Extraction of Bioethanol from Potatoes, Banana Peels and Wheat Straw

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Abstract— The increasing demand of ethanol worldwide is not fulfilled by the conventional crops e.g. corn and sugarcane so the urge for alternative and cheap source for the alcohol production is very challenging. Ethanol is at present the most widely used biofuel for motor vehicles. The importance of ethanol is increasing due to a number of reasons such as global warming and climate changes. Biomass in the form of Lignocellulosic materials is renewable, low cost and abundantly available. It includes crop residue, grasses, wood chips etc., Extensive research has been carried out in past two decades to use these materials to form ethanol. A forward step has been taken for the bioethanol production from potatoes and banana peels. The global production of potato is about 300 million tons per year and is highly rich in starch where on the other hand, fruit waste and agricultural waste are the products rich in cellulose and hemicelluloses like products which can be broken down to glucose and then to ethanol. The production of alcohol from agricultural waste requires certain enzymatic pre-treatments and comparatively more time for the fermentation than from potatoes and banana peels, these pretreatments increases the cost of production by some percent but the yield can be raised to significant level.

Key words: Bioethanol, Lignocellulosic, Wheat Straw

I. INTRODUCTION

Excessive consumption of fossil fuels[1], particularly in urban areas has resulted in generation of high levels of pollution during the last few decades. Import of transport fuels is affected by limited reserve of fossil fuels .Annual global oil production will begin to decline within the near future .In this scenario ,renewable sources might serve as an alternative .Wind ,water ,sun ,biomass ,geothermal heat can be the renewable sources for the chemical industry may depend on biomass[2] as an alternative source in the near future .All petroleum based fuels such as bioethanol ,bio-diesel ,bio-hydrogen, etc., derived from sugarcane, corn, switchgrass, algae, etc. Requirements of electricity may be supplied by solar and wind-farms. Countries across the globe have considered and directed state policies towards the increased economic utilization of biomass for meeting their future energy demands. Ethanol is at present the most widely used liquid bio fuel for motor vehicles. The importance of ethanol is increasing due to a number of reasons such as global warming[3] and climatic changes. The cost of bioethanol production is more compared to fossil fuels. The world bioethanol production in 2001 was 31 billion liters. It has grown to 39 billion liters in 2006 and is expected to reach 100 billion liters in 2015. Large scale production of fuel ethanol is mainly based on sucrose from sugarcane in Brazil or starch, mainly from corn, in USA. Cost is an important factor for large scale expansion of bioethanol[4] production. The green gold fuel from Lignocellulosic wastes avoids the existing competition of food versus fuel caused by grain based bioethanol production. It has been estimated that 442 billion liters of bioethanol can be produced from Lignocellulosic biomass and that total crop residues and wasted crops can produce 491 billion liters of ethanol per year, about 16 times higher than the actual world bioethanol production. Lignocellulosic materials are renewable, low cost and are abundantly available. It includes crop residues, grasses, sawdust, wood chips; etc.Extensive research has been carried out on ethanol production from Lignocellulosic in the past two decades. Hence bioethanol production could be the route to the effective utilization of agricultural wastes. Rice straw, wheat straw, corn straw, and sugarcane bagasses are the major agricultural wastes in terms of quantity of biomass available. In view of the rising demand of the ethanol there has been increasing worldwide interest in searching its alternatives source for production. Since there are various factors such as recent rise in oil prices, increase in demand of fossil fuels, depletion of the mineral oil reserves, demand of the energy increases of the world population and urbanization .According to the food and agriculture organization of the United Nations India is the largest banana producing nation .As the production of banana is more the waste generated is also more. According to scientists, approximately one tons of waste are produced every ten tons of bananas .So, the banana peel can be used as feed stocks to produce ethanol by fermentation and distillation. Ethanol is considered biodegradable and Sulphur free. In addition, the low flame temperature of ethanol results in good engine performance fossil fuels by means of its products of monoxide, nitrogen oxide and Sulphur is more when compared to natural gas, bio-ethanol and biodiesel. Apart from the known usage of ethanol as a fuel, about 45% of the produced ethanol is being used as potable alcohol, 40% in the industrial sectors and only the remaining is available for blending with petrol. Apart from the known usage of ethanol as a fuel, about 45%of the produced ethanol is being used as potable alcohol[6], 40% in the industrial sectors and only the remaining is available for blending with petrol.

II. MATERIAL AND METHODS

A. Extraction from Potatoes

- Materials: 1 kg potatoes were cleaned and washed. The potatoes were cut into small pieces.
- Method of cooking: Potatoes were added to 5 liter water in a pressure cooker and were cooked on a gas stove for about 30 -40 minutes until it was sufficiently cooked i.e., potatoes were soaked and could be mashed easily.

- Treatment after cooking: The potatoes were mashed within this water with the help of hand masher until it was mashed completely. The mixture was screened with the help of a sieve. 500g of table sugar was added in the filtrate (water) and dissolve completely. The liquid was left to cool down to room temperature.
- Fermentation: Saccharomyces cerevisiae (yeast) was grown about 50 ml of water and left for 15 minutes.
- The liquid was filled in plastic bottles and about 10 ml of grown yeast was added in each bottle. The bottles were packed were latex gloves to make it air tight. A pin hole was made on it. It was left undisturbed for 7 days and then distillation was done.
- Filtration and Distillation: The liquid to be distilled was filtered each day with the help of filter paper. The filtrate was to distilled 2-3 times. The distillate was measured and pH noted.

B. Extraction from Banana Peels

- Materials: banana peels (from 2 bananas) and yeast.
- Pre-treatment: Banana peels were taken and dried in oven upto 100 degrees. It was cut into pieces and ground in a grinder. The fine powder obtained was dissolved in a 200 ml of water and heated upto 120 degrees. It was left for 12 hours.
- Fermentation: Saccharomyces cerevisiae7 (yeast) was grown in about 15 ml of water and added in the mixture which was sealed and left undisturbed for 3-4 days.
- Filtration and Distillation: The mixture was filtered and distilled 2-3 times and volume and pH was recorded.

C. Extraction from Agricultural Waste

- Materials: wheat straw (~80 grams), NaOH pallets (10 grams) and yeast.
- Pre-treatment: Physical Pre-treatment:

1) Size reduction:
The wheat straw was ground in a grinder to get a coarse powdery substance.
The powder was wetted with water and was left undisturbed until excess water was strained and a semi dried substance was obtained.
2) Pyrolysis:
The matter was transferred to china dishes and kept in oven for 4 hours upto 180 degree Celsius .Residual char was obtained and CO_2 and H_2 gas were released as a result of cellulose decomposition[8].
3) Leaching:
The residual char was washed thoroughly with water. The lechate water was removed and the char was further treated.
4) Base Pretreatment:
The char was transferred to alkaline solution of NaOH of 2% concentration and was kept in oven upto 130 degrees for 2 hours; as a result the Lignocellulosic content gets dissolved to yield sugars.
5) Wet Oxidation:
Boiling water (90 degree Celsius) of volume 5 liter was left open to cool down upto room temperature.
6) Straining:
The water with the char was strained to avoid bigger particles to enter the liquid to be fermented with the help of a cotton cloth.
7) Fermentation:
The liquid was filled in bottles and the pre grown yeast was added to each bottle. The bottles were sealed with latex gloves .the bottles were left undisturbed for 1 month to let the breakdown of cellulose and hemicellulose into sugars and CO2 and further formation of ethanol.

III. RESULT AND DISCUSSION

A. Results of Ethanol from Potatoes:

Simultaneous distillation of the liquid was done along with formation after 7th day of fermentation.

S. No.	Day of distillation	Volume of the liquid taken(ml)	Vol. of alcohol distilled(ml)	pH of the alcohol distilled
1.	First	380	25	3.8
2.	Second	74	3	4.46
3.	Third	100	3	4.40
4.	Fourth*	100	10	4.10
5.	19th day	100	14	3.78
6.	20th day	100	7	4.61
7.	21st day	50	2	4.39
Total volume obtained			64 ml	

Table 1: Results of Ethanol from Potatoes

B. Re-Distillation of the Residual Liquid from Above Distillation

S. No.	No. of distillates	Volume taken(ml)	Volume obtained(ml)	pH measured
1.	First	250	3	3.20

2.	Second	250	3	3.90
3.	Third	250	2	3.86

Table 2: Re-distillation of the residual liquid from above distillation

IV. CONCLUSION

Bio-ethanol production on a large scale and with the use of specialized instruments can be used effectively to meet the requirement of the fuel up to some level. The production of alcohol from agricultural waste requires certain enzymatic pre-treatments and comparatively more time for the fermentation than from potatoes and banana peels, these pretreatments increases the cost of production by some percent but the yield can be raised to significant level.

Synthesis of alcohol from potatoes and banana peels are very efficient and cheaper methods hence can be used on large scale for the production of bio-ethanol and their yield can be increased by using sophisticated instruments.

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