Biotechnol Res 2016; Vol 2(4):176-178
eISSN 2395-6763

SHORT COMMUNICATION

Bioethanol production from whole Cassava flour hydrolysate by solid state fermentation

B AADINARAYANAN[1], Ebin ANTONY[1], KR SMITHA[1], MM JESLY[1*]
[1]St. Joseph's English Medium Higher Secondary School, Thrikkakkara
*Corresponding Author email: jmmkpb49@gmail.com

• Received: 30 August 2016 • Revised: 12 October 2016 • Accepted: 30 October 2016 • Published: 09 November 2016 •

ABSTRACT
Cassava is considered as a potential source for the commercial production of bioethanol because of its availability and low market price. Bioethanol reduces greenhouse gas emissions and can reduce the use or replace fossil fuels. Cassava flour was hydrolyzed by autoclaving to obtain a jelly like appearance for the fermenting biomass. Autoclaving resulted in the production of sugars which can be further fermented to bioethanol by baker's yeast. Direct fermentation of this hydrolysate without enzymatic saccharification resulted in production of 5.7±1.4 % (w/v) ethanol. This method can be considered as an economical method for the production of bioethanol.

KEY WORDS: *Bioethanol, cassava, non-enzymatic, SSF*

Introduction

Cassava (*Manihot esculenta Crantz*) is a shrubby perennial crop in the Family of Euphorbiaceae. Depending upon geographic locations it is named differently as yucca in Central America, mandioca or manioca in Brazil, tapioca in India and Malaysia and cassada or cassava in Africa and Southeast Asia (Sriroth *et al*.,2012) . It is incorporated into animal feed (20.0%) and about similar proportion is converted into starch for industrial purposes whereas; some of the portion is also used as food in several developing countries. Very high yield of starch (up to 70.0%), low ash content and rich organic nature makes cassava an ideal substrate for bioethanol production. In addition to this, cassava starch can be easily hydrolyzed by simple methods. As cassava starch does not have much industrial application in food industries as compared to corn starch, therefore it also lacks competition in terms of price and is available throughout the year due to its flexibility in terms of planting and harvesting (Pervez *et al*., 2014).

Emerging environmental issues like burning of petroleum-based fossil fuel resulting in the emission of toxic gases have diverted the attention of scientists and researchers towards the utilization of various renewable resources like starchy materials from corn, sugarcane, wheat, potato , corn stover, molasses, lignocellulosic biomass and purified starch have been successfully utilized for the commercial production of bioethanol (Pervez *et al*., 2014). The use of bioethanol has several advantages including reduction of greenhouse gas emissions, reducing the use of non-renewable fuels and will provide economic especially in agricultural sector and social benefits (Azmi *et al*., 2010).

The present study focuses on the direct production of bioethanol from cassava starch hydrolysate without undergoing enzymatic saccharification.

Materials and Methods

Cassava roots and baker's yeast (*Saccharomyces cerevisiae*) were purchased from the local market was used in the study. Cassava roots were peeled, sliced and dried in sunlight before using for ethanol production. Baker's yeast was maintained in potato dextrose agar and was transferred to broth before inoculation. All chemicals used in the study were analytical grade.

The dried cassava chips were then subjected to pretreatment by mechanical size reduction using a dry mixer jar. Particle size is reduced such as way that fine powder was further used in the study. Particulate matter is separated from the powder by sieving (Upendra *et al*., 2013).

Cassava flour hydrolysate was prepared from the fine cassava powder (50g) by autoclaving the neutralized moistened flour at 121^{o}C, 15 lbs. pressure for 15 minutes. The hydrolysate is further cooled and used as the fermentation medium.

Baker's yeast at a concentration of 2% was added to the hydolysate and incubated at 30±2^{o}C for 72 hours. After incubation 150 ml of sterile distilled water is added to the fermented product and incubate for 2 hours. Then filter the sample so that fine liquid containing ethanol was recovered which was used further for estimation of ethanol concentration (Upendra *et al*., 2013).

Concentration of ethanol was estimated spectrophotometrically (Spectronic 20,Mumbai) as per a modified protocol according to Sumbhate *et al*., 2012. 5 ml of potassium dichromate was taken in a conical flask. To that add 1 drop of 0.1 M silver nitrate and mix well. Using a buret or automatic dispenser, add 5 ml of 6M sulfuric acid to the beaker. To that mixture add the filtered solution and incubate for 5 minutes. Absorbance of the resulting solution was read at 560 nm against water as the blank. Concentration of the alcohol present was calculated from an ethanol standard graph.

Results and Discussion

Autoclaving of cassava flour was found to promote gelatinization and powder seems like a jelly like appearance (Figure 1). It may be due to the production of sugars by the breakage of bonds in the starch polymer. Direct fermentation with unpeeled Cassava roots with *S. occidentallis* resulted in a final ethanol yield of 0.0025 g.g^{-1} was too low to be economically feasible (Marx and Nquma, 2013). But in the present study using direct solid state fermentation without enzymatic saccharification resulted in 5.7±1.4 % (w/v) ethanol which was even better compared to ethanol production after enzymatic treatments (Ajibola *et al*., 2012). While some other studies fermentation of starch hydrolysate of cassava resulted in 8.3 % of bioethanol (Ocloo and Ayernor, 2010).

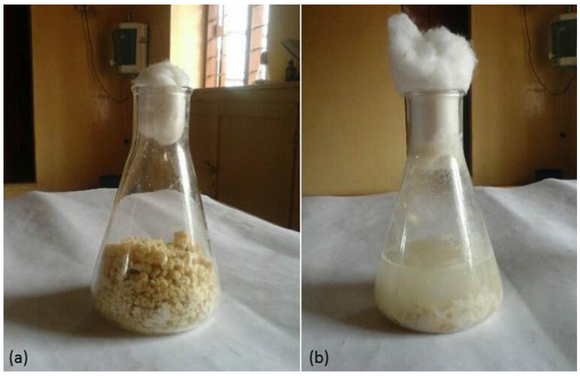

Figure 1: Cassava flour (a) before fermentation (b) after fermentation (72 hours)

Comparably the present study yielded good amount of ethanol which can be further increased by proper optimization of the culture conditions. Further this method can be utilized for low cost production bioethanol without the use of enzymes.

Acknowledgements

The authors thank Environmental Engineering Laboratory at School of Engineering, Cochin University of Science and Technology for providing UV Visible Spectrophotometer facility.

References

Ajibola, F. O., Edema, M. O., & Oyewole, O. B. (2012). Enzymatic Production of Ethanol from Cassava Starch Using Two Strains of Saccharomyces cerevisiae. *Nigerian Food Journal*, *30*(2), 114-121.

Azmi, A. S., Ngoh, G. C., Mel, M., & Hasan, M. (2010). Ragi tapai and Saccharomyces cerevisiae as potential coculture in viscous fermentation medium for ethanol production. *African Journal of Biotechnology*, *9*(42), 7122-7127.

Marx, S., & Nquma, T. Y. (2013). Cassava as feedstock for ethanol production in South Africa. African Journal of Biotechnology, 12(31).

Ocloo, F. C. K., & Ayernor, G. S. (2010). Production of alcohol from cassava flour hydrolysate. *Journal of brewing and Distilling*, *1*(2), 15-21.

Pervez, S., Aman, A., Iqbal, S., Siddiqui, N. N., & Qader, S. A. U. (2014). Saccharification and liquefaction of cassava starch: an alternative source for the production of bioethanol using amylolytic enzymes by double fermentation process. *BMC biotechnology*, *14*(1), 1.

Sriroth, K., Piyachomkwan, K., & Wanlapatit, S. (2012). *Cassava Bioethanol*. INTECH Open Access Publisher.

Sumbhate, S. V., Nayak, S., Goupale, D., Tiwari, A., & Jadon, R. S. (2012). Colorimetric method for the estimation of ethanol in alcoholic-drinks. *Journal of Analytical Techniques*, *1*(1), 1-6.

Upendra R.S, Pratima Khandelwal, Priyanka.S, Jagadish M L, Nandhini N J, (2013) Production Of Bioethanol From Hitherto Underutilized Agro Waste (Field Beans/Green Pea Pods Waste) Incorporating Zero Waste Generation Technique, *International Journal of Innovative Research in Science, Engineering and Technology* , 2(10), 5574-5579.