Production of Bioethanol From "Jatropha Oil Cake"

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Abstract: 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 an alcohol made by fermenting the sugar components of plant materials mostly from sugar and starch crops. Fermentation is process by which large organic molecules are broken down in to simpler molecules as the result of the activity of microorganisms. Biologically, bioethanol is produced by activity of some bacteria, yeast and their action on substrate containing carbohydrate. The present work deals with the bioethanol production by Jatropha oil cake by the process of fermentation and effect of physical parameters on bioethanol production. During present investigation, Jatropha oil cakes were fermented for 48 hours at 37^0C and distilled. The bioethanol production was studied during three, four, five and six days of incubation and for shaking and non- shaking condition and effect of temperature was also observed. The results indicate that the bioethanol production was observed in third day (1.32%), fourth day (4.81%), fifth day (7.76%) and sixth day (2.64%). The highest percentage of bioethanol was observed on fifth day of incubation and the amount of bioethanol produced in shaking condition was higher than static condition. Temperature variation also affects the production of bioethanol, at temperature 40^0C the production was maximum 8.04%.
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Introduction

In recent years, largely in response to uncertain fuel supply and efforts to reduce carbon dioxide emissions, Bioethanol has become one of the most promising biofuels today. Bioethanol is seen as a good fuel alternative because the source crops can be grown renewably and in most climates around the world. This is achieved because in the growing phase of the source crop, CO_2 is absorbed by the plant and oxygen is released in the same volume that CO_2 is produced in the combustion of the fuel. 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. *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). In the last two decades, numerous microorganisms have been selectively engineered to produce bioethanol. Lignocellulosic biomass contains complex carbohydrates that necessitate utilizing microorganisms capable of fermenting sugars not fermentable by brewer's yeast. Bioethanol has a number of advantages over the conventional fuels because it is produced from renewable resources. 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 and reduced polluting emission. 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). The toxicity of exhaust emissions from bioethanol is lower than that of petroleum sources and considered as fuel of the future (Wyman and Hinman, 1990). The continuously rising of petroleum costs and dependence upon fossil fuel resources, had made considerable attention on alternative energy resources. Production of ethanol from biomass is one way to reduce both the consumption of crude oil and environmental pollution (Lang *et al.,*2001). Bioethanol represents an important, renewable liquid fuel for motor vehicles (Lewis, 2001).

In our state Chhattisgarh, in CREDA (Chhattisgarh Renewable Energy Development Authority) the Jatropha seeds are used for biodiesel production, after this process the remaining waste oil cake was used for production of bioethanol in present study. Industrial production of bioethanol from fibers that are unusable for pulp production in pulp mills offers an approach to product diversification and more efficient exploitation of the

raw material (Sjode *et al.*,2007). Wasted crop and crop residues are also used for the bioethanol production (Kim *et al.,* 2004).

Material and Methods

Present work was carried out to study of bioethanol production from Jatropha oil cake and effect of physical parameters on production of bioethanol. The materials and methods were following:

Collection of sample

- Jatropha oil cake was collected from CREDA (Chhattisgarh Renewable Energy Development Authority), Raipur, Chhattisgarh, India. They used Jatropha plant seeds for biodiesel production and the oil cake is the waste product of it.

Determination of bioethanol production – By qualitative estimation

- 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 blue- green colour (Brooks, 2010).
- The presence of a green colour indicates that the used carbon source was able to produce bioethanol after confirmation.

Effect of incubation period and static and shaking condition

- The Jatropha oil cake was submerged in distilled water (50 g in 500 ml) and was kept at 37^{0}C for 48 hours and **s**tudied the effect of incubation period for 3, 4, 5 and 6 days.
- Effect of static and shaking conditions were observed, for this sample was kept on incubator (static condition) and incubator shaker (shaking condition) at 37^{0}C,50 rpm and for five days.

Effect of temperature variation on bioethanol production

- Sample was kept on shaker for 5 days at different temperature higher to 37^{0}C that is 40^{0}C, 43^{0}C, 46^{0}C, 49^{0}C, 52^{0}C, 55^{0}C, 58^{0}C and 61^{0}C and lower to 37^{0}C that is 34^{0}C, 31^{0}C, 28^{0}C, 25^{0}C, 22^{0}C and 19^{0}C to study the effect of temperature variation on bioethanol production.

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).

Results and Discussion

Jatropha oil cake is the waste product and source of second generation of bioethanol. Collected sample were fermented and distilled. Results was observed for parameter study that is incubation period on 3rd ,4th ,5th and 6th day. It was found that the percentage of bioethanol on third day was 1.10%, fourth day 3.26%, fifth day 5.50% and sixth day 1.56%. The highest percentage of bioethanol was observed on fifth day of incubation. Mohanty *et al.* (2009), worked on the production of bioethanol from Mahua flowers and effect of incubation period.

After observation of static and shaking condition, the percentage of bioethanol was 1.10% (day 3), 3.26% (day 4), 5.50% (day 5) and 1.56% (day 6) in static condition and in shaking condition the percentage of bioethanol was 1.32% (day 3), 4.81% (day 4), 7.76% (day 5) and 2.64% (day 6). It was observed that in comparison with static condition the percentage of bioethanol was more in shaking condition means shaking condition enhance the production of bioethanol.

Effect of temperature variation was seen on the production of bioethanol, the percentage of bioethanol was 7.76% at 37^{0}C, at 40^{0}C percentage of bioethanol was 8.04%, at 43^{0}C bioethanol was 5.62%, at 46^{0}C the percentage of bioethanol was 5.36%, at 49^{0}C percentage of bioethanol was 4.81%, at 49^{0}C the percentage of bioethanol was 4.81%, at 52^{0}C the percentage was 3.72%, at 55^{0}C the percentage bioethanol was 2.64%, at 58^{0}C the percentage bioethanol was 1.32% and at 61^{0}C the amount of bioethanol was 0.52%. After decrease the temperature the percentage of bioethanol at 19^{0}C was 1.8%, at 22^{0}C it was 4%, at 25^{0}C it was 5.52%, at 28^{0}C 6.95%, at 31^{0}C the percentage of bioethanol was 7.00% and 34^{0}C the percentage of bioethanol was 7.49%. Results indicates that at the temperature 40^{0}C the production of bioethanol was highest (8.04%) and after increasing the temperature the production of bioethanol was decreased. Temperature below 37^{0}C and decreased temperature there was no relevant effect on bioethanol production.

Neelakandan and Usharani worked on optimization and production of bioethanol from cashew apple juice using immobilized yeast cells. They studied on role of some fermentation parameters like substrate concentration, pH, temperature and inoculum concentration on ethanol production from cashew apple juice using immobilized yeast cells by *Saccharomyces cerevisiae*. Tiwari *et al.* studied the effect of temperature variation on bioethanol production. Jadhav *et al.* worked on bioethanol production from mahua flowers and studied the effect of temperature for maximum bioethanol production.

Table 1- Percentage of bioethanol in static and shaking conditions

Days	Static Condition	Shaking condition
3rd	1.10%	1.32%
4th	3.26%	4.81%
5th	5.50%	7.76%
6th	1.56%	2.64%

Table 2- Percentage of bioethanol at different temperature

S. No.	Temperature	Percentage of bioethanol
1	19^{0}C	1.80%
2	22^{0}C	4.00%
3	25^{0}C	5.52%
4	28^{0}C	6.95%
5	31^{0}C	7.00%
6	34^{0}C	7.49%
7	37^{0}C	7.76%
8	40^{0}C	8.04%
9	43^{0}C	5.62%
10	46^{0}C	5.36%
11	49^{0}C	4.81%
12	52^{0}C	3.72%
13	55^{0}C	2.64%
14	58^{0}C	1.32%
15	61^{0}C	0.52%

Conclusion

This is concluded that bioethanol can be promising fuel of future and can overcome the energy crisis in future. The Jatropha oil cake is waste product and bioethanol produced by it is of second generation of bioethanol which is produced from waste product not from the feedstock. Today world is facing the problems related to health, energy and environment, all can be solve by use of bioethanol because it is eco-friendly, less polluting and alternate source of energy.

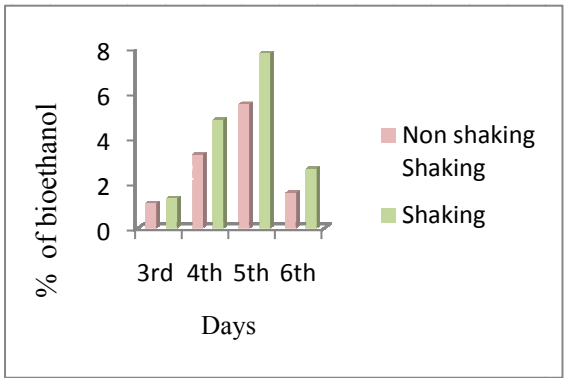

Fig. 1- Comparison of Percentage of bioethanol in Static and shaking condition

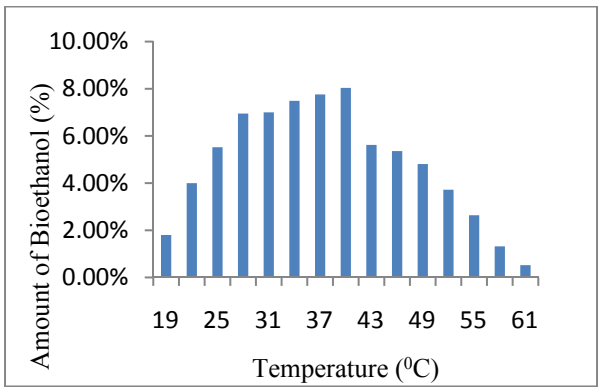

Fig.2- Percentage of bioethanol at different temperatures

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