BIOFUEL PRODUCTION USING WASTE MATERIAL AN ECOFRIENDLY ALTERNATIVE OF WASTE PRODUCT MANAGEMENT.

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Abstract: Energy consumption has increased steadily over the last century as the world population has grown and more countries have become industrialized. Crude oil has been the major resource to meet the increased the demand for energy. Yeasts are important microorganisms in food manufacturing and fermentation industry. In the current study attempt were made to investigate the potential of various waste materials for bioethanol production. Bioethanol is an important chemical product with emerging potential as a bio fuel to replace fossil fuels. An ecofriendly bio bioethanol is one of the alternate fuels that can be used in unmodified petro energies with current fuelling infrastructure also it can be easily applied in present day combustion engines by mixing it with gasoline. It can be used as desirable fuel adaptive because it burns without causing any environment lowers greenhouse gas emissions. Along with the production of industrial bioethanol, researches are also focused on the up gradation for bioconversion process of bioethanol production. In the current research attempt is been made to use waste materials such as fruit and vegetable peels for bioethanol production. For the very purpose the study was carried out from June 2016 to March 2017.

Keywords: Bioethanol, Crude oil, Fruit waste, Green house, Gasoline, *S.cerevisiae*.

I. INTRODUCTION

In the US bioethanol is widely used as a partial replacement of gasoline (Chandra J. Panchal 1997). Fuel bioethanol that is produced from corn has been used in oxygenated fuels since the 1980s. There are several different techniques to estimate the current known crude oil reserves. It is also predicted that the annual global oil production would decline from the current 25 billion barrels to approximately 5 billion barrels in 2050 (Shigechi H, et.al., 2008). The US transportation sector now consumes about 4540 million litres of bioethanol annually, about 1 percent of the total consumption of gasoline. A potential source of microorganism should utilize for low-cost bioethanol production lignocellulosic materials such as crop residues, grasses, sawdust, wood chips and solid animal waste. Extensive research has been done on conversion of lignocellulosic materials to bioethanol in the last two decades.

The conversion includes two processes, first is the hydrolysis which is catalyzed by cellulose enzymes and second is the fermentation which is carried out by yeasts or bacteria (K. Manikandan, et.al., 2008, Patle S et.al.,2008). Removal of lignin and hemicelluloses, reduction of cellulose crystalline and increasing the porosity in pre-treatment processes can significantly improve the process of hydrolysis. Bioethanol production from biomass is the focus of much interest worldwide because bio bioethanol is a renewable fuel contributing to the reduction of the global warming effect and the negative environmental impact generated by the worldwide utilization of fossil fuels (Consuelo et.al.,.2010, Beall DS, et.al., 1993). Banana wastes that have been discarded due to the imperfections are normally dumped as huge masses it affects the flora and fauna in water source, thus posing a serious threat to the environment and raising health issues. For biofuel purpose about 85-95 percent alcohol used is bioethanol (Davis L, et.al., 2005.). Further treatment may lead to production of 99 percent pure bioethanol. Various dehydrating agents like Cacl2, MgCl2 etc are used for the production of absolute bioethanol (Beall DS, et.al., 1993).

From 2000 to 2005, approximately 9.5 million metric tons of oranges and grape fruits per year were processed into juice and fruit sections in the US. Approximately 50-60 percent of the processed fruit becomes citrus peel waste, a waste product consisting of peels, seeds and membranes left over after juice extraction. Demand for fuels produced from renewable resources has increased in recent years due to increased prices for oil; concerns have increased for the production of greenhouse gas.

The largest single use of bioethanol is as a motor fuel additive. It is also an important industrial ingredient and has widespread use as a base chemical for other organic compounds and used in medical wipes. It is most commonly used as an antibacterial hand sanitizer gels and as an antiseptic (Hossain, et.al., 2011). Additionally bioethanol from biomass based waste materials is considered as bio bioethanol. Alcohol in dilute aqueous solution is somewhat sweet in flavour, but in more concentrated solutions it has a burning taste. The first generation of bioethanol production used corn as a substrate which was later considered as a feedstock (Ameh JB et. Al., 1989, Hughes SR et.al. 2009). This lead to the production of second generation of bioethanol which used micro organisms and wastes as substrates.

The cheapest and easily available potential energy source for the bioethanol production is fruit wastes. Fruit waste which is thrown away has very good antimicrobial and antioxidant potential. Thailand has a tropical climate with abundant natural resource it has various species of micro organisms (Consuelo, Pereira LF et.al., 2010). However yeasts are considered as an important group of micro organisms in the biosphere. Their Biodiversity in the natural environment have not been paid a considerable attention. They can be isolated from natural substances like leaves, flowers, sweet fruits, grains, freshly fungi, exudates of trees, insect, dung and soil etc.

Utilization of fruit wastes for bio bioethanol production is one of the best options. One examples of raw material is pineapple waste that is converted to bio bioethanol. Insoluble carbohydrates are generally present in the cell walls of the peels, particularly in the form of pectin, cellulose and hemicelluloses. Lignocellulose is the major structural component of woody plants and non woody plant. Waste material contains valuable components such as sucrose, glucose, fructose and other nutrients. Bioethanol production form banana and pineapple peels also have been investigated in past years. Dried orange peels have high contents of pectin, cellulose and hemicellulose, which make it soluble as fermentation substrate when hydrolyzed.

In assessing a yeast strain for industrial production of bioethanol specific physiological properties such as bioethanol tolerance, sugar tolerance and invertase activities are required. Due to the high bioethanol yield and high tolerance, *Saccharomyces cerevisiae* is the most commonly used microorganisms for bioethanol production(Hughes SR, Hector RE, et.al., 2009). To achieve significant economic and environmental benefit large amount of food waste can be utilized to produce bioethanol.

II. MATERIAL AND METHOD

2.1 Preparation of chemical solutions

A] 1N Sulphuric acid:

Reagents: Concentrated H_2SO_4**,** Distilled H_2O

In 100ml of distilled water, 2.75ml of concentrated Sulphuric acid was added.

B] Acid Dichromate Solution:

Reagents: $K_2Cr_2O_7$, Concentrated H_2SO_4, Distilled H_2O.

In a flask, 325 ml of concentrated H_2SO_4 was added in 125 ml of distilled water. The temperature of the flask decreases under cold water to which 34 grams of Potassium Dichromate ($K_2Cr_2O_7$) was added into the flask. The final volume of the flask was made up to 500 ml.

C] 2M Sodium Hydroxide Solution:

Reagents: NaOH, Distilled H_2O.

In 1000ml of distilled water, 40 grams of Sodium Hydroxide was added.

2.2 Production of Bioethanol

Initially the waste fruit peels were washed thoroughly. Then the fruit peels were dried and the grinded in appropriate pieces. The size of the grinded material was usually maintained to 10-30 mm. The power requirement for mechanical combination of agricultural materials depends on the final particle size and the waste biomass characteristics (Kingsley Otulugbu. 2012). After grinding the waste materials in appropriate size, 10 grams of each sample waste material was added in a conical flask (Lavarack B P, et.al.,2002) These conical flasks containing 10 grams of waste samples were then autoclaved at 121°C at 15 lbs pressure for 20 minutes.

2.2.1 Pretreatment by Pyrolysis

Mild acid hydrolysis was carried out. The autoclaved waste material was then treated with 1N H_2SO_4. The flasks were then kept for incubation at 97°C for 2 hours. Pyrolysis was also used for pretreatment of lignocellulosic materials. The materials were treated at temperature greater than 300°C. The cellulosic material rapidly decomposes to produce gaseous products and residual char. The decomposition is much slower and less volatile products are formed at lower temperature. Mild acid hydrolysis was carried out by adding 1N H_2SO_4 at 97°C for 2 hours. The residues from the pretreatment done using pyrolysis resulted in 80-85% conversion of cellulose to reducing sugars with more than 50% of glucose. When Zinc Chloride or Sodium Carbonate is added as a catalyst, the decomposition of pure cellulose can occur at a very low temperature.

2.2.2 Fermentation

After incubation period of 2 hours, 5gms of Baker's yeast which is the source of *Saccharomyces cerevisiae* was added into the conical flasks containing waste residues. After addition of dry yeast the conical flasks were kept for 20 to 25 days in a static condition at room temperature to complete the process of fermentation.

2.3 Quantitative Estimation of Bioethanol

After fermentation, these fermented mixtures were then filtered out to separate filtrate supernatant by using funnel. Supernatant contained the bioethanol produced which was further estimated quantitatively. After the time span of 20 to 30 days of fermentation period the bioethanol produced was quantitatively estimated (Hashem M et.al., 2010). For this 1ml of absolute alcohol was taken in test tube and labeled as control. 1ml of supernatant of wastes peels residues from the fermented mixture of waste material from various flasks were taken in different test tubes and were labeled as test samples. Then 4ml of distilled water in both test tubes were added (Brooks, A.A. 2008, Davis L, et.al., 2005). The test tubes containing control samples and test samples were shaken properly for about 30 seconds to get uniform distribution. 1ml of Potassium Dichromate (K2Cr2O7) solution was added followed by 2 ml of Sodium Hydroxide (NaOH) to the test tubes containing control samples and test sample. These test tubes were further Incubated at 50°C for 30 minutes. O.D of the samples and control were recorded at 600 nm with the help of spectrophotometer.

III. RESULTS AND DISCUSSION

In the current study it was found that bioethanol was produced using different waste materials as substrates such as potato peels, orange peels, sweet lemon peels, banana peels, paper peels, pumpkin peels etc. Thus the comparative study was carried out to check the efficiency of bioethanol produced from various waste materials by using Baker's yeast also known dry yeast in the form of *S.cerevisiae* for bioethanol production. The comparisons of production for bioethanol by using different waste samples are shown in Table. 3.1.

Table 3.1: Production of bioethanol

Sr. no.	Waste Materials used as a Substrates	O.D at 600 nm	Percent bioethanol production
1	Potato peels	0.34	11%
2	Apple peels	0.56	16%
3	Banana peels	0.48	18%
4	Leaf waste	0.54	18%
5	Paper waste	0.38	12%
6	Pumpkin peels	0.19	6%
7	Wood chips	0.35	12%
8	Sweet lemon peels	0.22	7%

Fig.1 Percent bioethanol production

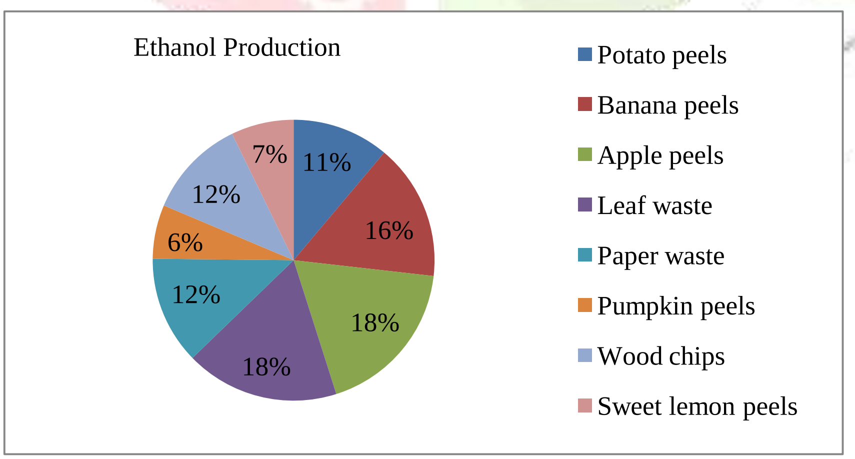

Fig.2: Bioethanol production by using various substrates



Apple Peels **Banana Peels** **Sweet Lemon Peels**



Pumpkin Peels **Potato Peels** **Leaf Waste**


Paper Waste **Wood Chips**

After the use fruit peels such as potato peels, banana peels, pumpkin peels, etc are considered as a waste materials. Due to the increasing price hike of petrol and diesel and also petrol and diesel are considered as non renewable resources, substitute for them or cheaper source for ethanol production is required. After consuming fruits the fruit peels are generally thrown away as waste as it is of no use to humans. Hence an effort was made to find out alternate cheaper and less pollution causing substrate for production of bioethanol an alternative source of energy through fermentation of sugars by using *S.cerevisiae* in the form of Baker's yeasts. Good quality of alcohol can be produced by fruits peels as substrate. In the present study, bioethanol was produced using various fruits peels such as wood chips, fruits peels, waste papers, leaves etc. In the present study, Baker's yeast was used as a source of *S.cerevisiae*. *S .cerevisiae* plays an important role in the fermentation of these waste residues for bioethanol production. The maximum bioethanol production was observed by apple peels and waste leaves. Similar project was carried out by Ye sun, Jiayang Cheng by using lignocellulosic materials and cellulose enzyme. The bioethanol production was found to be 80%. Amongst all fruit peels, wood chips dried, waste leaves can be a better option because it is cheap, easily available and also is help in waste product management.

IV. CONCLUSION

From the current research work it is proved that different fruit wastes, wood chips, dried leaves , paper waste can serve as a substrate for the production of bioethanol. It can be concluded that good quality bioethanol was produced from banana peels and leaves waste which can serve as fuel with less hazardous emissions in the engine for transportation purpose. There are several potential benefits of Baker's yeast which is a source of *S. cerevisiae* that exhibits rapid metabolic activity and high fermentation rate with high product output and minimized contamination. Finally, comparative studies of bioethanol production form different fruit peels waste or other waste residues shows that the apple peels has high efficiency than other waste materials such as other fruit peels, wood chips. It may help in relieving the environment from pollution. This process is cost effective and does not yield any toxic residues. Hence, use of bioethanol can be a cost effective and ecofriendly alternative to current fuel.

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