Improving performance and some metabolic response by using some antioxidants in laying diets during summer season.

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Abstract: The present work was conducted to define the effect of adding vitamin E (Vit. E) and/or selenium as seleno-yeast (SY) on performance, egg quality and some blood constituents of laying hens during summer months. Two hundred seventy Hi- sex Brown layers in their 25 weeks of age were randomly divided into nine dietary treatment groups. Each treatment included thirty hens in 6 replicates (5 birds/each). The obtained results showed that dietary Vit.E at either level 0.20 or0.40mg/kg considerably resulted in positive significant effect on egg production (EP) values and had no effect on egg weight (EW) compared to the control. Also, feed intake (FI) did not differ while, feed conversion (FC) values were improved due to Vit.E addition compared to the control. However, dietary organic se (SY) achieved significant increase on EP values but no differences on EW and FI values, while FC achieved the best values by adding SY as compared to the control. Both levels of Vit.E significantly improved shell-thickness and decreased shape index and yolk color than the control, whereas, no effects were observed on egg quality parameters due to SY addition, except, yolk index which improved compared to the control. On the other hand, plasma total protein (TP), albumin (AlB) and globulin (GLO) were significantly increased by adding Vit.E but AST, ALT and glutathione peroxidase were not affected versus to SY addition which caused significant effects on ALT and glutathione peroxidase and increased with the higher level of SY. There were significant interactions due to Vit.E x SY addition concerning the performance (EP, EW, FI and FC), most egg quality parameters (shape index, Haugh units and yolk index) and some blood plasma (TP, Alb, Glo. and glutathione peroxidase) to laying hens diets. So, it could be recommended that adding either Vit. E and/or selenium enriched yeast (SY) as antioxidants were found to be effective on improving laying performance and could be beneficial during the summer season.
[El-Mallah, G.M.; Yassein, S.A.; Magda, M. Abdel-Fattah and El-Ghamry, A.A. **Improving performance and some metabolic response by using some antioxidants in laying diets during summer season.** Journal of American Science 2011;7(4):217-224]. (ISSN: 1545-1003). http://www.americanscience.org.

Keywords: Improving performance, Blood metabolic, laying diets, summer season.

1. Introduction

Vitamin E (Vit.E) is a metabolic nutrient that has received a lot of attention with respect to its importance to the immune response in poultry. However, chicken cannot synthesis Vit.E, therefore, Vit.E requirements must be given from dietary sources (Chan and Deeker, 1994). Also, Vit.E has been reported an excellent biological functions as natural antioxidant prevents the oxidation of unsaturated lipid materials within cells, thus protecting the cell membrane oxidative damage (Gore and Qureshi, 1997). Furthermore, Vit.E serves as a physiological antioxidant through inactivation free radicals, improves egg production, feed intake, egg yolk and albumen solids (Kirunda et al.,2001), and improves egg quality (Puthpongsirporn, 1998).

On the other hand, selenium (Se) has been recognized as an essential nutrient required for laying hens for normal growth, maintenance of health and physiological functions. The role of Se in biological systems has been associated with its antioxidant activity (Schwary and Foltz, 1957), while its physiological importance was recognized when it is found to be an essential structural of the glutathione peroxidase enzymes (Rotruck et al., 1973) that destroy free radicals produced during normal metabolic activity (Wakebe, 1998 and Dvorska et al., 2003). The use of seleno-yeast (SY) in laying hens is very effective for increasing the Se content of egg (Cantor et al., 2000; Payne et al., 2005 and Utterback et al., 2005). However, Se can affect egg quality where, it can ameliorate some of the adverse effects of strong Haughunit value of eggs (Pappas et al., 2005). Also, it may affect metabolism and production because it is essential for the synthesis of active thyroid hormones, while, no differences in egg production, egg weight, feed intake or mortality by using organic SY which is very effective for increasing the Se content of eggs (Utterback et al.,2005).Therefore, adding Se to laying diets improves their health , productivity and can also be a natural way to produce functional food respectivity the production of egg enriched with Se (Yaroshenko et al.,2003 and Sara et al.,2008), which represents a commercially valuable use for the future.

The action of Se is closely linked with that of Vit.E. Vitamin E as a natural antioxidant, prevent the development of peroxides, while Se as a constituent of glutathione peroxidase function in the disposal of any peroxides that are formed. Due to the metabolic relationship between Vit.E and Se (Cook, 1991), it is essential that both nutrients be considered together when discussing their effects on productivity and immunity (Salwa Siam et al., 2005). So, the objective of this study was to establish the effects of Vit.E and/or SY to alleviate heat load on performance, egg quality and some biochemical blood parameters of laying hens under summer season in Egypt.

2. Material and Methods

This experiment was conducted to study the effect of different levels of vitamin E(VE) and /or selenium as seleno-yeast(SY) addition in laying hens diets during summer season(June, July and August) in Egypt. Two hundred seventy,25-weeks old, Hi-sex brown-egg type hens housed in individual wire cages, and divided into nine equal treatments groups of twenty five hens each(6 replicates of five birds each). All hens were kept under the same managerial, hygienic and environmental temperature which ranged from 22 to 38C and humidity from 40-60% during over all the experimental intervals (3 periods of 4 weeks each). Also, the lighting schedule was 16 h light: 8h dark/day. Hens received an iso-caloric and iso-nitrogenous (2819 ME Kcal/kg and 18%CP). Basal diet (Table 1), balanced to meet requirements of laying hens (NRC, 1994). The experimental groups were fed on one of the following diets:

T1: 0.0 mg/kg VE + 0.0%SY (control).
T2: T1+ 0.0 mg/kg VE + 0.25% SY.
T3: T1 + 0.0mg/kg VE + 0.50% SY.
T4: T1 + 0.20 mg/kg VE + 0.0%SY.
T5: T1 + 0.20 mg/kg VE +0.25% SY.
T6: T1 + 0.20 mg/kg VE + 0.50% SY.
T7: T1 + 0.40 mg/kg VE + 0.0%SY.
T8: T1 + 0.40 mg/kg VE + 0.25% SY.
T9: T1 + 0.40 mg/kg VE+ 0.50% SY.

Feed and water offered ad-libitum. Egg weight (EW) and egg number (EN) were recorded daily. Feed intake (FI) was recorded weekly, while feed conversion ratios (FCR) were calculated. Egg quality parameters were measured using 36 eggs (4 eggs/each group), these involved yolk, albumen, shell weight (%). Egg shell thickness was measured in mm using a micrometer. Egg shape index was calculated as egg diameter divided by an egg length. Yolk index was calculated as yolk height divided yolk diameter. Haugh unit was calculated using the calculation chart for rapid conversion of EW and albumen height.

At the end of the experiment, blood samples were collected in heparinized tubes from the brachial vein(5 hens /group), and centrifuged at 3000rpm for 15 minutes to separate clear serum which stored at 20ºC for determination of some blood constituents. Also, glutathione peroxidase concentration was determined by spectrophotometer using available commercial kits.

Data were analyzed using general linear model (GLM) procedure of statistical system (SPSS, 1997).Significant differences among individual means were analyzed by Duncan's multiple range test (Duncan, 1955).

3. Results and discussion

Productive performance:

Egg production (EP) and egg weight (EW):

As shown in Table 2, the results indicated that hens fed diets added with Vit.E had significant improvement in values of EP (%) when compared to the control. However, the hens fed 40mg/kg Vit.E had the highest EP (%) as compared to the other treatments and control group during the third period and the whole experimental period. Furthermore, EW had the same trend, when Vit.E was added up to 40 mg/kg in laying diets showing the best values of EW during the third period and the whole experimental period. In this respect, Abdel- Maksoud (2006) showed that supplemental Vit.E increased EP(%) by alleviating the adverse effects of high ambient temperature in laying hens during summer months. However, Vit.E supplementation may have enhanced synthesis of egg yolk precursors in liver through protecting the liver from lipid peroxidation and damage to cell membranes. This was previously confirmed in hens by Bollengier-lee et al.(1998 and 1999). Similar results were obtained in laying japanese quail reared under heat stress (34ºC) by Sahin et al. (2002), Abdel-Galil and Abdel-Samad (2004) and Ciftci et al. (2005).

On the other hand, hens fed diets added with organic Se as SY recorded significantly higher values of EP (%) when compared to the control. This improvement of EP increased by increasing SY level. In addition, dietary SY levels had no significant effect on EW during over all experimental periods comparable to the control. Similar results were obtained by Renema (2004), Simon (2004) and Sara et al.(2008),they showed that addition of organic Sel-Plex to laying hens diets significantly ($P<0.05$) increased EP(%) during the period ranged from 48-62 wk of age respectively. Similar trend was observed by Hanafy et al. (2009). However, Utterback et al. (2005) found that no significant differences ($P< 0.05$) in EW was attained with basal diet plus either sodium silinate or seleno-yeast.

Significant interactions between Vit.E x SY additives (Table2) were observed for EP and EW values, where, the highest EP was attained with high SY level (T9). Also, each of tested additives significantly ameliorated EP compared to the control. The highest value was for T3, followed by T6 and T9 which received a combination of Vit.E and SY diets during the tested periods. While, EW values were nearly similar between treatments and had no significant effect due to the tested additives during the whole period values. In this connection, Vit.E is effective antioxidant that protect cells from oxidative stress induced by free radicals (Bartov and Frigg, 1992), through scavenging the free radical (Zuprizal et al.,1993), transferring radical equivalents from lipil phases to aqueous compartment (Halliwell and Gutteridge,1989) or increasing the expression of antioxidant enzymes such as gluathion (Luadicina and Marnett,1990).

Feed intake (FI) and feed conversion (FC):

Results in Table 3, showed that adding Vit.E at different levels in laying hen diets was not achieved any significant increase in FI values as compared to the control diet throughout the different intervals and the total period. The non -significant differences in FI indicate the positive effect of Vit.E was mainly due to feed utilization. With respect to FC, the values were markedly improved (P 0.05) due to Vit.E addition in laying hen diets. The hens fed Vit. E up to 40mg/kg diet had significantly (P 0.05) better FC values during the 3 tested periods compared to the other and control ones. Similar trends were reported by Bollengier-lee et al. (1999) and Sahin et al.(2002) in Japanese quail, and Metwally (2003) on laying hens. Vitamin E might play an important role through the protection of liver and other organs against oxidative damage (as a metabolic regulator) as cited by Abdel-Maksoud (2006).

Furthermore, no significant effects of SY addition and with increasing level on FI were observed during all tested periods. Hens of T3 (fed 0.50% SY) showed the highest FI values. These results are supported by Payne et al. (2005), Utterback et al. (2005), Richter et al. (2006) and Hanafy et al. (2009), they reported that the organic Se supplementation had no significant effect on FI values in laying hens. However, the group fed diet containing SY improved FC, the best value was achieved by hens of T3 compared to the control value. Our results disagree with those of Osman et al. (2010) who found no significant effect in FC values for hens fed diet containing 100or200mg Se/kg diet as Sel-plex during the overall experimental period. A significant interaction between Vit.E x SY was noted in FI values (T5, T6, T8 and T9). Also the best ($P<0.05$) FC value was attained by T9, T8 and T6 followed by each of Vit.E and SY treatments, respectively.

Egg Quality Parameters:

As shown in Table 4, most egg quality parameters were not affected ($P<0.05$) by the treatments except, shape index and yolk color which significantly ($P<0.05$) decreased and shell thickness which significantly ($P<0.05$) improved compared to the control. These results confirmed those of El-Shikh and Salama (2010) who reported that Vit E improved shell-thickness and haugh unit score as compared to the control but, did not affect significantly shell weight% and albumen weight %as compared to control, Similar results were reported by Engelmann et al.(2001), Kirunda et al.(2001) and Abdel-Galil and Abdel-Samad (2004). In this connection, the achieved improvement in shell-thickness could be due to enhancement of calcium bioavailability by the action of supplemental Vit.E. These facts confirmed the results of increased serum-ca concentration that has been established in the present study(Abdel-Fattah and Abdel-Azeem,2007). Moreover, Vit.E addition was stated to influence the oestradiol dependant mechanisms by exerting a dirct effect on oestradiol or indirect effect through maintaining more normal function of cellular processes regulating oestradiol and restoration of estrogen secretion (Bollengier-lee et al., 1998).Concerning SY level, no significant ($P<0.05$) differences were found on egg quality parameters. Only the yolk index showed the significant effect ($P<0.05$) by using diets containing SY. These results are in agreement with Klecker et al. (2001), Renema (2006) and Sara et al; (2008), they reported that the administration of organic Se in laying hen diets increased shell-thickness consequently improved egg shell quality. Similar reports by Spring (2006) and Hanafy et al. (2009). However, SY addition, reduced deterioration of the albumen quality which results in slower carbon dioxideloss and thus maintains albumen quality after the egg is laid (Wakebe, 1998).

Shape index significantly ($P<0.05$) improved with Vit.E and/or SY addition. The highest being for T2 (0.25% Se), T7 (50 mg/kg Vit.E) compared to T1 (control group). On the other hand, there were significant interactions due to tested additives for shape index, haugh units and yolk index, where, the highest shape index was attained by T6 while haugh unit score and yolk index were improved by T9 and T6 compared to the control. The improvement of haugh units in this study may be explained by the interaction of dietary Vit.E with SY. Experimental results obtained are in harmony with those reported by Spring (2006) who indicated that organic Se supplementation in broiler and breeder layers improved egg quality and anti-oxidative properties.

Some Blood Constituents:

The results in Table 5 showed that hens fed diet added with Vit.E up to 0.50mg/kg had significant ($P<0.05$) increased on blood serum TP., Alb.,and globuline, whereas no effect ($P<0.05$) on serum AST, ALT, triglycerides and glutathione peroxidase comparing to the control during summer months of the experiment. These results supported to those of Gursu et al. (2003) who found that serum activities of AST and ALT were not influenced by dietary Vit.E supplementation. But through its known properties as an intra-membrane antioxidant, Vit.E may protect tissue membrane from lipid peroxidation caused by free radicals attack. It could therefore reduce the associated loss of integrity of function of cell membranes and associated increased cellular permeability and play a role in alleviating the effect of heat stress in laying hens.

However, the addition SY in the differences in the laying diets at 20-40mg/kg caused significant differences in ALT, TP, GLO and glutathione peroxidase , while in-significant effects in the other blood parameters being in AST, triglycerides, cholesterol and albumin compared to the control. Also, organic Se (SY) had more pronounced effect on TP, GLO and glutathione peroxidase. In this connection, Kim and Mahan (2003) indicated that Se is bio-chemically similar to sulphur, where, Se can replace the sulphur molecule in the normal biosynthetic pathway of the yeast cell and is absorbed activity across the intestine by the same amino acid carrier. Furthermore, organic Se addition to broiler breeder and layers was activity absorbed and can be directly incorporated into protein (Comb and Comb, 1986). On the other hand, the significant increase in serum glutathione peroxidase was due to Se addition in the laying diets.

The use of Sel-plex as a source of supplemental dietary Se provides a more efficiency utilized form of organic Se and facilitates a greater antioxidant enzymes presence in glutathione peroxidase which more readily reduced peroxides and other free radicals compromise cell membranes (Edens and Gowdy, 2005).

From Table (5), significant interactions between Vit.E x SY were found for TP, ALB, GLO and glutathione peroxidase to laying hens diets (i.e. T5, T6, T8 and T9, respectively). These additions alleviated the adverse effect of hot climate on AST and ALT. This improvement may be due to that both Vit.E and Se are involved in the formation of glutathione peroxidase, a compound vital in the cellular detoxification mechanisms.

It could be concluded that, either Vit. E or Se-enriched yeast (SY) alone or in combination recorded greater results of the performance, egg quality and some blood parameters in laying hens and the higher levels of these additions was suitable to cover the requirements without adverse effects on laying hens. So, adding Vit. E and/or SY levels in the present study were found to be effective in improving the laying performance.

Table (1): Composition of the experimental ration.

Ingredients (%)	%
Yellow corn	63.00
Soybean meal (44% CP)	18.00
Corn gluten meal (60% CP)	8.00
Limestone (CaCo3)	7.50
Bone meal	2.50
Vit & Mineral Premix*	0.30
Salt (NaCl)	0.4
L-Lysine HCl	0.15
DL-Methionine	0.15
Total	100.00
Calculated analysis:	
Crude protein %	18.08
ME (Kcal/Kg diet)	2810
Calcium %	3.67
Available phosphorous %	0.43
Lysine %	0.73
DL-Methionine %	0.35

** Vit. & Min. mixture: Each kilogram of Vit. & Min. mixture contains: 2000.000 IU Vit. A, 150.000 IU Vita. D, 8.33 g Vit. E, 0.33 gVit.K, 0.33 gVit.B_1, 1.0 gVit.B_2, 0.33g Vit.B_6, 8.33 g Vit.B_5, 1.7 mg Vit. B_{12}, 3.33 g Pantothenic acid, 33 mg Biotin, 0.83g Folic acid, 200 g Choline chloride, 11.7 g Zn, 12.5 g Fe, 16.6 mg Se, 16.6 mg Co, 66.7 g Mg and 5 gMn*

Table (2): Egg production and Egg weight in laying hen diets as affected by dietary Vit. E and/or Se addition during different periods.

Item	1st Period		2nd Period		3rd Period		Hole Period	
	Egg production%	Egg weight, gm	Egg production%	Egg weight, gm	Egg production%	Egg weight, gm	Egg production%	Egg weight, gm
Seleno-yeast effects								
0 %	77.73^{b}	60.00	84.26^{b}	61.16	84.21^{b}	61.34	82.07^{b}	60.85
0.25%	79.72^{ab}	59.90	84.26^{b}	61.11	85.83^{b}	61.43	83.27^{b}	60.84
0.50%	82.18^{a}	60.08	87.31^{a}	61.13	89.03^{a}	61.42	86.17^{a}	60.90
Vitamin E effects								
0 mg/Kg.	79.26	59.97	84.40	61.18	84.31^{b}	61.47^{ab}	82.65	60.89^{ab}
20 mg/Kg.	79.86	59.90	85.28	61.06	87.18^{a}	61.25^{b}	84.10	60.76^{b}
40 mg/Kg.	80.51	60.11	86.16	61.15	87.59^{a}	61.48^{a}	84.75	60.94^{a}
Seleno-yeast X Vitamin E								
T1	75.14^{c}	60.10	80.42^{b}	61.33^{a}	79.58^{c}	61.51^{a}	78.38^{c}	60.99
T2	79.03^{abc}	59.92	83.89^{ab}	60.95^{b}	82.92^{bc}	61.43^{ab}	81.94^{bc}	60.79
T3	83.61^{a}	59.90	88.89^{a}	61.27^{ab}	90.42^{a}	61.46^{ab}	87.64^{a}	60.90
T4	77.64^{bc}	59.91	87.22^{a}	61.12^{ab}	86.67^{ab}	61.05^{b}	83.84^{ab}	60.72
T5	80.14^{abc}	59.82	83.61^{ab}	61.12^{ab}	87.64^{ab}	61.33^{ab}	83.80^{ab}	60.78
T6	81.81^{ab}	59.98	85.00^{ab}	60.94^{b}	87.22^{ab}	61.35^{ab}	84.68^{ab}	60.77
T7	80.42^{abc}	60.00	85.14^{ab}	61.02^{ab}	86.39^{ab}	61.47^{ab}	83.98^{ab}	60.85
T8	80.00^{abc}	59.97	85.28^{ab}	61.27^{ab}	86.94^{ab}	61.53^{a}	84.07^{ab}	60.95
T9	81.11^{ab}	60.36	88.06a	61.17^{ab}	89.44^{a}	61.45^{ab}	86.20^{ab}	61.02
Overall mean± SE.	79.88 ± 0.62	59.99 ± 0.06	85.28 ± 0.62	61.13 ± 0.04	86.36 ± 0.65	61.40 ± 0.05	83.84 ± 0.53	60.86 ± 0.03

a, b, c. Means with different superscript in the same column for the same item differ significantly ($p < 0.05$).

Table (3): Feed intake and feed conversion in laying hen diets as affected by dietary Vit. E and/or Se addition during different periods.

Item	1st Period		2nd Period		3rd Period		Hole Period	
	Feed intake, gm/hen	Feed conversion	Feed intake, gm/hen	Feed conversion	Feed intake, gm/hen	Feed conversion	Feed intake, gm/hen	Feed conversion
Seleno-yeast effects								
0 %	125.16	2.43^{a}	124.91	2.42^{a}	121.35	2.43^{a}	125.16	2.43^{a}
0.25%	122.67	2.38^{b}	124.61	2.36^{b}	120.23	2.37^{b}	122.67	2.38^{b}
0.50%	126.18	2.36^{b}	127.85	2.34^{c}	123.57	2.35^{c}	126.18	2.36^{c}
Vitamin E effects								
0 mg/Kg.	115.93	2.44^{a}	125.07	2.42^{a}	125.11	2.42^{a}	122.03	2.43^{a}
20 mg/Kg.	113.84	2.38^{b}	124.42	2.39^{b}	126.53	2.37^{b}	121.60	2.38^{b}
40 mg/Kg.	114.32	2.36^{b}	124.52	2.36^{c}	125.74	2.34^{c}	121.52	2.35^{c}
Seleno-yeast X Vitamin E								
T1	114.26	2.54^{a}	121.89^{ab}	2.47^{a}	120.53^{b}	2.46^{a}	118.89^{b}	2.49^{a}
T2	113.53	2.40^{bc}	123.21^{ab}	2.41^{ab}	121.63^{b}	2.39^{b}	119.45^{b}	2.40^{bc}
T3	119.99	2.40^{bc}	130.11^{a}	2.39^{b}	133.17^{a}	2.40^{b}	127.75^{a}	2.39^{bc}
T4	111.88	2.41^{b}	129.35^{ab}	2.43^{ab}	127.39^{ab}	2.41^{b}	122.87^{ab}	2.41^{bc}
T5	114.02	2.38^{bc}	121.64^{b}	2.38^{b}	127.85^{ab}	2.38^{b}	121.17^{b}	2.38^{bc}
T6	115.64	2.36^{bc}	122.28^{ab}	2.36^{b}	124.36^{b}	2.32^{c}	120.76^{b}	2.35^{c}
T7	115.83	2.40^{b}	124.24^{ab}	2.39^{b}	126.82^{b}	2.39^{b}	122.30^{ab}	2.39^{bc}
T8	112.69	2.35^{bc}	123.17^{ab}	2.36^{b}	124.36^{ab}	2.32^{c}	120.07^{b}	2.34^{c}
T9	114.43	2.34^{c}	126.15^{ab}	2.34^{c}	126.03^{ab}	2.29^{c}	122.20^{ab}	2.32^{c}
Overall mean± SE.	114.70 ± 0.84	2.40 ± 0.01	124.67 ± 0.87	2.39 ± 0.01	125.79 ± 0.90	2.37 ± 0.01	121.72 ± 0.69	2.39 ± 0.01

a, b, c. Means with different superscript in the same column for the same item differ significantly ($p < 0.05$).

Table (4): Egg quality parameters of laying hens as affected by dietary Vit.E and/or Se addition during summer season.
a, b, c. Means with different superscript in the same column for the same item differ significantly (p <0.05).

Item	Egg weight	Shape index	Haugh unit	Yolk color	Albumin %	Yolk %	Shell %	Yolk index	Shell thickness
Vitamin E effects									
0 mg/Kg.	59.29	79.06[a]	85.29	8.67[a]	60.79	26.89	12.32	40.54	35.42[ab]
20 mg/Kg.	61.08	76.84[b]	86.75	7.83[ab]	61.18	26.19	12.62	43.79	36.58[a]
40 mg/Kg.	59.42	76.58[b]	88.75	7.67[b]	62.12	26.38	11.50	42.26	32.92[b]
Seleno-yeast effects									
0 %	58.97	77.79	83.33	8.17	61.62	26.24	12.14	43.04[ab]	34.67
0.25%	60.08	78.01	88.17	7.92	61.59	26.64	11.77	39.68[b]	35.08
0.50%	60.83	76.67	89.33	8.08	60.88	26.59	12.53	43.86[a]	35.17
Seleno-yeast X Vitamin E									
T1	57.50	78.63[ab]	79.50[b]	8.75	61.75	26.75	11.68	41.46[abc]	34.50
T2	61.00	81.50[a]	91.75[ab]	8.50	60.29	27.48	12.23	41.09[abc]	34.75
T3	59.25	77.04[b]	84.75[ab]	8.75	60.33	26.63	13.04	39.06[bc]	37.00
T4	61.00	76.52[b]	83.00[ab]	8.00	61.05	25.85	13.10	43.83[ab]	38.00
T5	59.75	76.31[b]	86.25[ab]	7.75	60.70	27.15	12.15	41.77[abc]	34.50
T6	62.50	77.69[ab]	91.00[ab]	7.75	61.80	25.58	12.62	45.78[ab]	37.25
T7	58.00	78.22[ab]	87.50[ab]	7.75	62.08	26.30	11.62	43.84[ab]	31.50
T8	59.50	76.23[b]	86.50[ab]	7.50	63.77	25.29	10.94	36.18[c]	36.00
T9	60.75	75.28[b]	92.25[a]	7.75	60.51	27.55	11.93	46.75a	31.25
Overall mean ± SE.	59.92 ±0.69	77.49 ±0.46	86.94 ±1.29	8.06 ±0.17	61.36 ±0.44	26.49 ±0.31	12.15 ±0.25	42.20 ±0.84	34.97 ±0.72

Table (5): Some blood plasma constituents in laying hens as affected by dietary Vit.E and/or Se addition.

Item	Got U/dl	Gpt U/dl	Triglesred Mg/dl	Cholesterol Mg/dl	T. Protein g/dl	Albumin g/dl	Globulin g/dl	A/G ratio	Glutathione Peroxidase Mg/L
Vitamin E effects									
0 %	27.33	115.92	340.58	130.25	4.15[b]	1.84[b]	2.32[b]	0.80	0.070
0.25%	31.00	115.50	322.58	126.25	4.42[b]	2.07[a]	2.35[b]	0.89	0.072
0.50%	30.58	111.25	510.33	125.67	4.73[a]	2.07[a]	2.66[a]	0.79	0.074
Seleno-yeast effects									
0 mg/Kg.	31.75	121.17[a]	522.92	126.25	4.25[b]	1.94	2.31[b]	0.85	0.056[b]
20 mg/Kg.	29.17	116.50[ab]	328.08	120.75	4.28[b]	1.94	2.34[b]	0.84	0.077[a]
40 mg/Kg.	28.00	105.00[b]	322.50	135.17	4.78[a]	2.09	2.69[a]	0.79	0.083[a]
Vitamin E X Seleno-yeast									
T1	28.50	130.75[a]	387.50	125.00[ab]	3.66[e]	1.57[e]	2.09c	0.76[b]	0.051[b]
T2	29.25	105.75[ab]	328.25	125.50[ab]	4.18[cde]	1.99[cd]	2.19[bc]	0.91[ab]	0.078[a]
T3	24.25	111.25[ab]	306.00	140.25[ab]	4.63[bc]	1.96[cd]	2.67[ab]	0.74[b]	0.080[a]
T4	35.25	123.75[ab]	313.50	113.50[b]	4.92[ab]	2.49[a]	2.44[bc]	1.04[a]	0.058[b]
T5	29.75	119.50[ab]	313.75	123.25[ab]	4.01[de]	1.76[de]	2.25[bc]	0.78[b]	0.075[a]
T6	28.00	103.25[b]	340.50	142.00[a]	4.33[cd]	1.98[cd]	2.36[bc]	0.85[ab]	0.084[a]
T7	31.50	109.00[ab]	867.75	140.25[ab]	4.17[cde]	1.77[de]	2.39[bc]	0.75[b]	0.059[b]
T8	28.50	124.25[ab]	342.25	113.50[b]	4.66[bc]	2.09[bc]	2.57[bc]	0.82[b]	0.079[a]
T9	31.75	100.50[b]	321.00	123.25[ab]	5.37[a]	2.34[ab]	3.03[a]	0.78[b]	0.085[a]
Overall mean± SE.	29.64 ±1.46	114.22 ±2.82	391.17 ±61.98	127.39 ±2.98	4.43 ±0.01	1.99 ±0.05	2.44 ±0.06	0.83 ±0.02	0.072 ±0.00

a, b, c, d, e. Means with different superscript in the same column for the same item differ significantly (p <0.05).

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3/27/2011