2009

Change Detection Analysis By Using Ikonos And Quick Bird Imageries

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Abstract: The application of urban satellite using for monitoring of changes specially in rapidly growing metropolitan areas not only sensible but utterly necessary. Arguments in favour of the use of satellite system are certainly the fast and accurate data access, the quick visual interpretation, the good representation on a planar surface and their great integrity of a map after the process of geometrical classification. In this paper we used maximum likelihood classification algorithm to attempt and monitor the land cover change .In this work we considered a test area, the Chenggong city in Yunnan province in the south of China. AquickBirds multi-spectral images taken on May 4, 2004 and Ikonos multi-spectral images taken on April 7, 2002, were used in this work. The two images were orthorectified and a first classification produced a map with 7 strata: water, forest, pasture & grass land, cultivated land, transportation, built up areas and unused land. The over all classification accuracy was 97% and the kappa coefficient was 0.92 (i.e. 0.92 more accurate than a random classification).The overall accuracy of land cover change map ,generated from post classification change detection methods and evaluated using several approaches ,ranged from 80 % to 90%.The results of change detection between two dates images were as follows : transportation has increased from 7.6% to 18.3% with change rate of 57.75 $km^2.yr^{-1}$, pasture & grass land has decreased from 26.3% to 8.9% with change rate of 217.5 $km^2.yr^{-1}$, built up areas has increased from 6.7% to 22.3% with change rate of 156 $km^2.yr^{-1}$, cultivated land has increased from 15.3% to 32.4% with change rate of 128.25 $km^2.yr^{-1}$, forest has decreased from 38.8% to 18.2% with change rate of 309 $km^2.yr^{-1}$, un used land has decreased from 25.7% to 9.5% with change rate of 145.8 $km^2.yr^{-1}$, and water have no changed mentioned. The results quantify the land cover change patterns in the metropolitan or urban areas and demonstrate the potential of multi temporal Quick Birds and Ikonos data to provide an accurate, economic means to map and analyze changes in land cover over time that can be used as inputs to land management and policy decisions. [Journal of American Science 2010;6(2):171-175]. (ISSN: 1545-1003).

Keywords: change detection, highmultispectral images, maximumlikelihood classification

1. Introduction

The importance of accurate and timely information describing the nature and extent of land resources and changes over time is increasing, especially in rapidly growing metropolitan areas. Change detection is a remote sensing techniques used to monitor and map land cover change between two or more periods and is now an essential tool in growing urban areas management activities[6] .Urban growth , particularly the movement of residential and commercial land use to rural areas, was, commonly referred to as urban sprawl.

Accurate and timely information on land use and land use change at a national scale is crucial for long term economic development planning and for short-term land management. Remote sensing technology as an efficient surface investigation method was introduced in China for such purpose three decades ago. In the end of1980s, CSLA sponsored the program to analyze land use status in Northwest China using Landsat TM imagery. Later in 1996, time series of Landsat TMdata were analyzed to monitor urban expansion in 17 metropolitan areas including Beijing. Many cases of misuse of cultivated land and illegal constructions were exposed through this investigation, which urged the China government to implement a strict protect policy for cultivated land. The technique to monitor land use transitions using remote sensing imagery was tested and improved in the following years. In 1999, the newly founded MLR launched the Program of National Land Use Change monitoring through remote sensing. The objective of the Program was to investigate the transition from cultivated land to construction land in66 metropolitan areas around China using Landsat TM and SPOT imagery between 1998 and 1999. Since then, the Program has been carried out continuously for seven years and provides fundamental information on land use change at the national scale for Central Government policy making. The success of this Program demonstrates that remote sensing can act as an operational technology serving land management in China.

The very high ground resolution of Quick Birds and Ikonos data is a new step towards a detailed image of land cover, close to an aerial photograph but

with the geometric quality, the homogeneity and periodicity proper to satellite imagery, and they provide a level of detail compatible with urban mapping, i.e. from 4 to 2.5 meters spatial resolution. In this research we used supervised classification which is based on comparison between the classifications maps obtain by classifying the two consider images independently.

2. Study area

The research in this paper addresses the Chenggong city in Yunnan province in the south of China, as shown in Fig .1 below. A Quick Bird images taken in May 4, 2004 and Ikonos images taken in April 7, 2002 for this area were used in this work, the area lies on longitude about 24 00 00 to 25 00 00N and latitude about 101 00 00 to 102 00 00 E. This area includes a diversity of land cover classes interspersed with large areas of cultivated and farm land. Both high and law density urban development are found in the central portion while several rural lands cover types of cultivated crops land ,pasture & grass land and forest characterize the surrounding landscape.

3. Materials and Methods

The spatial resolution of the satellite sensors can be characterized by the ability of defining the object boundaries [1and 8] .It is also possible to define the spatial resolution as, the area of a representative pixel on the ground.

Data and Pre-processing

Remote Sensing images used in this study include two satellite images. The first image was a Ikonos images taken in April 7, 2002. The second one was a Quick Bird images taken in May 4, 2004. The two satellite images characteristics and its centre wavelengths were shown in Table 1, below. The pre-processing of this dataset included geometric corrections .All images were geometrically corrected not only to eliminate geometric distortions present in the images but also to register the satellite images to ground data. Ground Control Points (GCPs) were extracted from vector files for the same region, using geographic features such as big and small rivers .The resampling method chosen was nearest-neighbor, which preserved original reflectance value. Fifty ground control points were chosen on the images, the points were spread quite evenly through out the image, allowing for good control. Image software allowed for easy zooming to assist in point selection. The points were registered in the header files of the image for later rectification .Once all ground control points were compiled, error checking was used to gauge the efficiency of the points used. The RMS errors for all a linear method of rectification were examined with varying accuracies, all approximately 0.5 m in displacement error. The nearest-neighbor resampling method was used in datum WGS 84 and projection UTM (49N). In order to remove or normalize the reflectance variation between images acquired at different times, relative radiometric correction was performed to yield normalize radiometric data on a common scale [9].Here, the histogram normalization, a simpler and more effective technique, was used to carry out the relative radiometric correction.For the analysis of Landsat satellite images, ERDAS Imagine 9.1 software was used.

4. Methodology

There are various ways of approaching the use of satellite imagery for determining land use change in urban environments. [2] divide the methods for change detection and classification into pre-classification and post- classification techniques. The pre- classification technique apply various a algorithms , including image differencing and image rationing , to single or multiple spectral bands, vegetation indices, principal components, directly to multiple dates of satellite imagery to generate “change” vs. “no- change” maps[7]. These techniques locate changes but do not provide information on the nature of change [10].On the other hand, the Maximum Likelihood classification (MLC) method was chosen to carry out this work .Maximum likelihood classification assumes that the statistics for each class in each band are normally distributed and calculates the probability that a given pixel belongs to a specific class. Unless a probability threshold is selected, all pixels are classified .Each pixel is assigned to the class that has the highest probability (i.e. the “maximum likelihood”). There are several studies in which this supervised classification method has been utilised successfully, either directly or in combination with other methods [3,4and5]. In this type of classification, the user selects the spectral signatures defined from recognized locations in the image or “training sample.” The computer system then identifies the pixels with similar characteristics and assigns them to a class based on specific criteria. For the initial training operation of the classification methods , (100) samples as learning data set of each class , and (1300) samples as “ground truth” for each class were defined with help of ortophotos (scale 1: 10.000) and available maps. These tools helped classify a seven-class legend: water, forest, pasture & grass land, cultivated land, transportation, built up areas and unused land, as shown in Table 2 below,

which was based on the land cover land use classification system developed by National Land use Change Program. Supervised classification was then performed using the maximum likelihood method, in which a pixel with the maximum likelihood is classified to its corresponding class. The over all classification accuracy was 97% and the kappa coefficient was 0.92 (i.e. 0.92 more accurate than a random classification). The existence of mixed pixels (pixels having more than one class in their footprint), in particular among vegetation classes, would require an analysis at a higher geometric resolution or a comparison with multitemporal data to exploit the phonological selected, the maximum likelihood classification results for Quick Bird and Ikonos images were shown in Figure 2 and Figure 3 respectively.

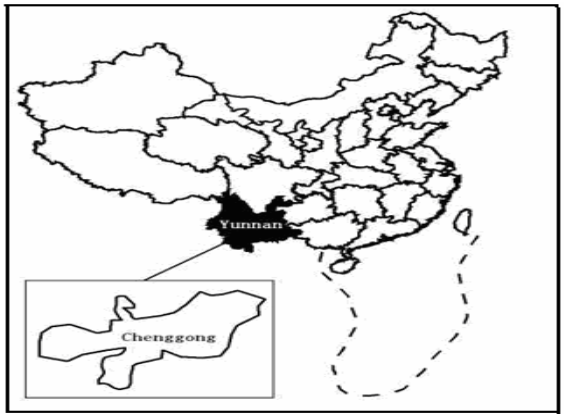

Figure1: The boundary map of China and Chenggong city

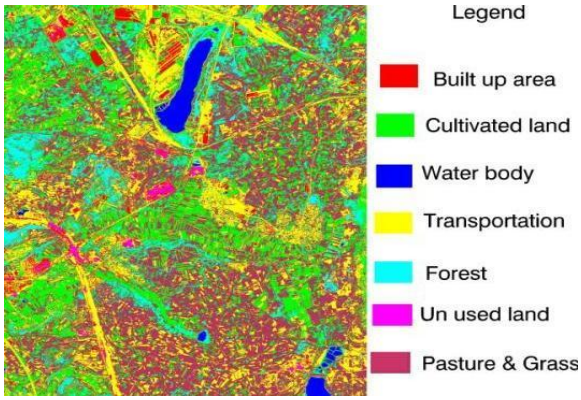

Figure 2: Maximum Likelihood classification for Quickbird image (2004).

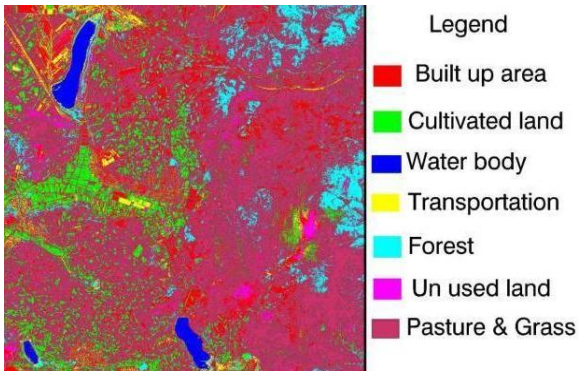

Figure 3: Maximum Likelihood classification for Ikonos image (2002).

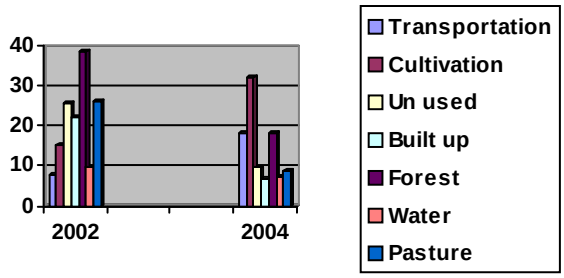

Figure 4: The percentage diagram of land covers change from 2002 to 2004

5. Result

Table 3and Figure 4 show the values of land cover change obtained after applying the supervised classification methods according to the "ground truth" samples.The results of change detection between two dates images were as follows : transportation has increased from 7.6% to 18.3% with change rate of 57.75 $km^2.yr^{-1}$, pasture & grass land has decreased from 26.3% to 8.9% with change rate of 217.5 $km^2.yr^{-1}$, built up areas has increased from 6.7% to 22.3% with change rate of 156 $km^2.yr^{-1}$, cultivated land has increased from 15.3% to 32.4% with change rate of 128.25 $km^2.yr^{-1}$, forest has decreased from 38.8% to 18.2% with change rate of 309 $km^2.yr^{-1}$, un used land has decreased from 25.7% to 9.5% with change rate of 145.8 $km^2.yr^{-1}$, and water has decreased from 9.5% to 7.1% with change rate of 9.6 $km^2.yr^{-1}$ during the study period.

Table 1. Quick Birds and Ikonos characteristics and its centre wavelength

	Quick Birds	Ikonos
Panchromatic band	725.0 nm	727.5 nm
Band 1 (blue)	479.5 nm	480.5 nm
Band 2 (green)	546.5 nm	550.5 nm
Band 3 (red)	654.0 nm	665.0 nm
Band 4 (nir)	814.5 nm	805.0 nm
Resolution (pan)	0.61 m	1.0 m
Resolution (multispectral)	2.44 m	4.0 m

Table 2: Classes of training data

Land use class	Description
Cultivated land	including crop fields
Pasture & grass	including pasture, natural and artificial grass, planted and improved pasture land
Transportation	including railway, high way, air port, port
Water body	including river, lake, reservoir, beach, canal, breeding plot
Unused land	including sandy land, desert, saline land, bare land, glaciers, permanent snow
Built up area	including urban, rural ,residences industry, mining, salt pan, specially used land
Forest	including forestry land, timber, fuel wood =, shelter, economic forests, sparse wood lands and shrubs

Table 3: Change rate of the 7 landscape patterns from 2002 to 2004

Land cover type	2002		2004		2002-2004		Change rate (+Gain,-Loss) 2002-2004
	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	($km^2.yr$)
Transportation	82.1	7.6	197.6	18.3	-115.5	-10.7	+57.75
Cultivated land	229.5	15.3	486.0	32.4	-256.5	-17.1	+128.25
Un used land	462.6	25.7	171.0	9.5	+291.6	16.2	-145.8
Built up areas	134.0	6.7	446.0	22.3	312.0	15.6	-156
Forest	1164.0	38.8	546.0	18.2	+618.0	20.6	-309
Water body	76.0	9.5	56.8	7.1	+19.2	2.4	-9.6
Pasture& grass	657.5	26.3	222.5	8.9	+435.0	17.4	-217.5

6. Conclusion

In this work two very high resolution images were classified with the purpose to detect the land change. In this paper we found the big changed that occurred in the study area in this limited period of time, just two years, especially from pasture & grass land to cultivated land ， built up area and transportation, so I would like to say that it must be diurnal researches for cities every year if it is possible because of high and accelerating rate of urban expanding, in particular in the developing countries like China

Acknowledgement:
Many thanks to Professor Hu Guangdao at the Institute of geology and Remote Sensing ,faculty of earth resources ,china university of geosciences For providing the data .

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9/22/2009

Object-based land use/cover extraction from QuickBird image using Decision tree

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Abstract The traditional pixel-wise statistical and mono-scale based classification approaches do not lead to satisfactory results for neglecting the shape and context aspects of the image information, which are among the main clues for information extraction at very-high spatial resolutions like QuickBird image. This paper extracts land use/cover information from occurrence filters texture features that were derived from the grey-level occurrence matrix from QuickBird image using CART Decision tree, because, this method have substantial advantages for remote sensing classification problems due to their nonparametric nature, simplicity, robustness with respect to non-linear and noisy relations among input features and class labels, and their computational efficiency. CART has a simple form which can be compactly stored and that efficiently classifies new data ,also it can recursively partitions a data set into smaller subdivisions on the basis of tests applied to one or more features at each node of the tree. Overall accuracy of texture features using CART Decision tree is higher than other methods. It concluded that texture features can be used to improve classification accuracy. [Journal of American Science 2010;6(2):176-180]. (ISSN: 1545-1003).

Keywords object-based, land use / cover, classification, decision tree,QuickBird

1. Introduction

The automatic analysis of remotely sensed data has become an increasingly important topic over the last decades. Especially land use/cover and land change information is useful for city development. The segmentation of satellite images into regions of different land cover is of major interest: given data from several spectral bands, one wants to determine for each pixel of the image which type of land cover is present at the corresponding area on the surface (Keuchel et al., 2003, Carlson and Arthur, 2000, Le Hegarat-Mascle et al., 2005, Fan et al., 2007). In land cover classification of remote sensing data, it is desirable to use multisource data in order to extract as much information as possible about the area being classified.

However, classification of multisource remote sensing and geographic data is a challenging problem, especially since a convenient multivariate statistical model is in general not available for such data (Gislason et al., 2006). The traditional pixel-wise statistical and mono-scale based classification approaches do not lead to satisfactory results for high spatial resolution remote sensing data like QuickBird image.

The main drawback of these methods is that they neglect the shape and context aspects of the image information, which are among the main clues for information extraction at very-high spatial resolutions. The successful launch of very-high spatial resolution panchromatic and multi-spectral satellites renders the potential to carry out thematic mapping at large scales in urban areas.

Unfortunately, the high spatial resolution of these advanced sensors increases the spectral within field variability and, therefore, may decrease the classification accuracy results.

This is because most classification techniques are based on spectral homogeneities only (Cushnie, 1987), and do not take into account the textural attributes of the mapped image's features. Due to the more heterogeneous spectral-radiometric characteristics within the land-use/cover units portrayed in high resolution images, applications of traditional single resolution classification methods have led to unsatisfactory results. This paper extracts land use/cover information from texture features that were derived from the grey-level occurrence matrix using CART Decision tree.

2. Study area

The study area covers Chenggong districts in Yunnan province in southwest of China (Fig. 1). The centre is latitude 24°55’43″N and longitude 102°50’10″E. The remote sensing data consisted of QuickBird multispectral and panchromatic images that

were acquired simultaneously on 4 May, 2004. The QuickBird radiances were not atmospherically corrected as time series analysis of consecutive image data was not required for this study, and detailed information on the atmospheric conditions at the time of overpass was not available.

3. Methods

Within the last 10 years, there has been increasing interest in the use of classification and regression tree (CART) analysis. CART analysis is a tree–building technique which is unlike traditional data analysis methods .Because CART analysis is unlike other analysis methods it has been accepted relatively slowly .Furthermore, the vast majority of statisticians have little or no experience with the technique. Other factors which limit CART analysis general acceptability are the complexity of the analysis and, until recently, the software required to perform CART analysis was difficult to use. Luckily, it is now possible to perform a CART analysis without a deep understanding of each of the multiple steps being completed by the software .In a addition, CART is often able to uncover complex interactions between predictors which may be difficult or impossible to uncover using traditional multivariate techniques.

CART analysis has a number of advantages over other classification methods, including multivariate logistic regression, first, it is inherently non-parametric .In other words, no assumptions are made regarding the underlying distribution of values of the predictor variables. Thus, CART can handle numerical data that are highly skewed or multi-model, as well as categorical predictors with either ordinal structure (Quinlan, 1993). This is an important feature ,as it eliminates analyst time which would otherwise be spent determining whether variables are normally distributed, and making transformation if they are not.

As discussed bellow ,CART identifies “splitting” variables based on an exhaustive search of all possibilities .Since efficient algorithms are used, CART is able to search all possible variables as splitters ,even in problems with many hundreds of possible predictors. Finally, another advantage of CART analysis is that it is a relatively automatic” machine learning” method .In other words, compare to the complexity of the analysis, relatively little input is required from the analyst. This is in marked contrast to other multivariate modeling methods, in which extensive input from the analyst, analysis of interim result, and subsequent modification of the method are required.

Despite its many advantages, there are a number of disadvantages of CART which should be kept in mind. First, CART analysis is relatively new and somewhat unknown. Thus, there may be some resistance to accept CART analysis by traditional statisticians. In addition, there is some well-founded skepticism regarding tree methodologies in general, based on unrealistic claims and poor performance of earlier techniques. Thus, some statisticians have a generalized distrust of this approach. Because of its relative novelty, it is difficult to find statisticians with significant expertise in CART. Thus, it may be difficult to find someone to help you use CART analysis at your own institution .Because CART is not a standard analysis technique, it is not included in many major statistical software packages (e.g., SAS).

This paper extracts land use/cover information using texture features that were derived from the grey-level occurrence matrix. Occurrence Measures can output five different texture filters. The occurrence filters available are data range, mean, variance, entropy, and skewness. Occurrence measures use the number of occurrences of each gray level within the processing window for the texture calculations. In this paper, 3×3, 5×5, 7×7, 9×9, 11×11 processing windows size were selected. In every processing window, all 4 bands can render 20 layers gray level images (one band has 5 layers). Adding the original 4 bands, Total 104 image layers were used in classification.

In this paper, CART (Classification and Regression Tree) algorithm was used. CART was suggested by Breiman et al. in 1984 (Brieman et al., 1984). The decision trees produced by CART are strictly binary, containing exactly two branches for each decision node. It recursively partitions the records in the training data set into subsets of records with similar values for the target (Steinberg et al., 1997, Manoj Kumar et al., 2002, Bittencourt et al., 2003). CART is able to search all possible variables as splitters, and it is inherently non-parametric ,the non-parametric property means that non-normal, non-homogenous and noisy data sets can be handled, s well as non-linear reations between features and classes.missing values and both numeric and categorical inputs (Friedl et. al., 1997). CART trees are relatively simple for nonstatisticians to interpret. Another advantage of CART analysis is that it is a

relatively automatic "machine learning". It analysis has a number of advantages over other classification methods. In this paper, inputting all 104 layers into CART algorithm, the final decision tree is shown in Fig. 2.

4. Results and disscusion

The classification map constructed by CART Decision tree is shown in Fig. 3. In order to verify classification accuracy, the result classified by different classification methods and data were compared. Overall accuracy of original bands using Maximum likelihood, texture features using Maximum likelihood, original bands using CART Decision tree and texture features using CART Decision tree are 93.5%, 97.3%, 92.6% and 98.5% respectively. Furthermore, the CART algorithm is more transparent compared to the other algorithm, because in the former the classification sequence that is followed is controlled by the analyst. Classification and Regression Tree (CART) analysis is a powerful technique with significant potential classification utility. Nontheless, a substantial investment in time and effort is required to use the software, select the correct options, and interpret the result. Nontheless, the use of CART has been increasing and is likely to increase in the future, largely because of the substantial number of important problems for which it is the best available solution. From the Decision tree (Fig. 2), some main results can be concluded:

1) Overall accuracy of texture features that were derived from the grey-level occurrence matrix is higher than the original data. Texture features can be used to improve classification accuracy.

2) Among all occurrence filters included data range, mean, variance, entropy, and skewness, mean is more effective in classification than others.

3) Different processing windows size can enhance different land use/cover information. Band1 when processing windows size is 9×9 or 11×11 can distinguish different land use/cover type.

4) Due to low spatial resolution or other reasons, some band like band4 is not suitable for occurrence filters.

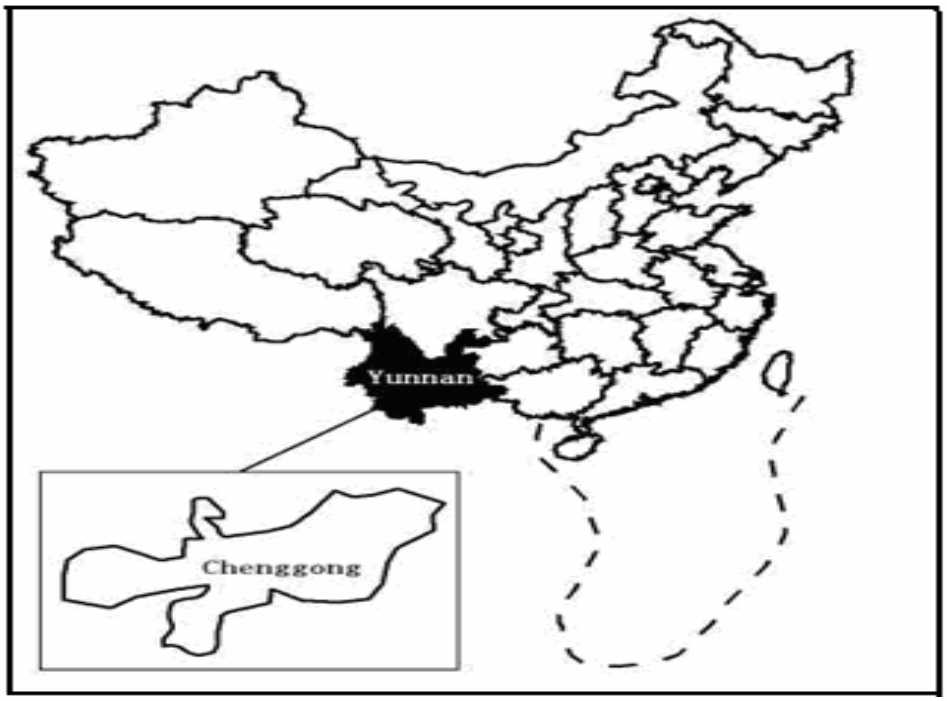

Figure1: The boundary map of China and Chenggong city

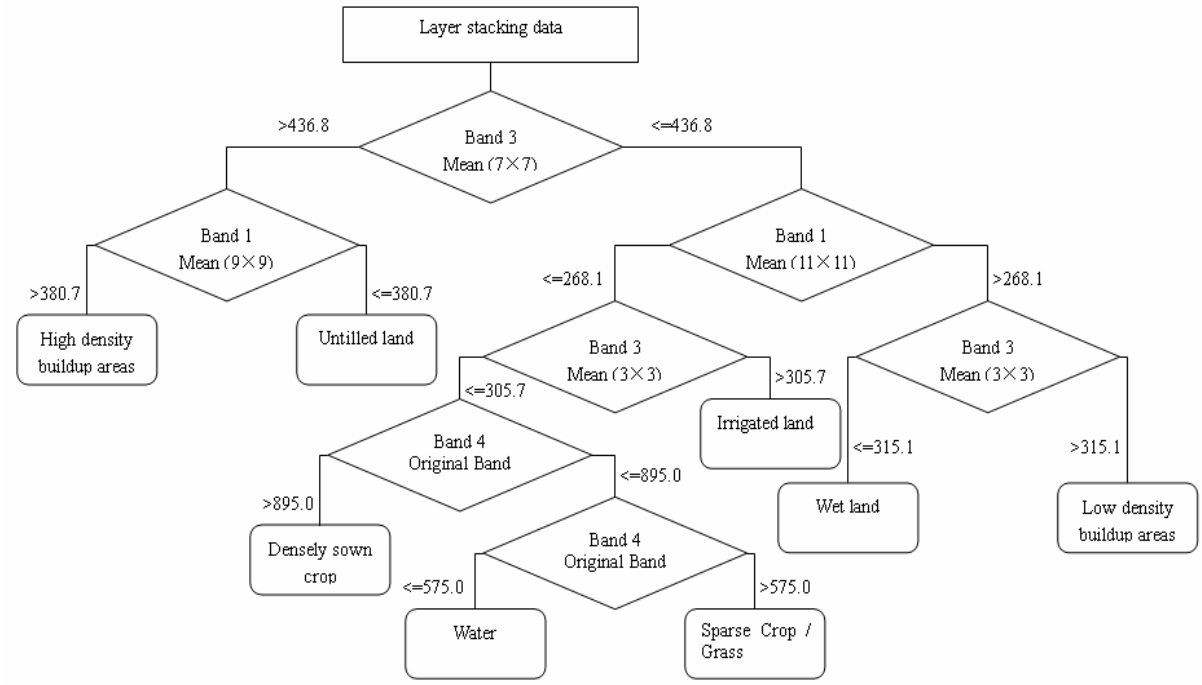

Figure 2: The decision tree constructed by CART algorithm.

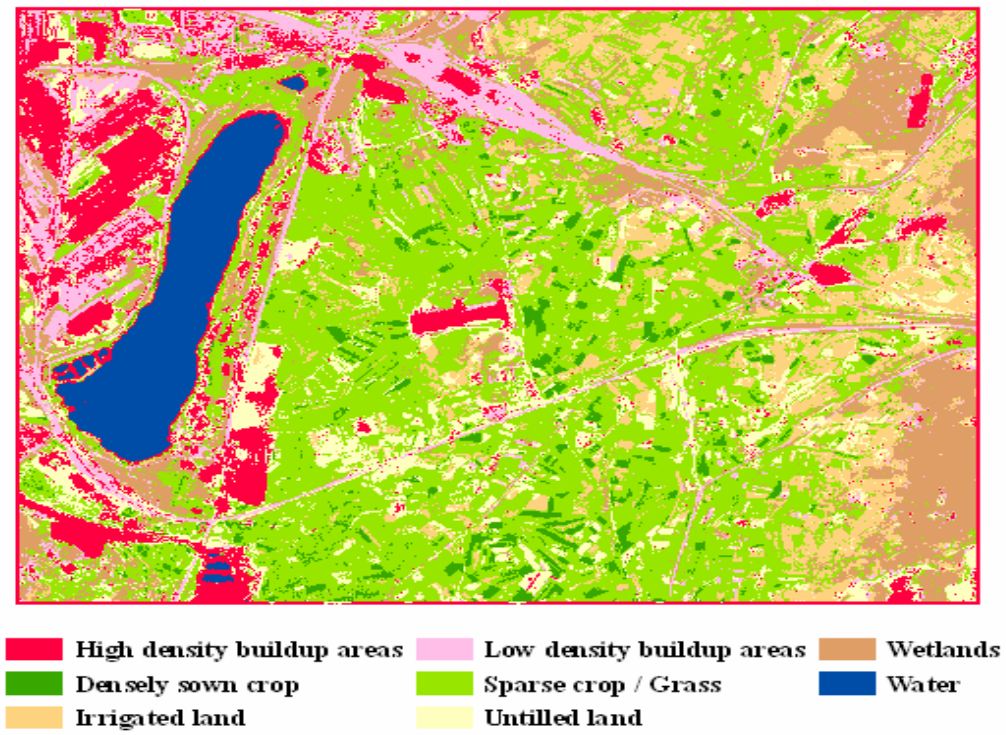

Figure 3**:** the classification map using CART decision tree.

Acknowledgement:

Many thanks to Professor Hu Guangdao at the Institute of geology and Remote Sensing, faculty of earth resources, China university of geosciences For providing the data .

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9/22/2009

Effects of specific heat ratio on the power output and efficiency characteristics for an irreversible dual cycle

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Abstract: In the present study, the performance of an air standard Dual cycle is analyzed using finite-time thermodynamics. The variations in power output and thermal efficiency with compression ratio, and the relations between the power output and the thermal efficiency of the cycle are presented. The results show that if compression ratio is less than certain value, the increase of specific heat ratio makes the power output and the thermal efficiency bigger. In contrast, if compression ratio exceeds certain value, the increase of specific heat ratio makes the work output and the thermal efficiency less. The results also show that the maximum power output and the maximum thermal efficiency increase while the compression ratio at the maximum power output point, the working range of the cycle and the compression ratio at maximum thermal efficiency point decrease with increasing specific heat ratio. It is noteworthy that the results obtained in the present study are of significance for providing guidance with respect to the performance evaluation of practical internal combustion engines. [Journal of American Science 2010;6(2):181-184]. (ISSN: 1545-1003).

Key words: Irreversible, Optimization, Dual cycle, performance

1. Introduction

Optimization studies for air-standard reciprocating cycles, i.e., Otto, Diesel and dual cycles, with rate-dependent loss mechanisms have appeared as early as in the 1980s physics literature. In the fundamental analysis of modern Diesel engines, the dual cycle is commonly employed as it includes the heat-addition processes both at constant volume and at constant pressure. Landsberg and Leff (1989) found that these important reversible thermodynamic heat engine cycles can be regarded as special cases of a more universal generalized cycle without any loss. Vecchiarelli et al. (1997) indicated that the hypothetical modification of gas turbine engines to include two heat additions (rather than one) may result in some efficiency improvement as compared with conventional engines. Chen et al. (1998) derived the relations between net work output and efficiency of the Diesel cycles. The relation between net work output and the efficiency as well as the maximum net-work output and the corresponding efficiency for internal-combustion Dual cycles are derived in this paper. Aragon-Gonzalez et al. (2000) derived the maximum irreversible work and efficiency of the Otto cycle by considering the irreversible adiabatic processes with the compression and expansion efficiencies. Ghatak and Chakraborty (2007) analyzed the effect of variable specific heats and heat transfer loss on the performance of the dual cycle when variable specific heats of working fluid are linear functions of its temperature. Zhang et al. (2007) built a generalized endoreversible steady flow thermodynamic cycle consisting of two constant-thermal-capacity heating branches, a constant thermal capacity cooling branch, and two adiabatic branches with consideration of heat resistance loss. The characteristics of the power output, efficiency, and exergy based ecological function were derived. Ge et al. (2008a; 2008b; 2009) analyzed the performance of an air standard Otto, Diesel and dual cycles. In the irreversible cycle model, the non-linear relation between the specific heat of the working fluid and its temperature, the friction loss computed according to the mean velocity of the piston, the internal irreversibility described by using the compression and expansion efficiencies, and the heat transfer loss are considered. Ebrahimi (2009a) studied the effects of stroke length on the performances of the Diesel cycle.

As can be seen in the relevant literature, the investigation of the effect of specific heat ratio on performance of dual cycle with considering heat transfer loss and friction loss of the piston does not appear to have been published. Therefore, the objective of this study is to examine the effect of specific heat ratio on performance of air standard dual cycle.

2. Thermodynamic analysis

The pressure-volume $(P-V)$ diagram of an irreversible dual heat engine is shown in Fig. 1. The compression $(1\rightarrow 2)$ process ignition is isentropic; the heat additions are an isobaric process $(2\rightarrow 3)$ and an isentropic process $(3\rightarrow 4)$; the expansion process $(4\rightarrow 5)$ is isentropic; and the heat rejection $(5\rightarrow 1)$ is an isobaric process. The net cyclic work output per unit mass of working fluid without considering the lost power due to friction is:

$$W = c_v\left(T_3 - T_2\right) + c_p\left(T_4 - T_3\right) - c_v\left(T_5 - T_1\right) = \frac{R}{\gamma - 1}\left(T_3 - T_2 + \gamma\left(T_4 - T_3\right) - T_5 + T_1\right) \quad (1)$$

Where c_v is the constant volume specific heat, c_p is the constant pressure specific heat, γ is the specific hear ratio and R is the gas constant.

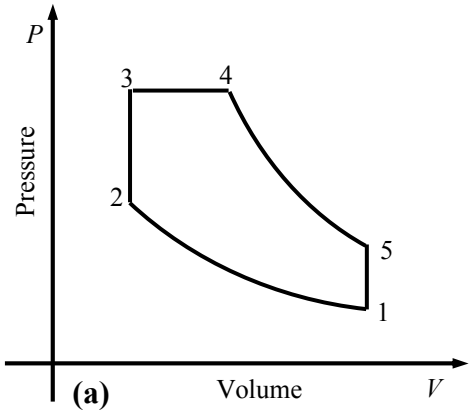

Figure 1. $P-V$ diagram of a dual cycle

The compression ratio r_c, the pressure ratio α and the cut-off ratio β are defined as:

$$r_c = \frac{V_1}{V_2} = \left(\frac{T_2}{T_1}\right)^{\frac{1}{\gamma-1}} \quad (2)$$

$$\alpha = \frac{p_3}{p_2} = \frac{T_3}{T_2} \quad (3)$$

and

$$\beta = \frac{V_4}{V_3} = \frac{T_4}{T_3} \quad (4)$$

The total heat added to the working fluid during process $2 \to 3$ and $3 \to 4$ is

$$Q_{in} = c_v\left(T_3 - T_2\right) + c_p\left(T_4 - T_3\right) = \frac{R}{\gamma - 1}\left[T_3 - T_2 + \gamma\left(T_4 - T_3\right)\right] \quad (5)$$

On the other hand, the heat added to the working fluid by combustion per unit mass of the working fluid is given in the following expression linear expression (Ebrahimi, 2009b):

$$Q_{in} = A - B\left(T_2 + T_4\right) \quad (6)$$

where A and B are two constants related to heat transfer and combustion.

In addition, process $1 \to 2$ is isentropic, hence

Since from the adiabatic processes we have

$$T_2 = T_1 r_c^{\gamma-1} \quad (7)$$

Substituting equation (7) into equation (3) yields

$$T_3 = \alpha T_1 r_c^{\gamma-1} \quad (8)$$

Combining equations (1) and (8), we get

$$T_4 = \frac{\left(\gamma-1\right)\left(A - T_1 B r_c^{\gamma-1}\right) - RT_1\alpha\left(1-\gamma-\alpha^{-1}\right)r_c^{\gamma-1}}{R\gamma + B} \quad (9)$$

By combining the results obtained from Eqs. (8) and (9) into Eq. (4), gives

$$\beta = \frac{\left(\gamma-1\right)\left(A - T_1 B r_c^{\gamma-1}\right) - RT_1\alpha\left(1-\gamma-\alpha^{-1}\right)r_c^{\gamma-1}}{\left(R\gamma + B\right)T_1\alpha r_c^{\gamma-1}} \quad (10)$$

Combining equations (3), (7) and (9), and bearing in mind that process $4 \to 5$ is isentropic, we get:

$$T_5 = T_1\alpha\left[\frac{\left(\gamma-1\right)\left(A - T_1 B r_c^{\gamma-1}\right) - RT_1\alpha\left(1-\gamma-\alpha^{-1}\right)r_c^{\gamma-1}}{\left(R\gamma + B\right)T_1\alpha r_c^{\gamma-1}}\right]^{\gamma-1} \quad (11)$$

Since W is work output per unit mass of working fluid of the cycle, the total power output of the cycle is

$$P_{out} = \dot{m}_t W - P_{lost} \quad (12)$$

where $\dot{m}_t$ is average mass flow rate of the working fluid in the cycle, P_{lost} is the lost power due to friction $= b\left(r_c - 1\right)^2$ and b is constant.

Substituting equations (7)-(9) and (11) into equation (12) yields

$$P_{out} = \frac{\dot{m}_t R}{\gamma-1}\left(T_3 - T_2 + \gamma\left(T_4 - T_3\right) - T_5 + T_1\right) - b\left(r_c - 1\right)^2 = \frac{\dot{m}_t R}{\gamma-1}\left\{\alpha T_1 r_c^{\gamma-1} - T_1 r_c^{\gamma-1} + \gamma\left[\frac{\left(\gamma-1\right)\left(A - T_1 B r_c^{\gamma-1}\right) - RT_1\alpha\left(1-\gamma-\alpha^{-1}\right)r_c^{\gamma-1}}{R\gamma + B} - \alpha T_1 r_c^{\gamma-1}\right] - T_1\alpha\left[\frac{\left(\gamma-1\right)\left(A - T_1 B r_c^{\gamma-1}\right) - RT_1\alpha\left(1-\gamma-\alpha^{-1}\right)r_c^{\gamma-1}}{\left(R\gamma + B\right)T_1\alpha r_c^{\gamma-1}}\right]^{\gamma-1} + T_1\right\} - b\left(r_c - 1\right)^2 \quad (13)$$

The thermal efficiency of the Dual cycle is

$$\eta = \frac{p_{out}}{\dot{m}_t Q_{in}} \quad (14)$$

Equations (13) and (14) determine the relations between the power output, thermal efficiency and compression ratio. The relation between power output and thermal efficiency to the maximum power output

and the corresponding efficiency may be obtained using numerical calculations.

3. Results and discussion

The effects of γ on the performance of the dual cycle with $\dot{m}_t = 0.0156\,kg/s$, $A = 4280\,kJ/kg$, $b_1 = 15\,kW$, $B = 0.5\ kJ.kg^{-1}K^{-1}$, $r_c = 1 \rightarrow 40$ $\gamma = 1.3 \rightarrow 1.4$ and $T_1 = 350\,K$ (Heywood, 1988; Chen et al. 2004; Ghatak and Chakraborty, 2007; Ge et al., 2009; Ebrahimi, 2009c and 2009d) are shown in figures 2-4. Using the above constants and range of parameters, the power output versus compression ratio characteristic and the power output versus efficiency characteristic with varying the mean piston speed can be plotted. Numerical examples are shown as follows.

Figures 2–4 show the effects of the variable specific heat ratio on the cycle performance with heat resistance and friction losses. From these figures, it can be found that the specific heat ratio plays an important role on the power output and the thermal efficiency. They reflect the performance characteristics of an irreversible Diesel cycle engine. It can be seen from these figures that if compression ratio is less than certain value, the increase of specific heat ratio makes the power output and the thermal efficiency bigger. In contrast, if compression ratio exceeds certain value, the increase of specific heat ratio makes the work output and the thermal efficiency less. Therefore, it can be resulted that the effect of specific heat ratio on the performance of the cycle is related to compression ratio.

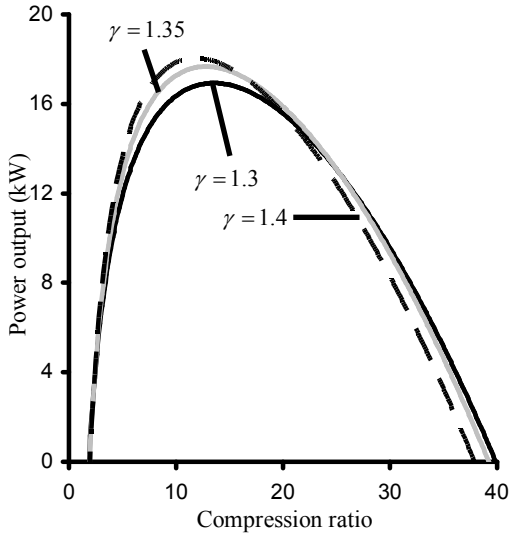

Figure 2. Effect of specific heat ratio on the variation of the power output with compression ratio

It can be also seen that the power output versus compression ratio characteristic and the power output versus efficiency characteristic are parabolic-like curves. They show that the maximum power output point and the maximum efficiency point are very adjacent. With increasing specific heat ratio, the maximum power output and the maximum thermal efficiency increase while the compression ratio at the maximum power output point, the working range of the cycle and the compression ratio at maximum thermal efficiency point decrease. It should be noted that the increase of the value of maximum power output with increasing specific heat ratio is due to the increase in the ratio of the heat added to the heat rejected. Numerical calculation shows that when specific heat ratio increases by about 7.7%, the maximum power output and the maximum thermal efficiency increase by about 6.2% and 22.8%, respectively. Furthermore, the compression ratio at the maximum power output point, the working range of the cycle and the compression ratio at maximum thermal efficiency point decrease by about 14.5%, 5.9% and 5.3%, respectively, as the specific heat ratio increases by about 7.7%.

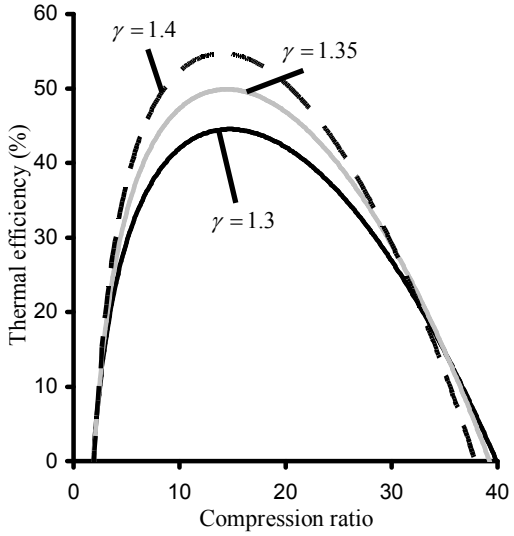

Figure 3. Effect of specific heat ratio on the variation of the thermal efficiency with compression ratio

Figure 4 shows the effects of the specific heat ratio on the power output versus the thermal efficiency characteristic. The power output versus thermal efficiency characteristics exhibit loop shaped curves as is common to almost all real heat engines (Gordon and Huleihil, 1992). From the figure, it is found that the parameter specific heat ratio has a significant influence on the power output versus thermal efficiency characteristic. When specific heat ratio increases, the efficiency at the maximum power output point, as well as the power output at the maximum efficiency point, will also increase. If specific heat ratio increases by about 7.7%, the optimal power output corresponding to maximum efficiency and the optimal thermal efficiency

corresponding to maximum power output increase by about 22.8% and 6.6%, respectively.

According to the above analysis, it can be found that the effects of the specific heat of the working fluid on the cycle performance are obvious, and they should be considered in practice cycle analysis to make the cycle model more close to practice.

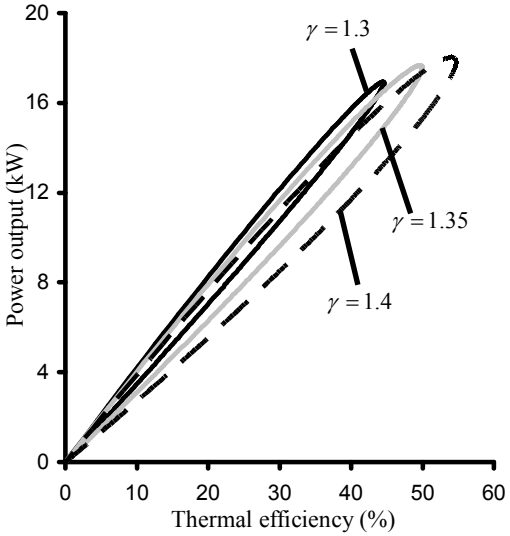

Figure 4. Effect of specific heat ratio on the variation of the power output with thermal efficiency

4-Conclusion

In this paper, the effects of specific heat ratio on the Dual cycle are investigated. The relation between power output, thermal efficiency and compression ratio are derived. These results show that if compression ratio is less than certain value, the increase of specific heat ratio makes the power output and the thermal efficiency bigger. In contrast, if compression ratio exceeds certain value, the increase of specific heat ratio makes the work output and the thermal efficiency less. With increasing specific heat ratio, the maximum power output and the maximum thermal efficiency increase while the compression ratio at the maximum power output point, the working range of the cycle and the compression ratio at maximum thermal efficiency point decrease. The results provide significant guidance for the performance evaluation and improvement of real Dual engines.

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9/27/2009

Effect Of Foliar Application Of Seaweed Based Panchagavya On The Antioxidant Enzymes In Crop Plants

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ABSTRACT - A modified formulation of panchagavya, amended with thee seaweed extract (*Sargassum wightii*) has been investigated for its effect on the antioxidant enzymes namely, SOD, GR and GPx in the leaves of the seedlings of the pulses, *Vigna radiata*, *Vigna mungo*, *Arachis hypogaea*, *Cyamopsis tetragonoloba*, *Lablab purpureus*, *Cicer arietinum* and the cereal *Oryza sativa* var. *ponni*. The seaweed based panchagavya formulation increased the levels of all the three enzymes in the experimental plants when used as a foliar spray. The spray was highly effective at 3% level. [The Journal of American Science. 2010;6(2):185-188]. (ISSN 1545-1003).

Key words: Panchagavya, Seaweed, SOD, GR, GPx, pulses, cereal.

INTRODUCTION

Panchagavya, a Vedic formulation of the five products of cow is used as a foliar application to boost yield of crop plants and to restrict the incidence of common diseases. This traditional panchagavya formulation is now being used by some farmers in organic farming with some modifications (Natarajan, 2002). Similarly, in the recent past, concentrated liquid preparations of brown seaweeds have been shown to exhibit biostimulant and biofertilizer properties (Bukhare and Untawale, 1978; Albertz *et al*., 1983; Kannan and Tamilselvan, 1990; Crouch and van Staden, 1992; Verkej, 1992; Immanuel and Subramaniam, 1999; Thevanathan *et al*., 2005). However, foliar application of panchagavya in combination with seaweed extract has not been tried by any. We have earlier shown that panchagavya amended with seaweed extract has biofertilizer potential in increasing the yield of some crop plants (Sangeetha, 2009). In this paper, we present the results of an investigation on the effect of the foliar application of seaweed based panchagavya on the levels of the antioxidant enzymes namely, superoxide dismutase (SOD), glutathione reductase (GR) and glutathione peroxidase (GPx).

MATERIALS AND METHODS

Seeds of the pulses *Vigna radiata*, *Vigna mungo*, *Arachis hypogaea*, *Cyamopsis tetragonoloba*, *Lablab purpureus*, *Cicer arietinum* and the cereal *Oryza sativa* var. *ponni* . were surface sterilized with 1.0% mercuric chloride, washed several times in running water, soaked overnight in sterile water and allowed to germinate in dark. Germinating seeds were implanted in soil preparations kept in pots of the size 5.2" tall and 3.5" radius. Seedlings raised in sterilized garden soil were used as control. The developing seedlings were sprayed with seaweed based panchagavya in desired concentrations (1.0%, 2.0% and 3.0% in sterile water) at intervals of 7 days for 3 times. A day after the third spray, the leaves were harvested and crude enzyme preparations were made to assay the enzymes SOD, GR and GPx.

Extraction of cell-free enzymes

Freshly harvested leaves were rinsed in ice-cold, sterile water and homogenized with 5.0 mL of ice-cold Marsden's buffer, pH 7.4 containing 50.0 mM MOPS [3-(N-morpholino)propanesulfonic acid)], 2.0 mM EDTA, 50.0 mM ascorbic acid, 0.5 mM dithiothreitol, $CaCl_2$ (0.2 g L^{-1}), TWEEN 80 (1.0 mL L^{-1}) and insoluble polyvinyl pyrrolidone (PVP) (100 g L^{-1}) (pretreated according to Loomis, 1974). The homogenate was strained through three layers of cheese cloth and centrifuged at 7000 x g for 15 minutes. The supernatant was collected and centrifuged at 20,000 x g for 30 minutes. The supernatant (crude extract) thus obtained was treated with Sephadex G-25 and dialysed overnight. The dialysate was centrifuged at 20,000 x g for 30 minutes. The resulting clear supernatant was used as the enzyme extract (Thevanathan, 1980). The entire operation was carried out at 4°C. The extraction

procedure is same for all the enzymes, unless otherwise mentioned.

Enzyme assay

1. Superoxide dismutase (SOD; E.C. 1.15.1.1): Superoxide dismutase was assayed following the method of Mishra and Fridovich (1972). The reaction mixture contained 50.0 µL of the crude enzyme extract, 2.5 mL of carbonate – bicarbonate buffer (0.05 M, pH 10.2), 500 µL of EDTA solution (11.4 mg in 30 mL of buffer) and 50.0 µL of water. The reaction was initiated by the addition of 200.0 µL of epinephrine (7.5 mg in 7.5 mL of buffer) and the increase in absorbance at 480 nm was measured for 2 minutes at every 15 sec. interval in a Shimadzu UV Spectrometer. Simultaneously, 100% autoxidation of epinephrine to adrenochrome was performed without enzyme and used as control. The enzyme activity is expressed as units mg^{-1} protein. One unit of enzyme activity is defined as the enzyme required to cause 50% inhibition of epinephrine autoxidation.

2. Glutathione reductase (GR; E.C.1.11.1.9): Glutathione reductase activity was measured by the method of Dubler *et al.*(1981). The reaction mixture containing 2.2 mL Tris buffer (pH 7.6), 0.5 mL GSSG (14.14 mg oxidized glutathione dissolved in 14.0 mL of d_2O) and 0.1 mL NAD(P)H (20.004 mg in 3.0 mL of d_2O) was made up to 3.0 mL with water. Reaction was initiated by the addition of 0.1 mL of the enzyme extract and the change in O.D at 340nm was monitored for 2 minutes at 30.0 sec. intervals. The enzyme activity is expressed as n moles of GSSG utilized min^{-1} mg^{-1} protein.

3. Glutathione peroxidase (GPx; E.C.1.11.1.12): GPx activity was determined following the method of Rotruck *et al.*(1973). To 1.0 mL of phosphate buffer (0.1 M, pH7.4) taken in a tube, 0.5 mL Sodium azide solution (29.25 mg in 15.0 mL of buffer), 0.5 mL of EDTA solution (50.4 mg in 15.0 mL of buffer0, and 100.0 µL of the enzyme were added and mixed well. To this mixture, 0.5 mL glutathione (36.75 mg in 15.0 mL of buffer) was added and incubated at 37°C for 10 minutes, followed by the addition of 1.0 mL of hydrogen peroxide (freshly prepared by mixing 240 mL of hydrogen peroxide in 40.0 mL of buffer). The control contained all the reagents except the enzyme. After the incubation period, aliquots (1.0 mL) of the samples (both test and control) were taken in a tube to which 2.0 mL of Meta phosphoric acid and 1.0 mL of DTNB (5, 5'- dithio-bis-2-nitrobenzoic acid) reagent were added. The absorbance was then read at 412 nm in a Spectrophotometer. The enzyme activity is expressed as n moles of GSH oxidized min^{-1} mg^{-1} protein.

RESULTS

Foliar application of the panchagavya amended with seaweed extract increased the activities of all the three enzymes of antioxidation.

a. Superoxide dismutase (SOD; E.C. 1.15.1.1)

Levels of SOD in the experimental plants ranged between 119 and 141 units / mg protein (Figure 1). Maximum activity was found in *Arachis hypogea* while minimum activity was recorded in the leaves of *Oryza sativa*.

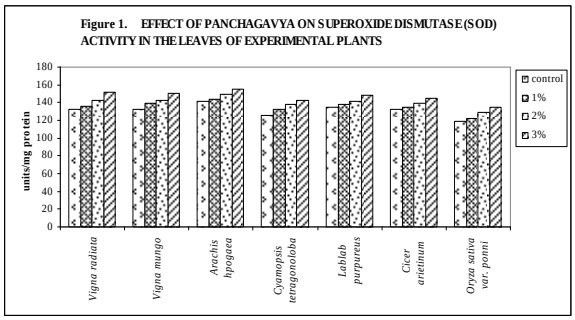


Figure 1. EFFECT OF PANCHAGAVYA ON SUPEROXIDE DISMUTASE (SOD) ACTIVITY IN THE LEAVES OF EXPERIMENTAL PLANTS

Spraying the seedlings with panchagavya resulted in an increase in the superoxide dismutase activity in all the experimental plants. Increasing the concentration of panchagavya from 1% to 3% concomitantly increased the levels of the enzyme in all the seedlings. Seedlings that received 3% panchagavya spray exhibited 9 to 14% more activity for the enzyme than their respective controls.

b. Glutathione reductase (GR; E.C.1.11.1.9)

High levels of glutathione reductase were detected in the seedlings of all experimental and control seedlings and the levels were in the range of 141 to 153 n moles GSSG utilized min^{-1} mg^{-1} protein (Figure 2).

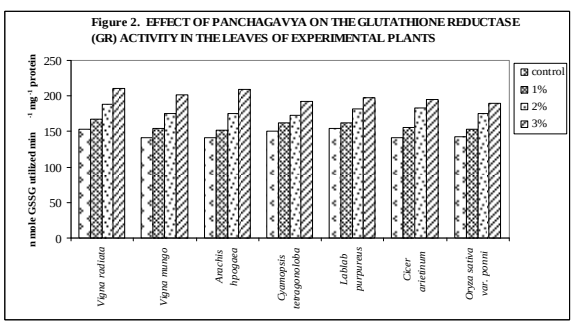
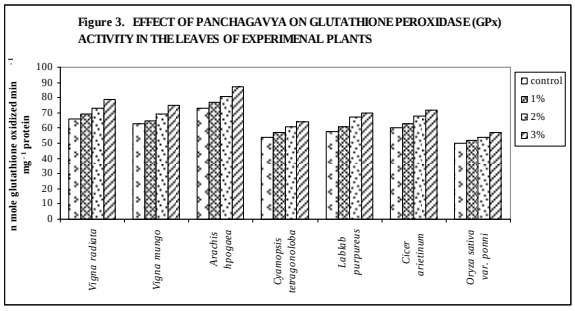


Figure 2. EFFECT OF PANCHAGAVYA ON THE GLUTATHIONE REDUCTASE (GR) ACTIVITY IN THE LEAVES OF EXPERIMENTAL PLANTS

Seedlings that received the spray treatment with 1% panchagavya increased the levels of the enzyme by about 5 to 9% and the effect was high in the pulses *Vigna radiata* and *Cicer arietinum*. A linear relationship existed between the levels of GR in the seedlings and the concentration of panchagavya treatment given. Increase in the levels of the enzyme in seedlings that received 3% panchagavya was 27 to 48% more than that of the respective control seedlings. *Arachis hypogea* recorded the highest activity for the enzyme for 3% panchagavya treatment.

c. Glutathione peroxidase (GPx; E.C.1.11.1.12)

Arachis hypogea recorded the highest activity (73 n moles glutathione oxidized min^{-1} mg^{-1} protein) among the experimental plants while *Cyamopsis tetragonoloba* registered the lowest (54 n moles glutathione oxidized min^{-1} mg^{-1} protein) (Figure 3).



All experimental seedlings except *Oryza sativa* showed significant levels of increase in glutathione peroxidase activity in response to spray treatment with panchagavya. In rice, the quantum of increase in the levels of the enzyme was low. Nevertheless, the foliar application was able to influence the activity of this enzyme in rice also. Increasing the concentration of panchagavya resulted in concomitant increases in the activity of glutathione peroxidase of the seedlings exhibiting positive correlation between the two. Seedlings that received 3% panchagavya treatment recorded 12 to 20% more activity for the enzyme than that of the respective control seedlings (Figure 3).

DISCUSSION

Production of reactive oxygen species (ROS) or the superoxide radical is of common occurrence in biological systems either through exposure to ionizing radiations and xenobiotics or through normal metabolic reactions. Reactive oxygen species mediated reactions in plants can inactivate enzymes and interfere with the integrity of membranes, DNA strands and many other macromolecules (Bowler *et al*., 1992; Mehdy, 1994). This would in turn lead to a decrease in the yield potential of crop plants primarily through pathological conditions. Organisms have evolved mechanisms that can scavenge the superoxide radicals in cells to ameliorate the damage caused by ROS mediated pathological conditions either through specific enzymes or antioxidants. Enzymes mediated scavenging of reactive radicals is one such mechanism observed in plants. Three enzymes namely, superoxide dismutase (SOD), glutathione reductase (GR) and glutathione peroxidase (GPx) play a key role in scavenging these reactive radicals. The effect of panchagavya as a foliar spray on these three antioxidant enzymes in the leaves of the experimental plants has been investigated in the present study.

Glutathione is a naturally occurring tripeptide and is a major source of intracellular non-protein thiol group (Meister and Anderson, 1983). It serves an important role in antioxidant defense as it scavenges free radicals produced by oxidation or radiation and protects cells against a variety of endogenous and exogenous toxic agents (Brehe and Burch, 1976; Cook *et al*., 1991; Colvin *et al*., 1993). Glutathione exists as reduced glutathione (GSH) and oxidized glutathione (GSSG). In the reduced state, the aminoacid residue cysteine of glutathione provides reducing equivalents (protons and electrons) to other unstable molecules such as reactive oxygen species. As a result, glutathione itself becomes reactive to form GSSG by reacting with another glutathione. Under such conditions, the enzyme glutathione reductase plays a key role in regenerating reduced glutathione (GSH) from GSSG. Glutathione is a cofactor for the enzyme glutathione peroxidase which by its peroxidase activity protects cells from oxidative damage. Glutathione peroxidase plays a major role by reducing lipid hydroperoxides to their corresponding alcohols in addition to reducing free hydrogen peroxide to water (Rotruck *et al*., 1973).

Spraying the seedlings with seaweed based panchagavya increased the activities of all the three antioxidant enzymes namely; superoxide dismutase (SOD), glutathione reductase (GR) and glutathione peroxidase (GPx) in the leaves of all the experimental plants (Figures 1, 2 and 3). A linear relationship existed between the levels of these three enzymes and the concentration of panchagavya used in the foliar spray. Seedlings that received 3% panchagavya increased the activity of SOD by 9 – 14% (Figure 1), GR by 27 – 48% (Figure 2) and GPx by 12 – 20% (Figure 3). The effect of panchagavya was more pronounced on the glutathione reductase levels as compared to the

other two enzymes. Induction in the levels of these three enzymes by the foliar spray of panchagavya indicates a better defense mechanism in the plants that received the treatment against ROS mediated pathological conditions and this could be construed as a positive aspect of panchagavya in promoting the yield potential of crop plants.

CONCLUSION

The study revealed that foliar application of panchagavya amended with seaweed extract to the experimental pulse and rice seedlings induced the activities of the antioxidant enzymes in all the seedlings. The spray was effective at a concentration of 3% and needed at least three applications at an interval of seven days each. Of the three enzymes studied, GR exhibited highest response to the treatment.

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9/25/2009

Creativity as a predictor of intelligence among undergraduate students

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Abstract: This research examines the extent to which the level of creativity and different components of creativity: Something about myself, Environmental sensitivity, Initiative, Intellectuality, Self-strength, Individuality and Artistry among undergraduate students predict intelligence. Respondents in the research comprises of 153 from six Malaysian universities. Multiple regression analysis reveals that a total variance in intelligences accounted for by the creativity factors is 13.5% (multiple R2 = 0.135, F (7, 145) =3.222, p = .003). This implies that creativity is important when considering the factors that influence the intelligence of students. [The Journal of American Science. 2010;6(2):189-194]. (ISSN 1545-1003).

Keywords: Intelligence, Creativity, Something about myself, Environmental sensitivity, Initiative, Intellectuality, Self-strength, Individuality and Artistry

1. Introduction

Furnham & Bachtiar (2008) stated there are more than 60 definitions of creativity with no single authoritative and consensus on its definition, or operational measure. An straightforward meaning of creativity view is generating something novel, original, and unexpected (Sternberg & Lubart, 1999). According to Palaniappan (2007b), creativity is some of the many intellectual constructs that has been defined in as many different ways as the number of researchers investigating them. Creativity has been defined as a product, process, person as well as the press (environment) that impact on the individual (Rhodes, 1961). For purpose of this study, creativity is investigated as a personality (KTCPI as the measure), because it is a new measure for assessment of creativity by this instrument. Creativity perception refers to the perception of oneself as being creative and capable of creative productions. It is one of the most important personality traits related to creativity (Biondi, 1976; Davis, 1983). This is further confirmed by (Khatena, 1977) when he said that " an individual who perceives himself as creative and with accuracy, is a person who can be expected to behave in creative ways" .

The conception of creativity is frequently related to intelligence (Furnham & Bachtiar, 2008), but several early researchers (Andrews, 1930; Getzels & Jackson, 1962; McCloy. W and N.C. Meier, 1931) have revealed that the relationship between creativity and intelligence has only modest (r = .07, .22, .26, respectively). In another study (Furnham & Bachtiar, 2008), intelligence [as measured by the Wonderlic Personnel Test (WPT)] was not correlated with any of the creativity [as measured by the Divergent Thinking (DT), Biographical Inventory of Creative Behaviours (BICB), Self-Rating of creativity (SR), Barron–Welsh Art Scale (BWAS)].

In a study conducted by Olatoye & Oyundoyin (2007) on the creativity and intelligence among 460 students who were randomly selected from 20 secondary schools, it was found that intelligence quotient (I.Q) [as measured by Slosson's Intelligence Test (SIT)] was significantly related to creativity [Ibadan Creative Assessment Scale (ICAS)]. Their finding demonstrated that intelligence quotient (I.Q) accounted for 80% of the variance in creativity (R2 = 0.80). This percentage is statistically significant. According to this study, intelligence quotient (I.Q) also significantly predicts each of the four components of creativity (fluency, originality, flexibility and creativity motivation). Funchs and Karen (1993) examined the creativity and intelligence among 496 preschoolers applying for admission to a special program for gifted preschoolers. It was found that creativity (as assessed by the Thinking Creativity in Action and Movement Scales) was significantly

related to intelligence (as assessed by the standard I.Q tests).

This research is therefore designed to examine the influence of creative perception inventory and the different components of creativity in Something About Myself, which include Environmental Sensitivity, Initiative, Intellectuality, Self-strength, Individuality and Artistry on intelligence among Iranian undergraduate students in Malaysian Universities. This study attempts to investigate the following hypotheses: (i) creative perception inventory will not significantly predict the intelligence among students, and (ii) The components of creativity will not significantly predict intelligence among the students.

2. Methodology

2.1 Sample

One-hundred-and-fifty-three Iranian undergraduate students in Malaysian Universities (31.4% females and 68.6% males) were recruited as respondents in this study. Their ages ranged from 18-27 years for females and 19-27 years for males.

2.2 Measures

2.2.1Catell Culture Fair Intelligence Test

To evaluate the intelligence, every student was administered a Scale 3 of the Catell Culture fair Intelligence Test (CFIT-3a & b). Roberto Colom, Botella, & Santacreu (2002) reported that this test is a well-known test on fluid intelligence (GF). Participants completed Cattell's culture fair intelligence test battery to assess individual differences in fluid intelligence. Cattell's Culture Fair Intelligence Test (1971), which is a nonverbal test of fluid intelligence or Spearman's general intelligence. This test comprised four individually timed subsections a) Series, b) Classification, c) Matrices, and d) Typology. Each is made up of multiple-choice problems with progressing difficulty and incorporates a particular aspect of visuospatial reasoning. Raw scores on each subtest are summed together to form a composite score, which may also be converted into a standardized IQ.

2.2.2 Khatena-Torrance Creative Perception Inventory (KTCPI)

Every student was examined using a Khatena-Torrance Creative Perception Inventory (KTCPI) to measure the creative perception of the undergraduate students (Palaniappan, 2005). The KTCPI instrument was comprised of two subscales, namely, "Something About Myself" (SAM) and "What Kind of Person Are You" (WKOPAY)? The SAM measure of creative perception, which is based on the rationale that creative behavior is reflected in an individual's personal creative characteristics, characteristics possessed and in use in creative thinking and creative productions (Palaniappan, 2005; 2007). It tests six factors, namely, Environmental Sensitivity, Initiative, Intellectuality, Self-strength, Individuality and Artistry.

According to Palaniappan's (2005; 2007) definitions, Environmental Sensitivity relates to being open to ideas of others, relating ideas to what can be seen, touched, or heard, interest in beautiful and humorous aspects of experiences, and sensitivity to meaningful relations. Initiative relates to directing, producing, and /or playing leads in dramatic and musical productions; producing new formulas or new products; and bringing about changes in procedures or organization. Self-strength relates to self-confidence in matching talents against others, resourcefulness, versatility, willingness to take risks, desire to excel and organizational ability. Intellectuality relates to intellectual curiosity, enjoyment of challenging tasks, imagination, preference or adventure over routine, liking for reconstruction of things and ideas to form something different, and dislike for doing things in a prescribed routine. Individuality relates to preference for working by oneself rather than in a group, seeing oneself as a self-starter and somewhat eccentric, critical of others' work, thinking for oneself and working for long periods without getting tired. Artistry relates to production of objects, models, paintings, carvings, musical composition, receiving awards or prizes or holding exhibitions, production of stories, plays, poems and other literary pieces.

The SAM consisted of 50 items that required 'yes' or 'no' answers. The scoring of responses to this measure presented little difficulty; it was done by simple frequency counts of the positive responses on the total scale. The reliability for the assessment of creativity [the SAM], established in a pilot study was good (alpha =0.779)].

2.2.3 Cumulative Grade Point Average (CGPA)

For the purposes of this study, Cumulative Grade Point Average (CGPA) was used as a proxy of academic achievement. The CGPA was calculated by dividing the total number of grade points earned by the total number of credit hours attempted. A student's academic achievement was based on their mid-year examination results. Academic achievement was the aggregate or the total number of grade points in the mid-year examinations. In these examinations, each university subject was graded along a one hundred (or four) point scale, the best grade point being one hundred (or four) and the lowest being zero. The aggregate ranged from 75 to 100 (3 to 4). Hence, the higher aggregate the better the academic achievement. This approach was used because other researchers have used the measure and found it an acceptable one for measuring academic achievement. Palaniappan (2007a) cited some researchers using CGPA as a proxy for academic achievement (Nuss, 1961; Parker, 1979; Taylor, 1958; Wilson, 1968).

3.2 Procedure

The students who participated in this study were all undergraduates. The research questions posed for the study required the students to identify and analyze the distributions and correlations of certain creativity perception were best addressed in the form of a descriptive study. Creativity levels were assessed by self- report instruments and were confirmed based on the results from the administration offices of the universities (described below). They were then divided by gender, with the total scores and subscales calculated for each male and female. The participants, women (18-27 years) and men (19-27years), were asked to respond during the regular course time. Both written and oral instructions were given to all participants. Multiple significance tests were conducted and the data were analyzed using Regression analysis. Participants were allowed to answer the tests either using their name or anonymously (whichever they preferred). They received no rewards for participating but were advised they would be given information of their results in the form of a self-referenced level of abilities at a later date. Scores for the intelligence, the creativity scale and its factors, were entered into the SPSS statistical program.

3. Result

3.1 Descriptive Statistics

Table.1 shows descriptive statistics on intelligence. The finding of this result shows that the mean score for intelligence was 104.55, standard deviation (15.70), while the mean scores for creativity and its components were as follows: the SAM (M=32.30, SD= 4.44), Environmental Sensitivity (M= 4.83, SD= 1.15), Initiative (M= 2.74, SD=1.48), Self Strength (M=7.24, SD= 1.62), Intellectuality (M=6.69,SD=1.70),Individuality(M=3.54,SD=1.39) and Artistry (M= 2.50, SD=1.51).

Table 1. Descriptive Statistics (N=153)

Variables	Mean	Std. Deviation
Intelligence (The A Form)	104.55	15.70
Creativity (The SAM)	32.30	4.44
Environmental Sensitivity	4.83	1.15
Initiative	2.74	1.48
Self Strength	7.24	1.62
Intellectuality	6.69	1.70
Individuality	3.54	1.39
Artistry	2.50	1.51

3.3 Data Analysis

3.3.1 Hypothesis One

It states that the creativity of the subjects will not significantly predict intelligence. In Table 2, creativity significantly predicts intelligence among subjects. The total variance accounted for by the creativity factor is 13.5% (multiple R2 = 0.135), F (7, 145) = 3.222, p = .003). This implies that creativity is important when considering the factors that influence intelligence of Iranian undergraduate students in Malaysian universities.

Table 2. Regression summary table showing the effect of creativity on intelligence b

	Sum of Squares	Df	Mean Square	F	Sig*
Regression	5043.436	7	720.491	3.222	.003a
Residual	32428.446	145	223.644		
Total	37471.882	152			

a. Predictors: (Constant), Artistry, Individuality, Environmental Sensitivity, Self Strength, Intellectuality, Initiative, Creativity (Something About Myself)
b. Dependent Variable: intelligence
* = Significant at 0.01
Multiple R= .367
Multiple R2 = .135
Adjusted R2 = .093
Standard Error of the Estimate= 14.95475

3.3.2 Hypothesis Two

It states that the each of the constituents of creativity of the subjects will not significantly predict intelligence. In Table 3, the multiple R2 columns reveals the total variance in intelligence accounted for by each of the creativity components of students. The highest contributing component to intelligence is Environmental Sensitivity (R2=0.165). This is closely followed by Intellectuality (R2=0.134), then, followed by Initiative (R2=0.122), artistry (R2=0.114), Individuality (R2=0.113) and lastly, by Self Strength (R2=0.090). The contribution of each of the component is different. The difference between the highest and lowest contributors is 0.156 (15.6%). each component of creativity except Environmental Sensitivity (Sig= .041). Each component of creativity except Environmental Sensitivity (Sig= .041) does not significantly predict intelligence. However, Normal P-P Plot graphs (Expected Cumulative Probability by Observed Cumulative Probability) were obtained for intelligence scores is shown in Figure 1.

Table 3. Regression summary table showing relative effect of intelligence on each of the creativity constituents

Creativity components	R	Multiple R Square	Adjusted R Square	Standard Error of the Estimate	F	Sig
Artistry	.114	.013	.006	15.651	1.972	.162
Environmental Sensitivity	.165	.027	.021	15.536	4.232	.041*
Self Strength	.090	.008	.001	15.689	1.228	.270
Individuality	.113	.013	.006	15.652	1.941	.166
Intellectuality	.134	.018	.011	15.611	2.751	.099
Initiative	.122	.015	.008	15.634	2.279	.132

* Significant at 0.05 level of confidence

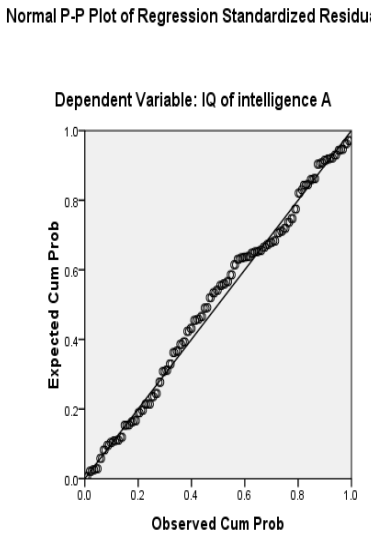

Figure 1. Normal P-P plot of Regression Standardized Residual

4. Discussion and Conclusion

Creativity predicts intelligence in this research, but the fact is that the value is low i.e. 13.5% (multiple R2 = 0.135), ($F7, 145=3.222$, $p<0.05$). The findings of past studies have shown low correlation between intelligence and creativity scores in various instruments (Andrews, 1930; Getzels & Jackson, 1962; McCloy. W and N.C. Meier, 1931). However, the finding of this study is not out of place. It supports the relationship between intelligence and creativity found in studies conducted by Funchs and Karen (1993) as well as Olatoye and Oyundoyin, (2007). These researchers found a significant relationship between the intelligence and creativity. Intelligence is a good predictor of creativity. It is recommended and suggested that employers of schools, universities and teachers may include assignments requiring creative skills for high intelligence students.

Creativity as used in this research has six components, namely Environmental Sensitivity, Initiative, Intellectuality, Self-Strength, Individuality and Artistry. The relative effect of each of the creativity component considered in this investigation on intelligence indicates that their contributions are each unique. On its own, each of the creativity component (except Environmental Sensitivity) is not enough to measure the creativity of the students. This means that if a counselor or teacher wishes to measure creativity, using any of the components separately (except environmental sensitivity) will not be sufficient to measure a student's creativity. This study was conducted in Kuala Lumpur (capital city) and a metropolitan area (Selangor) in which the Malaysian universities were located. As such, the extent to which the results apply to other cities and universities is not known. Therefore, the conclusion in this study needs to be verified by conducting similar studies in other universities in Malaysia (Naderi et. al. 2009).

Acknowledgment

We thank the administration officers at Universiti Putra Malaysia, Universiti Malaya, Multimedia University, Lim KokWing University, Universiti Tenaga Malaysia and APIT University for giving us information about Iranian students in their Universities. We also appreciate the contribution of Iranian Undergraduate students by participating in this research, thus allowing us to collect the necessary data for the study.

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10/07/2009

The Journal of American Science

ISSN 1545-1003

Marsland Press

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Okemos, Michigan 48864, USA

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Websites: http://www.americanscience.org;
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ISSN 1545-1003