SUBSTRAT USED FOR BIOETHANOL PRODUCTION USING SACCHAROMYCES CEREVISEAE

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Abstract : Fuels are major concerns of developing countries from past few decade. It makes developing countries dependent over oil producing countries and produce large amount of air pollutant. Bioethanol can be a substitute for petroleum oils. By the production of ethanol we can reduce the import of petroleum oil. There are distinct microorganisms involved in ethanol manufacturing, among them the most powerful microorganism is Saccharomyces cerevisiae. It displays high tolerance and manufacturing of ethanol. There is hues benefit with Saccharomyces cerevisiae that it can utilize different cellulosic, lignocellulosic, sucrose, starch, algal biomass as a substrate for the production of ethanol. It mines waste that can be used to generate ethanol. We transform waste products into environmentally friendly bioethanol through this technique. Simple sugar molecules are transformed straight to ethanol during the ethanol manufacturing phase, while other molecules are transformed to simple sugar, these simple sugars are then transformed to ethanol. This review shows the various kinds of feed stock.

IndexTerms **- Saccharomyces cereviseae, Bioethanol, Sugar, Ethanol, Lignocelluloses, Cellulose, Starch.**

1.INTRODUCTION

Air pollution is a major concerns of the world. The main cause of air pollution are fossil fuels. Ethanol is a most important green renewable fuels it produce very small amount of pollutant as compare to the fossil fuels. Fermentation of sugar based raw materials was refferd to as “first generation” bioethanol production and ligncellulose material was used in the “second generation” bioethanaol production. *S. cerevisiae* is widely studied in the household and industrial level. Ethanol is generated as a the main fermentation product of *S.cerevisiae* . *S. cerevisiae* use sugar containing substrate of different feedstocks (mainly sugar cane), starchy materials and lignocellulosic biomass for ethanol production. In Brazil 79% ethanol produced from sugarcane juice and the remaining percentage from cane molasses. The purpose of this study to focus on substrate (media) being used for the production of bio ethanol.

2.RAW MATERIALS (MEDIA) FOR ETHANOL PRODUCTION

Different row materials are being used for the production of ethanol. But the principle of the production of ethanol is to conversion sugar to the ethanol. The simplest form of sugar (glucose, fructose) is fermented to ethanol by *saccharomyces cerevisiae*. Glucose does not exist in free form in nature manly it is present in the form of cellulose, glycogen and starch etc.

Different raw materials are being studied for the production of ethanol. The purpose of this row material is to provide free glucose units. As we know there are different cellulosic and starchy waste are found abundantly. The purpose of the all study to produce glucose (monosaccharide) from the polysaccharide (cellulose, starch) for this some of the scientist have used acid hydrolysis(Harris et. al. 1946) and some have used α-amylase, cellulase (Keller 1996).

All the plant material contain diffract concentration of carbohydrates (**Glucan, Mannan, Galactan, Xylan, Arabinan, Lignin)** so all the different plant material will produce different amount of ethanol. The different concentration of ethanol production is discussed in bellow table-

Table 1- different concentration of ethanol being produced at different conditions by Saccharomyces cereviseae

Substrate	Additive and Condition	Production	References
Wheat straw Starch cassava pulp Rice husks	Treated with different chemical such as steam explosion, NaOH, H_2O_2, H_2SO_4, pH 4.5 to 5.0, temp 30°C-40°C	10 g/l 14 g/l 40 g/l fermentation broth	Bhadsna B et al (2016)
Sweet sorghum	0.25 g/g DM H_2SO_4, Batch fermentation	0.39–0.48 (g g-1 consumed sugar)	Ratnavathi et.al. (2011)
Sweet potato	.2 % Ammonium Sulphate, 80% moisture containing 10% inoculums size, pH5.0, Temp. 30°C, 72h, Solid state fermentation	47 g/100g sugar consumed	Swain et. al. (2013)
Flower (Quisqualis indica), YPD	37°C	1.41 gm/100 gm flower	Potphode Arati et. al (2015)
Flower (Mahula)	Immobilization in agar agar	154gm/l of fermentation broth	Behera, S. et. al. (2011)
Mahua (*Madhuca indica*) flower	Ammonium sulphate, $CaCl_2$ etc. Batch bioreactor , pH 4.9, temperature 30°C	35-41 g/L fermentation broth	Benarji, et.al (2016)
Sugarcane	Temp 30°C, pH 3.5	73 ml/100 ml Sugarcane juice	Sanchez and Cardona, 2008
Carob pod,	immobilized with Ca alginate, pH5.5, 24h	32gm/kg Carob pod	Ercan, Y. (2013)
Grape pomace, Sugar beet pomace Sugar beet juice (LF-SBJ)	Solid state fermentation, pH 5.0,	148 mg/ml	Rodriguez et. al. (2010)
Waste bread	24h, 55°C	54 ± 2 g/l Bread hydrolysate	Datta, P., et. al. (2018)
Kitchen waste	30°C for 24 h	30.9 g /kg waste	Tang et. al. (2008)
Coffee extract	30°C	28g/ kg Coffee extract	Tehrani et. al. (2015)
Waste potato mash	pH 5.5,24h, 30°C	35g/l Waste potato mash	Izmirlioglu et. al (2012)
Madhuca latifolia L. Flowers	70% Moisture, pH of 6.0 and temperature 30 °C, Solid State fermentation	225.0 ± 4.0 g/kg flower	Sujit Kumar Mohanty et. al. (2009)
Corn Stover	30°C	40.0 g/L	Ming W et. al. (2009)

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Hydrolysis of the plant material has direct effect on the production of ethanol because as we know glucose and fructose molecule are only converted to the ethanol so concentration of glucose and fructose depends upon the efficiency of the hydrolysis of the polysaccharides.

3.CONCLUSION

The literature study above suggests that ethanol manufacturing is dependent on the concentration of glucose, fructose. There is no free glucose and fructose in nature. In the form of glycogen, cellulose, lignocelluloses,, starch, various carbohydrates are present in nature. All these molecules are the polymer of the various forms of glucose so that ethanol can be produced through. The various scientists suggest distinct techniques of hydrolyzing complicated sugar to the easy unit such as glucose. Among these three techniques, one is commonly proposed in hydrolysis with hydrochloric acid and sulfuric acid, the other is hydrolysis with distinct biological enzymes, the third is the cultivation used to generate hydrolyzing enzymes.

The above research also suggests that any material that has glucose or fructose as a substratum for ethanol manufacturing can be used up to now is sugar cane as the best source for ethanol manufacturing..

REFERENCES

1. Bhadana, B., & Chauhan, M. (2016). Bioethanol production using Saccharomyces cerevisiae with different perspectives: Substrates, growth variables, inhibitor reduction and immobilization. *Ferment. Technol*, *5*(131), 3.
2. Sanchez, O. J., & Cardona, C. A. (2008). Trends in biotechnological production of fuel ethanol from different feedstocks. *Bioresource technology*, *99*(13), 5270-5295.
3. Gnansounou, E., Dauriat, A., & Wyman, C. E. (2005). Refining sweet sorghum to ethanol and sugar: economic trade-offs in the context of North China. *Bioresource technology*, *96*(9), 985-1002.
4. Olofsson, K., Bertilsson, M., & Lidén, G. (2008). A short review on SSF–an interesting process option for ethanol production from lignocellulosic feedstocks. *Biotechnology for biofuels*, *1*(1), 7.
5. Adesanya, O. A., Oluyemi, K. A., Josiah, S. J., Adesanya, R., Shittu, L., Ofusori, D., ... & Babalola, G. (2008). Ethanol production by Saccharomyces cerevisiae from cassava peel hydrolysate. *The Internet Journal of Microbiology*, *5*(1), 25-35.
6. Ratnavathi, C. V., Chakravarthy, S. K., Komala, V. V., Chavan, U. D., & Patil, J. V. (2011). Sweet sorghum as feedstock for biofuel production: a review. *Sugar Tech*, *13*(4), 399-407.
7. Kang, Q., Appels, L., Tan, T., & Dewil, R. (2014). Bioethanol from lignocellulosic biomass: current findings determine research priorities. *The Scientific World Journal*, *2014*.
8. Sun, Y., & Cheng, J. (2002). Hydrolysis of lignocellulosic materials for ethanol production: a review. *Bioresource technology*, *83*(1), 1-11.
9. Hahn-Hägerdal, B., Galbe, M., Gorwa-Grauslund, M. F., Lidén, G., & Zacchi, G. (2006). Bio-ethanol–the fuel of tomorrow from the residues of today. *Trends in biotechnology*, *24*(12), 549-556.
10. Tropea, A., Wilson, D., Cicero, N., Potortì, A. G., La Torre, G. L., Dugo, G., ... & Waldron, K. W. (2016). Development of minimal fermentation media supplementation for ethanol production using two Saccharomyces cerevisiae strains. *Natural product research*, *30*(9), 1009-1016.
11. Becker, J., & Boles, E. (2003). A modified Saccharomyces cerevisiae strain that consumes L-arabinose and produces ethanol. *Appl. Environ. Microbiol.*, *69*(7), 4144-4150.
12. Tofighi, A., Azin, M., Mazaheri Assadi, M., Assadi-rad, M. H. A., Nejadsattari, T., & Fallahian, M. R. (2010). Inhibitory effect of high concentrations of furfural on industrial strain of Saccharomyces cerevisiae. *Int J Environ Res*, *4*(1), 137-142.
13. Della-Bianca, B. E., de Hulster, E., Pronk, J. T., van Maris, A. J., & Gombert, A. K. (2014). Physiology of the fuel ethanol strain Saccharomyces cerevisiae PE-2 at low pH indicates a context-dependent performance relevant for industrial applications. *FEMS yeast research*, *14*(8), 1196-1205.
14. Swain, M. R., Mishra, J., & Thatoi, H. (2013). Bioethanol production from sweet potato (Ipomoea batatas L.) flour using co-culture of Trichoderma sp. and Saccharomyces cerevisiae in solid-state fermentation. *Brazilian archives of Biology and technology*, *56*(2), 171-179.
15. Behera, S., Mohanty, R. C., & Ray, R. C. (2011). Ethanol production from mahula (Madhuca latifolia L.) flowers with immobilized cells of Saccharomyces cerevisiae in Luffa cylindrica L. sponge discs. *Applied energy*, *88*(1), 212-215.
16. Behera, S., Mohanty, R. C., & Ray, R. C. (2010). Comparative study of bio-ethanol production from mahula (Madhuca latifolia L.) flowers by Saccharomyces cerevisiae and Zymomonas mobilis. *Applied energy*, *87*(7), 2352-2355.
17. Swain, M. R., Kar, S., Sahoo, A. K., & Ray, R. C. (2007). Ethanol fermentation of mahula (Madhuca latifolia L.) flowers using free and immobilized yeast Saccharomyces cerevisiae. *Microbiological Research*, *162*(2), 93-98.
18. Ercan, Y., Irfan, T., & Mustafa, K. (2013). Optimization of ethanol production from carob pod extract using immobilized Saccharomyces cerevisiae cells in a stirred tank bioreactor. *Bioresource technology*, *135*, 365-371.

19. Benarji, D. S. N., & Ayyanna, C. (2016). Statistical Optimizations of Fermentation Factors on Bioethanol Production from Mahua Flower (Madhuca indica) with Saccharomyces cerevisiae by Response Surface Methodology in Batch Bioreactor. *Journal of Microbiology and Biomedical Research*, *2*, 1-7.
20. Rodríguez, L. A., Toro, M. E., Vazquez, F., Correa-Daneri, M. L., Gouiric, S. C., & Vallejo, M. D. (2010). Bioethanol production from grape and sugar beet pomaces by solid-state fermentation. *International Journal of Hydrogen Energy*, *35*(11), 5914-5917.
21. Swain, M. R., Mishra, J., & Thatoi, H. (2013). Bioethanol production from sweet potato (Ipomoea batatas L.) flour using co-culture of Trichoderma sp. and Saccharomyces cerevisiae in solid-state fermentation. *Brazilian archives of Biology and technology*, *56*(2), 171-179.
22. Datta, P., Tiwari, S., & Pandey, L. M. (2018). Bioethanol Production from Waste Breads Using Saccharomyces cerevisiae. In *Utilization and Management of Bioresources*(pp. 125-134). Springer, Singapore.
23. Tang, Y. Q., Koike, Y., Liu, K., An, M. Z., Morimura, S., Wu, X. L., & Kida, K. (2008). Ethanol production from kitchen waste using the flocculating yeast Saccharomyces cerevisiae strain KF-7. *Biomass and Bioenergy*, *32*(11), 1037-1045.
24. Hong, Y. S., & Yoon, H. H. (2011). Ethanol production from food residues. *Biomass and bioenergy*, *35*(7), 3271-3275.
25. Tehrani, N. F., Aznar, J. S., & Kiros, Y. (2015). Coffee extract residue for production of ethanol and activated carbons. *Journal of Cleaner Production*, *91*, 64-70.
26. Izmirlioglu, G., & Demirci, A. (2012). Ethanol production from waste potato mash by using Saccharomyces cerevisiae. *Applied Sciences*, *2*(4), 738-753.
27. Graves, T., Narendranath, N. V., Dawson, K., & Power, R. (2006). Effect of pH and lactic or acetic acid on ethanol productivity by Saccharomyces cerevisiae in corn mash. *Journal of Industrial Microbiology and Biotechnology*, *33*(6), 469.