Research Paper Biotechnology

Biofuel from Banana Peel: One Step Ahead in Sustainable Development

Tamakuwala Tanvi Research Scholar Department of Biotechnology, Veer Narmad South Gujarat University, Surat.

Shah Gaurav Assistant Professor, Department of Biotechnology, Veer Narmad South Gujarat University, Surat.

ABSTRACT

Production of green energy from waste material has played an important role in recent years due to the depletion of non renewable energy sources. Starchy materials, especially maize, are widely used for the ethanol production, but banana peels are waste materials and generated in large quantity every day. The present study was done to investigate optimum parameters for bio-ethanol production from waste banana peels by Saccharomyces cerevisiae. Ethanol was produced from banana peels at different pH ranges from 5.0 to 8.0 and using temperature range from 25 ºC to 55 ºC. Liberated sugars were measured using 3, 5-dinitrosalicylic acid and ethanol was determined by iodometric method. Highest ethanol was found to be produced at pH 6.5 with temperature of incubation 30 ºC.

KEYWORDS Saccharomyces cerevisiae, waste banana peel, bio-ethanol

Introduction:

As we know that banana is one of the major cash crops of this country and it produces in a huge amount as a waste peels after consumption of fruit. Biofuel is emerging as a very promising renewable fuel against conventional fossil fuels. Because of burst in population over the last century, fossil fuel consumption increased steadily resulting into depletion of same at alarming rate. So, it is very much essential to find the alternative source of fuel. Production of bioethanol is a true effort in this direction. Work was carried out for "Ethanol" production using "banana peel" as a substrate by employing a strain of *Saccharomyces cerevisiae*. Banana peel is an agricultural byproduct. According to the report (Banana Market Review and Banana Statistics 2012-2013) worldwide production of banana are about 16.5 million tons while in Asia.

The industrial and fuel ethanol production from starchy biomass commonly consist of three-step process (Laluce and Mattoon, 1984) : (i) liquefaction of starch by an endoamylase (ii) enzymatic saccharification of the low molecular weight liquefaction products like dextrins to produce glucose; and (iii) fermentation of glucose monomers to ethanol. Commercial amylases (frequently those produced by *Aspergillus* species) are used for liquefaction and saccharification of starch and represent a significant expense in the production of fuel alcohol from starchy materials.

Method & Materials:

Materials: Waste banana peels were collected from local market in Surat city. Peels were washed with the help of distilled water and chopped into small pieces.

Inoculum Preparation: *Saccharomyces cerevisiae* was used for the fermentation of ethanol from waste banana peels. For the preparation of inoculum GYE (Glucose Yeast Extract) broth was used. GYE broth contains (g/L) Glucose 20.0, Yeast Extract 10.0, Peptone 20.0 and pH was set to 6.5 with the help of concentrated HCl.

Protocol Set-up:

1. 5 g of waste chopped banana was taken into 100 mL of distilled water.
2. pH was set to 6.5 with the help of HCl and NaOH.
3. 5 mL sample was collected to measures the sugar concentration before autoclaving.
4. Broth was autoclaved at 121 ° C and 10 psi pressure for 15 minutes.
5. 10% inoculum was used to inoculate fermentation media for production of ethanol.
6. After every 24 h, 5 mL sample was withdrawn to check the sugar concentration and ethanol concentration.

Effect of Temperature on Ethanol Production:

To determine the temperature parameter, inoculated broths were kept at different temperature v/z 25 ° C, 37 ° C, 45 ° C, 55° C and at room temperature.

Effect of pH on Ethanol Production:

To check the effectivity of pH on Ethanol production, various pH was selected ranges from 5.5 to 7.5. pH was adjusted with the help of 0.1 N HCl and 0.1 N NaOH.

Results & Discussion:

Composition of banana peel:

Constituents	% of wet weight
Moisture	82.47–86.21
Organic components	Variable
Hemicellulose	12.57 ± 1.4
Cellulose	15.48 ± 0.24
Lignin	11.48 ± 1.67

Table-1 Composition of Banana peel

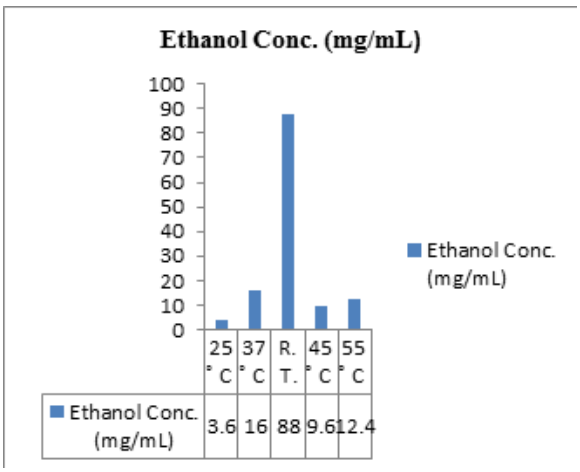
Starch, cellulose and hemicelluloses contents of banana peel were relatively high. The result indicated that banana peels could be a good source of carbon source for bioconversion.

Optimization of Temperature on Ethanol Production:

No.	Temperature (° C°)	Ethanol Conc. (mg/mL)
1	25 ° C	3.6

2	37 ° C	16.0
3	Room Temperature (Near to 32 ° C)	88.0
4	45 ° C	9.6
5	55 ° C	12.4

Table-2 Effect of Temperature on Ethanol Production



Graph-1 Effect of Temperature on Ethanol Production

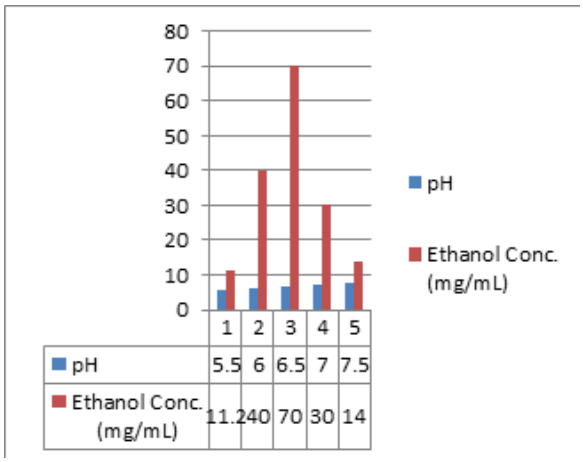
Optimization of pH on Ethanol Production:

No.	pH	Ethanol Conc. (mg/mL)
1	5.5	11.2
2	6.0	40.0
3	6.5	70.0
4	7.0	30.0
5	7.5	14.0

Table-3 Effect of pH on Ethanol Production

It is reported that maximum ethanol production at room temperature was found to be 88 mg/mL. Highest ethanol concentration i.e. 70 mg/mL was observed at pH 6.5.

Graph-2 Effect of pH on Ethanol Production



Conclusion:

Ethanol was efficiently produced from the waste banana peels. Using banana peel reduces the utilization of other food based materials which was earlier used to produce ethanol. In future, there is possibility of large scale utilization of waste banana peels for the high ethanol production by optimizing the various parameters as well as by manipulating the organism to fulfill the recent market demand.

REFERENCES

A.E. Farrell, R.J. Plevin, B.T. Turner, A.D. Jones, M. O'Hare, and D.M. Kammen (2006)." Ethanol can contribute to energy and environmental goals," Science, vol. 311 no. 5760, pp. 506–508. Banana Market Review and Banana Statistics 2012-2013,(2014). Market and Policy Analyses of Raw Materials, Horticulture and Tropical (RAMHOT) Products Team. FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS Rome. Brooks, A.A. (2008). Ethanol production potential of local yeast strains isolated from ripe banana peels, African journal of Biotechnology, 7(20): 3749- 3752. Essien, J.P., Akpan, E.J., Essien, E.P. (2005). Studies on mould growth and biomass production using waste banana peels, Bioresource Technology, 19: 361-363. G.L. Miller (1959). "Use of dinitrosalicylic acid reagent for determination of reducing sugars," Anal. Chem., vol. 31, pp. 426–428. Hossain, A.B.M.S., Ahmed, S.A., Ahmed, M.A., Faris, M.A.A., Annuar, M.S.M., Hadeel, M., and Norah, H. (2011).Bioethanol Fuel Production from Rotten Banana as an Environmental Waste Management and Sustainable Energy. 5(6), 586-598. Kimberly R. Librero, Catherina A.Barcel and Martin.L.(2010).Ethanol from waste banana peelings, Technical Report, TheDepartment of Science & Technology at School of Engineering Institution, Philippines. Lin, Y., Tanaka, S. (2006). Ethanol fermentation from biomass resources, current state and prospects. App. Microbiol.Biotechnol, 69,627-642. Shilpa, C., Malhotra, Girisha and Chanchal (2013). Alcohol Production from Fruit and Vegetable Waste. International Journal of Applied Engineering Research. 8(15):1749- 1756. Shyam kumar Rajaram, Ganesh Moorthy Innasi Muthu, Rajeswari R., Harikrishnan H. (2011). Utilization of waste ripe Banana, and peels for Bio ethanol production using Saccharomyces cerevisiae. JOURNAL OF BIOSCIENCES RESEARCH 01; Vol. 2(2):67-71.