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A review on Ethanol production from Various Agricultural waste materials.

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ABSTRACT

In the age of rapid industrialization, the requirement of biofuel is increasing day by day. Petrol and diesel are two major liquid fuels used in vehicles in India. The cost of the fuels can be minimized by using bioethanol which has good liquid fuel properties can be mixed with liquid fuel. Ethanol can be extracted from different agricultural sources like groundnut shell, rice straw, molasses, wheat straw, banana waste, waste food grain etc.

Keywords: Bioethanol, fermentation, yield, pretreatment, SSF, Temperature, pH.

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INTRODUCTION

Many Chemical compounds like ethanol, starch, lactic acid etc. can be produced by operating on low cost agricultural waste materials [1].Use of agricultural wastes as raw materials serves two purposes. it minimizes the waste so reducing the pollution and economizes the production process of these chemical compounds[2]. Ethanol is used in alcoholic beverages, and its use as biofuel, is obtained by fermentation where microorganisms like *Saccharomyces cerevisiae* and *Zymomonas mobilis* metabolize sugars in anaerobic conditions to yield ethanol and carbon dioxide.

BIO-ETHANOL FROM GROUNDNUT SHELLS AND AGRICULTURAL WASTE

Padmaja *et.al.* [3] investigated various agri-wastes like groundnut shells, rice straw etc by making use of various anaerobic bacteria for ex. Clostridium thermocellum and found 0.20-0.12 g ethanol per g of substrate degraded. The reaction is carried out by continuous sparging of nitrogen so as to make the system free from oxygen at 60^0C and pH of 7.5 the substrate is given mild treatment of alkali so as to enhance the yield and utilization of ethanol. Thus conversion to ethanol from treated and untreated wastes ranges between 65% and 42% respectively. Archana Mishra *et al*. performed enzymatic hydrolysis on rice straw and other agri wastes by T.viride which is treated with S. cerevisiae for fermentation. The yield of was found to be 55.27 mg/g of biomass and ethanol of the order of 17.54 mg/ml of substrate from 3:1 ratio of rice straw and vegetable waste after 9 days of incubation at 27 ^{0}C. Chandrasekhar Gajula, Anuj Kumar Chandel *et.al* [4] investigated that the fermentable sugars were obtained from the groundnut shells. The use of Sodium sulfite to delignify. The substrate yield 670 mg/g of glucose after biological treatment (50 ^{0}C, 120 rpm, 50 hrs) using cellulase that is commercially manufactured. The hydrolysate obtained after enzymatic treatment (45.6 g/L reducing sugars) was fermented for ethanol extraction with free and immobilized cells of Pichia stipitis were immersed in souse cultivation conditions. Immobilization of s.cerevisiae on sorghum stalks were done by scanning electron microscopy (SEM). In batch fermentation bioethanol extraction (17.83 g/L, yield 0.44 g/g and 20.45 g/L, yield 0.47 g/g was finished with free and immobilized cells of P. stipitis respectively while reusing they watched stable bioethanol recovery (20.45g/L, yield 0.47 g/g) till 5 bunches and afterward there was a progressive downfall in ensuing cycles. Sheelendra Mangal Bhatt and Shilpa [5] used Groundnut shells (GS) as a substrate. They were first grinded and then physical and chemical treatment was done. Physical treatment was done by steam explosion method, after this they were given chemical treatment with inorganic (0.25N HCl and 0.25N NaOH) chemicals and also organic (0.25N CH_3COOH and 0.25N lactic acid) to separate out lignin and cellulose. This structural change was confirmed after FTIR analysis. After the physical and chemical treatment and confirmation in structure and chemical change, the sample was set for saccharification following by fermentation. The microorganisms used for fermentation were Saccharomyces cerevisiae and Bacillus stearothermophilus. The process was carried out for 16 days and after 16 days the solution was distilled and estimation of ethanol was done. Abdullahi Bako Rabah, Solomon Bankole Oyeleke *et.al* [6] investigated that the groundnut shells and rice husks were treated with 3, 4 and 5% of dil. hydrochloric acid and dinitrosalicylic acid (DNS) method was used to determine the reducing sugar concentration**.** The production of bioethanol was determined by using potassium dichromate method. There was no significant difference seen in the yield of reducing sugar obtained at different treatments. Silverstein *et.al* [7] determined the effectiveness for conversion of various solid residues like cotton stalk to ethanol like sulfuric acid, sodium hydroxide(NaOH), hydrogen peroxide(H_2O_2), and ozone(O_3) pretreatments for the conversion of cotton stalks to ethanol. There was significant lignin degradation after treating the solids with various pretreatments like sodium hydroxide(NaOH) and sulphuric acid(H_2SO_4) and higher sugar availability. the highest level of delignification was observed in sodium hydroxide pretreatment (65.6% for 2% NaOH, 90 min, 121 °C/15 psi) and cellulose conversion. the highest level of xylan reduction was observed in Sulfuric acid pretreatment (95.2% for 2% acid, 90 min, 121 °C/15 psi. A. KOLI, B. PATIL and F. PAREKH *et.al* [8] resulted in concluding that enough glucose was produced by pretreating groundnut shell and maize cobs with sulphuric acid. The groundnut shell and maize cobs were present in the ratio of 1:3. The parameters that help in optimizing the ethanol production were 4.5M H_2SO_4 and temperature 80°c. A significant amount of ethanol is produced if glucose is fermented with S.cerevisiae at specific condition. The researcher should take into account the chances of production of ethyl alcohol which is the required component in the beverage industry, as a solvent, and fuel produced by hydrolysis of sugar. MIR NAIMAN ALI, MAZHARUDDIN KHAN *et.al* [9] present the work that was focused on production of fuel ethanol by saccharification and fermentation of cellulosic substrates. The substrates that were utilized for ethanol were easily available and were less costly were groundnut shells and rice husk. Before beginning the saccharification and maturation tests add up to sugars, diminishing sugars and cellulose substance were assessed Cellulose in Rice husk was 45% and that of groundnut shell was 65%. Nyachaka C.J , Yawas D.S *et.al* [10] studied the production of ethanol and the yield was produced by fungal organism like A. niger and S. cerevisiae that convert pentose and other carbon molecules. The result of the experiment performed revealed that the agro-waste material (groundnuts shell) is an required source as substrate and can be used at large scale production in industries for bioethanol extraction as they are cheap and renewable sources. M. Abdullahi, and J. J. Ijah *et.al* [11] worked on ethanol production from maize cobs and groundnut shells taking them in different ratios and ethanol content was determined. Firstly sample was grinded to obtain the particle of size 300 micrometer average. After grinding, the sample was dried in hot air oven to remove the moisture. After this process, 10 gram of sample was mixed with 20 ml of diethyl ether. As benzyl alcohol is a component of lignin and is soluble in diethyl ether. Hence the cellulose bound to lignin is removed and become available for further process. Groundnut shells and Maize cobs were taken in different ratios and both acidic and basic treatment was given to it. Acidic and basic treatment was given by H_2SO_4 and NaOH respectively. After hydrolysis, the solution was set for fermentation and after the fermentation, when the ethanol estimation done, it was found that the best yield of ethanol was obtained from the ratio of maize cobs and groundnut were mixed in a ratio of 3:1. Upendra *et.al.* [12]carried out investigation on production of ethanol from field beans/green pea pods waste. They were able to produce 250ml of bioethanol per kg of agro wastes. Since the production of glucose per litre was 90 gm. Sarkar *et.al*. [13] carried out review on ethanol manufacturing from agricultural waste. They are considered as one of the important source for the production bioethanol as they are renewable sources and causes reduction in various forms of pollution. Xylose and glucose co-fermentation, and the use of recombinant microbial strains are according to them, challenges in fermentation configuration. they perform the process of hydrolysis which is a challenge for depolymerization of the cellulose and hemicellulose to obtain higher concentration of fermentable sugar. Wyman *et al.*[14] studied concentrated different pretreatment innovations for corn and broke down that distinctive strategies yields diverse outcomes because the preference for pretreatment depends which part of lignocellulose you are interested in the particular material. Priyamwada Bharthare *et.al* [15]studied on groundnut shell hydrolysis which reveals that the chemical pretreatment for groundnut shells is much better than steam explosion i,e physical pretreatment method and in chemical pre-treatment 0.25 N HCl (acidic) was far better in comparison to 0.25 N NaOH(basic). Chandrasekhar Gajulaet.al[16] investigated that Mangamoori GS was found to be potential, cheap, renewable and is available everywhere for ethanol production on a commercial scale. The substrate released 670 mg/g of glucose upon the enzymatic hydrolysis after the pretreatment with sodium sulfite. Sorghum stalks immobilized P. stipitis cells showed more ethanol production (20.45 g/L, yield 0.47 g/g) as compared to free cells (17.83 g/L, yield 0.44 g/g) at flask level using the GS enzymatic hydrolysate upon batch fermentation. During repeated batch fermentation cycles, ethanol production was found to be same up to 5 cycles followed by a gradual downfall.

CONCLUSION

Biomass to ethanol will be technical and economical viable alternative to Ist generation ethanol, if appropriate conditions are developed. Current production problems hence determine immediate and future research priorities.

Pretreatment is the first step in the ethanol production which accounts for 33% of the total cost. So we need better and cost efficient pretreatment techniques so that we can reduce the microbial contaminants that reduce the yield. Now in order to overcome these problems various membranes were used like ultrafiltration, microfiltration and nanofiltration or reverse osmosis.

The genetically recombinant modification of fermentative and cellulolytic microorganisms is permitted to expand the ethanol yield and profitability under the stress condition of high generation bioethanol forms. A new powerful biotechnological tool that is genetic engineering is essential for making new strategies for increasing the ethanol fermentation performance. Since fermentative microorganisms must be capable of surviving the high temperatures of SSF processes, further research is required. Various altered genes have been introduced into the genome of these fermentative organisms and their heterologous expression of genes has been incorporated into *Z. mobilis* to extend its effectiveness toward other substrates. Further research is certainly required in optimizing biological pretreatment involving fungi (e.g., *T. reesei* and Basidiomycetes) that exhibit lignocellulolytic properties at low pH levels and high temperature. Improvement in each of these individual aspects is required to achieve high conversion and cost-effective biomass-to-bioethanol operations [17].

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