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A Review on Ethanol Production from Agricultural Waste Raw Material

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ABSTRACT

Ethanol is very widely used compound in beverages and many food applications. Ethanol has good liquid fuel properties. In the era of rapid industrialization, the demand of fuel is increasing day by day. Petrol and diesel are two major liquid fuels used in vehicles in India. The cost of fuel can be reduced if ethanol is mixed with liquid fuel. For this, it is very important to produce ethanol in cost effective manner. Ethanol can be manufactured from various agricultural raw materials like potato waste, molasses, banana waste, waste food grain etc. The current review summarizes the ethanol manufacturing by using various low cost raw materials.

Keywords: Feed Stock, Fermentation, Yield, pH, Temperature

I. INTRODUCTION

Production of various chemicals by using low cost processes is important from the economical considerations. This is more important for the developing countries. Many compounds like acetic acid, starch, ethanol, lactic acid, formic acid etc. can be manufactured by using low cost feed stocks and waste materials [1, 2, 3]. Use of agricultural waste as a raw material serves two purposes. It reduces waste and also economizes the production process of these chemicals [4, 5]. Ethanol is one important chemical used in wide range of applications starting from food industry to petroleum industry. Various agricultural raw materials can be used for ethanol production. The current review summarizes research carried out on various aspects of ethanol production from agricultural waste as raw material.

II. RESEARCH ON ETAHNOL FROM AGRICULTURAL WASTE

Meenakshi and Kumaresan carried out investigation on the manufacturing of ethyl alcohol from corn, potato peel waste[6]. They carried out an investigation for optimization of the parameters like pH, substrate concentration and particle size. They observed that submerged fermentation was very effective technique for the fermentation. 10 percent substrate concentration was optimum for highest yield. A maximum yield was observed at a pH of 5.5. Also it was observed that tieldwas higher using an intermediate particle size (0.157mm). Bhatt and Shilpa carried out an investigation on production of ethanol from groundnut shell waste[7]. They carried out simultaneous saccharification and fermentation (SSF). The pre-treatment of waste was carried out using various chemicals. The pre-treatment by using hydrochloric acid was most effective. The media used for fermentation by was inoculated with 2% (v/v) overnight grown culture of saccharomyces cerevisiae and bacillus stearothermophilus. Potassium dichromate method was used for ethanol production. According to their analysis, groundnut shell showed 35 % Cellulose, 32.10 % Lignin, 4.3% other Substances, 27.7 % Organic Carbon content and 23.4 % Nitrogen content. Singh et.al. carried out comparative studies on the bioethanol production from various agricultural organic waste residues[8]. They observed that after fermentation and different treatments 41%-46% alcohol was obtained. They studied potato peel, banana peel, rice straw and corn cob for conversion. Maximum sugar to alcohol conversion was possible in potato peel and corn cob. Udhayaraja and Narayanan used saccharomyces cerevisiae with sorghum stovar as a substrate [9]. They observed the effect of pH, innoculum level and temperature on ethanol production. They observed that the ethanol yield was maximum at 10% inoculums level followed by 8% and 6%. They

observed the highest yield at 35oC. The maximum yield was obtained at pH value of 6.5. Upendra et.al. carried out investigation on production of ethanol from field beans/green pea pods waste[10]. They obtained 90g of glucose/ litre. Filtration and distillation were carried out in downstream processing. They were able to produce 250 ml of ethanol per kg of agro waste. Koshy and Nambisan carried out an investigation on pre-treatment process for waste used for ethanol manufacturing [11]. According to them, due to high costs and production of undesired by-products, chemical method is not suitable for the purpose. During their investigation, they observed that, edible mushrooms (Pleurotus sp.) produce several extracellular enzymes. The spent substrate after mushroom cultivation can be used for the alcohol production. Paddy straw was used in the present study for the cultivation. They observed that 5.5 times more ethanol production was possible by this method than use of raw paddy straw. Itelima et.al. used banana, plantain and pineapple Peels in the simultaneous saccharification and fermentation process for bio-ethanol production[12]. They observed that pineapple peels had the highest biomass yield of 1.89 (OD), followed by banana peels 1.60 (OD), while plantain peels had the least 0.98 (OD). Aspergillums Niger and Saccharomyces cerevisiae co cultures were used by Rath et.al. in the ethanol production from waste potatoes[13]. They observed that maximum yield for potatoes were 12.124 percent. The optimum pH for ethanol fermentation was 6 and temperature was 300oC.Reddy et.al. carried out an investigation on use of banana agro waste for the ethanol production[14]. They used cellulolytic thermophilic Clostridium thermocellum CT2 for the biological production of ethanol. This culture was isolated from elephant droppings. They obtained the maximum ethanol yield of 0.41g/g substrate used. Azad et.al. carried out investigation on production of ethanol by using Bangaladeshi potatoes[15]. They observed maximum yield for 20 percent potato solution. For yeast cell growth 31 o C was optimum temperature .The optimum pH value was 6. The optimum incubation period was 6 days. Vazirzadeh and Robati carried out review for alcohol production from waste potatoes[16]. During their review they observed that waste potatoes are very cheap and abundant raw material for ethanol production. Banana peels were used for bioethanol production by Singh et.al.[17]. They carried out simultaneous saccharification and fermentation process . They used co cultures of aspergillums Niger and Saccharomyces cerevisiae. The pH value of 6 and 30 degree Celsius temperature were optimum conditions for the production. They observed the maximum yield 6.540 % by using banana peels. Akin-Osanaiye et.al. used Carica papaya (pawpaw) agro waste for the production of ethanol[18]. They observed that reducing sugar was highest after 48 h of saccharification using Aspergillums Niger. Also according to the investigation, Brewer's yeast gave a higher ethanol yield than baker's yeast. Duhan et.al. used Kufri Bahar (KB) flour as carbon source for ethanol production[19]. They observed the maximum ethanol production 7.89(V/V) at pH 6.0 after 48 h. Sarkar et.al. carried out review on ethanol manufacturing from agricultural waste[20]. They concluded that Lignocellulosic biomass is one of the main resources for economically attractive bioethanol production. The ethanol manufacturing is very attractive research area because agricultural wastes are renewable, less costly and abundantly available in nature. Xylose and glucose co-fermentation, and the use of recombinant microbial strains are according to them, challenges in fermentation configuration. In hydrolysis the challenge was efficient process for depolymerisation of cellulose and hemi-cellulose to produce fermentable monomers with high concentration. Also exploring cost effective pre-treatment technology is very important aspect of bioethanol production. According to the studies carried out by Gashaw, enzymatic hydrolysis may be the most potent alternative process for saccharification of complex polymer[21]. Ghosal et.al. obtained 9 percent yield of ethanol by using potato waste[22]. During their they found that carrying out saccharification and fermentation simultaneously is equally effective as separate hydrolysis and fermentation. Ebabhi et.al. carried out an investigation on bioethnol production by cashew nut shell extract for hydrolysing raw material.[23]. They observed that the ethanol extract of cashew nut shell is capable of producing cellulases and xylanase enzyme.

III. CONCLUSION

Ethanol manufacturing from agricultural waste material is widely explored alternative. Cleaner and greener production of the compounds like ethanol is important for sustainable growth. These environment friendly processes can be made more economical by optimizing the process parameters and finding more effective techniques for conversion of these agricultural and other low cost raw materials into usable product.

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