ISSN: 0975 -8542

Journal of Global Pharma Technology

Available Online at: www.jgpt.co.in

REVIEW ARTICLE

Bioethanol Production from Starch- A Short Review

S. Sivakrishnan, G. Veeramani*, V.P. Mahesh Kumar

Department of Pharmacy, FEAT, Annamalai University, Annamalai Nagar, Chidambaram, Tamilnadu, India.

***Corresponding Author: G. Veeramani**

Abstract

Bioethanol is an alcohol made by fermentation, mostly from carbohydrates produced in sugar or starch crops such as corn or sugarcane. Cellulosic biomass, derived from non-food sources, such as trees and grasses, is also being developed as a feedstock for ethanol production. Concentrated acid hydrolysis, dilute acid hydrolysis, wet milling process, dry milling process, sugar fermentation and fractional distillation process were used for production of bioethanol. Bioethanol is colourless and clear liquid. Brazil and United States of America are the largest ethanol producers, widely used alternative automotive fuel consists lower toxicity level. India produced 111 crore liters of ethanol in year 2015-2016, while the production was 38 crore liters in 2013-2014. Bioethanol fuel is mainly produced by the sugar or cellulosic fermentation process and it is transport fuel to replace gasoline and power generation by thermal combustion, fuel for fuel cells by thermochemical reaction, fuel in cogeneration systems and feedstock in the chemical industries because it is much more environmental friendly.

Keywords: *Bioethanol, Starch, Fuel, Hydrolysis, Hexoses, Fermentation.*

Introduction

Biofuels for transport have to a certain extent been in use for a very long time. In recent years however, they are enjoying renewed interest in both developed and developing countries as a result of the need to curb rising emissions from the transport sector [1, 2], reduce dependence on increasingly expensive fossil oil imports and increase farm incomes.

An important advantage of biofuels is that they can easily be integrated into the existing transport infrastructure, thus avoiding the significant investment costs associated with other renewable options for the transport sector. Depending on the feedstock and conversion route, we can distinguish first and second generation bioethanol [3, 4].

First generation bioethanol [5], also known as carbohydrate ethanol, can be produced from sugar or starch based crops. Starch biomass is a cheap and abundant renewable carbon source in bioethanol production. Therefore, it may be important to develop low cost ethanol production processes with a suitable energy balance in order to foster the development of a low carbon society.

At present, the cost associated with supplying the enzymes required to produce bioethanol makes it a less competitive fuel. Eliminating the need for amylases in bioethanol production is a key step toward reducing its operating costs. Consolidated bioprocessing, which integrates enzyme production, saccharification and fermentation in a single reactor and a single yeast strain, is a promising strategy for low cost ethanol production from starchy biomass.

The main countries producing first generation bioethanol are the US and Brazil. Current ethanol production based on corn, starch and sugar substances [6, 7] may not be desirable due to their food and feed value [8].This review aims to present a brief overview of the available and accessible technologies for bioethanol production using starch. Bioethanol will be produced various processes are as follows:

- Concentrated acid hydrolysis
- Dilute acid hydrolysis
- Wet milling process

- Dry milling process
- Sugar fermentation
- Fractional distillation process

Bioethanol Production from Starch

Starch was a polysaccharide composed exclusively of glucose mayors, which storages energy in plants that was a high yield feedstock for ethanol production [9, 10]. Production of bioethanol from starch was a process of three stages: hydrolysis of higher sugars to monosaccharides (e.g. glucose), fermentation of glucose to produce ethanol and carbon dioxide, product separation or purification [11]. Hydrolysis was a chemical reaction in which a molecule was cleaved into two parts by the addition of a molecule of water. Hydrolysis came to the disintegration of the polymer into monomeric sugars. Hydrolysis of starch could be carried out chemically by acids or enzymatically by amylases [12] and cellulases.

Enzymatic hydrolysis might be carried out by using: soluble enzymes is the most conventional method or immobilized enzymes. Recent advances in the development of enzyme immobilization showed promising results in many industries. The enzymes used for biomass hydrolysis should be more efficient and far less expensive.

Modern achievements in the yield of biotechnology made it possible to improve the process of bioethanol production by: increasing productivity of genetically modified corn that leads to a reduction in costs of feedstock production, the starch in gene engineered corn was more amenable to enzymatic bioconversion to sugars, design of bacterial enzymes that enhanced stability and greater capacity for rapid bioconversion of starch as monosaccharides, microorganisms subjected to engineering to withstand higher levels of toxic ethanol and achieve rapid fermentation.

Amylases were catalyst generally used for this process, because: the specificity of the enzymes, their inherent mild reaction conditions, the absence of secondary reactions. The second stage of bioethanol production was fermentation. Fermentation was the term used to define the process of conversion of sugar (glucose) into alcohol (ethanol) and carbon dioxide gas by microorganisms in anaerobic conditions. The reactions within the yeast to make this happen were very complex. *Saccharomyces cerevisiae* not metabolize xylose, which was found in the biomass pentoses. Add to yeast and other natural ethanlogens additional pentose metabolic pathways by genetic engineering and improve ethanol yields by genetic engineering in microorganisms that have the ability to ferment both hexoses and pentoses are the ways to increase the efficiency of ethanol fermentation of sugars derived from biomass [13].

The hexoses were readily carried out by the fermentation of many naturally occurring organisms. The most common used for ethanol production were *Saccharomyces cerevisiae* [14] and *Zymomonal mobilis* and wild type *Escherichia coli,* which fermented sugars to a mixture of ethanol and organic acids. The pentoses were fermented to ethanol by few native strains, and usually at relatively low yields. The ketose of xylose, xylulose was converted to ethanol by *Schizosaccharomyces pombe, Saccharomyces cervisiae, Saccharomyces amucae* and *Kluveromyces lactis*.

Through genetic modification of bacteria and yeast strains were obtained capable of co-fermentation of pentose sugar to ethanol and hexose high yields. So far, the optimization of bioethanol production was possible to use of metabolic engineering. There were often used effective alternative pathways and enzymes of several model organisms often. Since the production of ethanol by fermentation from renewable carbohydrate materials for use as an alternative to liquid fuels attracting worldwide interest, therefore, had a great interest in the search for new sources of carbohydrates [15].

Conclusion

Production of ethanol through various processes from sugar and starch is a technically mature and commercially available process. However, a number of technical improvements can still be made to several steps of commercial ethanol production routes. Bioethanol may be produces various steps such as pretreatment, hydrolysis, fermentation, purification. Concentrated acid hydrolysis, dilute acid hydrolysis, Wet milling process, Dry milling process and Fractional distillation process, each of these methods have their advantages and disadvantages.

It was very important to selection of the optimal method of pretreatment. It was important to pay attention to the development and use of appropriate pretreatment methods, as well as other stages of the production of bioethanol. Since the production of ethanol by fermentation from renewable carbohydrate materials for use as an alternative to liquid fuels attracting worldwide interest, therefore, had a great interest in the search for new sources of carbohydrates.

References

1. Taherzadeh MJ, Karimi K (2008) Pretreatment of Lignocellulosic Wastes to Improve Ethanol and Biogas Production: A Review, Int. J. Mol. Sci., 9: 1621-1651.
2. Demirbas A (2007) Progress and recent trends in biofuels, Progress in Energy and Combustion Science, 33: 1-18.
3. Dias MOS, Junqueira TL, Cavallet O, Cunha MP, Jesus CDF, Mantelatto PE, Rossell CEV, Filho RM, Bonomi A (2013) Cogeneration in integrated first and second generation ethanol from sugarcane, Chem. Eng. Res. Des., 91: 1411-1417.
4. Raele R, Boaventura JMG, Fischmann AA, Sarturi G (2014) Scenarios for the second generation ethanol in Brazil, Technol., Forecast, 87: 205-223.
5. Walter A, Rosillo-Calle F, Dolzan P, Piacente E, Borges da Cunha K (2007) Market evaluation: Fuel ethanol, Deliverable 8 for IEA Bioenergy, 40: 75.
6. Dias MOS, Cunha MP, Maciel Filho R, Bonomi A Jesus, CDF Rossell CEV (2011) Simulation of integrated first and second generation bioethanol production from sugarcane: comparison between different biomass pretreatment methods, J. Ind. Microbiol. Biotechnol., 38: 955-966.
7. Wang M, Han J, Dunn JB, Cai H Elgowainy (2012) A Well-to-wheels energy use and Greenhouse gas emissions of ethanol from corn, sugarcane and cellulosic biomass for US use, Environ. Res. Lett., 7: 1-13.
8. Fischer G (2008) Implications for land use change, Paper presented at the Expert Meeting on Global Perspectives on Fuel and Food Security, Rome, FAO.
9. Kadam KL, McMillan JD (2003) Availability of corn stover as a sustainable feed-stock for bioethanol production, Bioresour. Technol., 88: 17-25.
10. Kim S, Dale BE (2004) Global potential bioethanol production from wasted crops and crop residues, Biomass and Bioenergy, 26: 361-375.
11. Demirbas A (2008) Biofuels sources, biofuel policy, biofuel economy and global biofuel projections, Energy Conversion and Management, 49: 2106-2116.
12. Sanchez OJ, Cardona CA (2008) Trends in biotechnological production of fuel ethanol from different feed stocks, Bio resource Technology, 99: 5270-5295.
13. Emeka, EE, Chales, OO Anthony, OC (2015) Utilization of cellulosic cassava waste for bio-ethanol production, J. Environ. Chem. Eng., 3: 2797-2800.
14. Ajibola FO, Edema MO, Oyewole OB (2012) Enzymatic Production of Ethanol from Cassava Starch Using Two Strains of Saccharomyces Cerevisiae, Niger. Food J., 30: 114-121.
15. M Zabochnicka-Świątek, L Sławik (2010) Bioethanol-Production and Utilization, Archivum Combustionis, 30(3): 237-246.