# Comparative Study of Bioethanol Production from Different Carbohydrate Sources

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**Abstract:** Bioethanol is also biodegradable, less explosive, less poisonous and easier to extinguish if burning, compared to petrol and diesel. It is normally produced by fermenting starchy or sugary solids from crops based feedstock like corn, sugar beet, sugarcane, barley, feedstock containing cellulosic biomass such as stalks, leaves and husk from corn plants and woodchips. Biofuels are a wide range of fuels which are derived from biomass. Biofuels are gaining increased public and scientific attention, driven by factors such as oil price spikes, the need for increased energy security and concern over greenhouse gas emissions from fossil fuels. Bioethanol is produced by process of fermentation in which large organic molecules are broken down in to simpler molecules as the result of the activity of microorganisms. The present work deals with the bioethanol production from some carbohydrate source like rice bran, jatropha oil cake and mahua flowers. Among all mahua flowers produced maximum bioethanol 9.40%. Rice bran and jatropha oil cake can also able to produce bioethanol. All substrate produced maximum bioethanol on fifth day of incubation.
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## Introduction

During the last two decades, advances in technology for ethanol production from biomass have been developed to the point that large-scale production will be a reality in next few years. The fuels of bio origin can provide a feasible solution to this worldwide problem of energy crisis (Chauhan *et al*., 2009). The ever rising cost of fossil fuel internationally has forced major world economics to examine renewable and cheaper alternatives to fossil fuel to meet their energy demands. Henry Ford (1925) stated that, "The fuel of the future is going to come from apples, weeds, sawdust almost anything. There is fuel in every bit of vegetable matter that can be fermented." Today Henry Ford's futuristic vision significance can be easily understood. Bioethanol has emerged as the most suitable renewable alternatives to fossil fuel as their quality constituents match diesel and petrol, respectively. Bioethanol can be groped in different generations first generation bioethanol is made from carbohydrate based feedstock like corn, sugar beet, sugarcane, barley. Second generation bioethanol is produced from feedstock containing cellulosic biomass such as stalks, leaves and husk from corn plants, woodchips and saw dust. Third generation of bioethanol is produced by algae. In the last two decades, numerous microorganisms have been selectively engineered to produce bioethanol.

Ethanol is high octane fuel that can replace lead as an octane enhancer in petrol by helping to oxygenate the fuel mixture so it burns more completely. The burning of ethanol closely represents carbon dioxide cycle because the released carbon dioxide is recycled back into plants using carbon dioxide to synthesize food during photosynthesis cycle (Rudravaran *et al.,* 2007). Various bacteria like *Zymomonas mobilis, Klebsiella oxytoca* and fungi like *Trichoderma* and *Aspergillus sp.* can produce bioethanol by their action on different carbohydrate sources. *Zymomonas mobilis* is a unique bacterium offering a number of advantages over the current ethanol producing microorganisms and reported for maximum bioethanol production (Thauer *et al.*, 1977; Dumsday *et al.*, 1997). During the last two decades, advances in technology for ethanol production from biomass have been developed to the point that large-scale production will be a reality in next few years.

## 2. Material and Methods

### Collection of different carbohydrate sources

Different carbohydrate sources as mahua flowers, rice bran, jatropha oil cake was collected. They were washed, weighed (50 g of substrate into 500 ml of distilled water) and autoclaved.

### Isolation of bacteria from effluent

Effluent water was poured in nutrient agar medium containing plates for culture of bacteria and kept it for incubation at $37^0$C. Several bacterial colonies were grown in plates, morphological study of these colonies was done. Five different bacterial sp. were indentified morphologically (Tiwari *et al.*, 2011).

### Fermentation Test

Fermentation test was performed to check whether the obtained bacteria were fermentative or

not. The composition of fermentation broth was peptone-10 g, sodium chloride- 15 g, carbohydrate- 5 g, phenol red-0.018 g and 1000 ml of distilled water (Prescott, 2002).

**Inoculation of fermentative bacteria**

Out of five only one bacteria was positive to fermentation test. It was inoculated in to mahua flowers, rice bran and jatropha oil cake dipped in distilled water. It was kept for incubation and fermentation.

**Qualitative estimation of bioethanol**

Bioethanol production was examined by Jones reagent [$K_2C_{r2}O_7$+$H_2SO_4$] 1ml of $K_2C_{r2}O_7$ (2%), 5ml $H_2SO_4$ and 3ml of sample was added after incubation. It was reported that ethanol oxidized to acetic acid with an excess of potassium dichromate in the presence of sulfuric acid, giving off a green colour (Brooks, 2010). The presence of a green colour indicates that the used carbon source was able to produce bioethanol after confirmation.

**Quantitative estimation of bioethanol**

Quantitative estimation of bioethanol was done by specific gravity method. Specific gravity refers to the density of any liquid (Pharmacopoiea of India, 1985). The fermented sample was taken 25 ml and distilled water was added 150 ml, this mixture was distilled on distillation unit. After distillation of sample specific gravity was taken and percentage of bioethanol was calculated (Yadav, 2003).

## 3. Results and Discussion

Present study deals with bioethanol production from different carbohydrate sources as rice bran, jatropha oil cake and mahua flowers by effluent's bacteria. Mahua flowers are rich in sugars so it can be a good source of bioethanol production with the help of efficient microorganism. Fermented substrates were distilled and amount of ethanol was measured by specific gravity method. The bioethanol content of the fermented broth was determined by measuring specific gravity of the distillate according to the procedure described by Amerine and Ough (1984).

Incubation period is also an important parameter which affects the process of fermentation. It was observed that on day three amount of bioethanol was 6.95±0.12% from rice bran, 3.32±0.10% from jatropha oil cake and 7.67±0.11% from mahua flowers. On day four rice bran produced 8.04±0.33% of bioethanol, jatropha oil cake produced 4.81±0.41% and mahua flowers produced 8.76±0.32% of bioethanol. After fifth day of incubation 8.85±0.21% from rice bran, 7.76±0.52% from jatropha oil cake and 9.40±0.22% of bioethanol was produced from mahua flowers. On sixth day 6.22±0.05%, 2.64±0.31% and 7.85±0.15% of bioethanol was produced from rice bran, jatropha oil cake and mahua flowers respectively.

Results indicates that the rice bran, jatropha oil cake and mahua flowers can produce bioethanol efficiently by process of fermentation. Among all mahua flowers are the best source for bioethanol production due to high carbohydrate content but rice bran and jatropha oil cake can also be serve as potential substrate with the help of better technology and appropriate use of microorganism. It was also observed that on fifth day, all substrate produced maximum bioethanol and it was optimum day for bioethanol production.

Many researchers worked on different sources of carbohydrate for the bioethanol production. Doelle and Doelle (1990) worked on sugar cane molasses for bioethanol production. Tanaka *et al.* (1999) utilized pineapple juice and pine waste as low cost substrate for ethanol production Beaugrand *et al.* (2004) worked on contents of wheat bran for bioethanol production. Pimentel and Patzek (2005) produced ethanol by using corn, switchgrass and wood. Swain *et al.* (2007) produced bioethanol from mahua flowers by help of *Saccharomyces cerevisiae.* Mohanty *et al.* (2009) investigated bioethanol production from mahua flowers by *Saccharomyces cerevisiae* in solid state fermentation. Jadhav *et al.* (2011) worked on bioethanol production by four gram positive bacteria on substrate mahua flowers. Tiwari *et al.* (2011) studied bioethanol production from some carbohydrate sources barley, maize, oat and sugar cane by gram positive bacteria. Pandey *et al.* (2013) used Azolla a lignocellulosic waste for bioethanol production.

## 4. Conclusion

Environment contains different types of fermentative bacteria in different sources such as vegetable waste, fruit waste, effluent and soil. These fermentative bacteria can be utilized by process of fermentation for the production of bioethanol by their action on different carbohydrate sources. Mahua flower can be serve as most promising source for bioethanol and bioethanol is an attractive alternative source of energy in present scenario.

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Table 1: Percentage of bioethanol from different substrates

| S.No. | Days | Rice Bran | Jatropha oil cake | Mahua Flower |
|---|---|---|---|---|
| 1 | 3rd | 6.95±0.12% | 3.32±0.10% | 7.67±0.11% |
| 2. | 4th | 8.04±0.33% | 4.81±0.41% | 8.76±0.32% |
| 3. | 5th | 8.85±0.21% | 7.76±0.52% | 9.40±0.22% |
| 4. | 6th | 6.22±0.05% | 2.64±0.31% | 7.85±0.15% |

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