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# PRODUCTION OF ETHANOL FROM PLANTAIN, PINEAPPLE AND BANANA WASTE BY FERMENTATION PROCESS

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## ABSTRACT

*Agricultural residues or waste are usually faced with the problem of disposal and treatment thus creating environmental problems. Agricultural waste especially those rich in carbohydrates can be treated in several ways and converting into useful substances, therefore reducing the bulk of waste. Bio-ethanol production from fruits in Nigeria is not a common practice, in this study, wastes from Pineapple, Banana and Plantain fruits are subjected to fermentation for a period of 120 to 168 hours using combined cultures of Yeast (Saccharomyces cerevisae) and Aspergillus niger (mold). Fermentable sugar concentration and alcohol production were determined at an interval of 24 hours throughout the fermentation period. Results from the study showed reducing sugar concentration that ranged between 0.30- 0.91mg/cm$^3$ for pineapple, 0.18-0.46 mg/cm$^3$ for plantain and 0.20- 0.80mg/cm$^3$ for banana. Alcohol (Ethanol) production ranged from 3.98 to 8.40% v/v. that is plantain peels had the lowest ethanol yield of 3.98% v/v, followed by banana peels which had 7.43% v/v and the highest ethanol yield in pineapple, 8.40% v/v. This study revealed the importance of Agricultural waste especially from fruits which have fermentable sugars.*

**Key words**: Fermentable Sugars, Ethanol, Plantain, Pineapple, Banana, Peels.

## INTRODUCTION

The production of Bio-fuel from agricultural waste is a well-known and established technology. Ethanol production has been on for ages with countries as USA and Brazil having the first productions, (Jackson, 2008).

The production capacity of Ethanol has reached abort 51,000 million litres (RFA 2007). Since it is estimated that fossil fuel will be running out by the next few decades, attention has currently been dedicated to the conversion of biomass into fuel ethanol. Main feedstock for No-ethanol production is sugar cane in Brazil and corn grains in USA while many other raw materials are used worldwide. Among the three major types of raw materials, the production of ethanol from sugary and starchy materials arc easier as compared to Ligmn/cellulose based raw materials since they require technical challenges such as pretreatment ( Peterson *et al.,* 2007, Jove, 2018)

Research efforts are focused to design and improve a process which would produce a sustainable transportation fuel using low cost feed stock, many agricultural raw materials rich in fermentable carbohydrates were tested worldwide for bioconversion from sugar to ethanol but the cost of carbohydrates raw materials has been a limiting factor for large scale production by the industries employing fermentation processes (Cavpo *et al.,* 2006)

The production of ethanol from comparatively cheaper source of raw materials using efficient fermentative micro-organisms is the only possible way to meet the great demand for ethanol in the present situation of energy crisis (Pramanik *et al.,* 2005)

Pineapple, plantain and banana arc significant fruits that are easily prone to spoilage during harvesting, storage, marketing or processing resulting in waste. Losses from agricultural waste is high and estimated at 20 to 30% of production. According to FAQ (2003), the total waste generated from fruits was estimated at 3.36 million tones out of the total production of 16.8 million tones.

The failure to salvage and reuse such materials economically results in was Wage and depletion of natural resources (Essien, *et al.,* 2005).



The solid waste generated by fruits processing industries can serve as potential raw materials for the production of secondary metabolites of industrial significance by micro-organisms. Peels are the major by-products obtained during the processing of various fruits and these were shown to be a good source of various bioactive compounds which posses various beneficial effects. But, significance quantities of fruit peels are discarded as waste by the processing industries which cause a real environmental problem (Zang *et al.,* 2005). These fruits processing wastes can be used as potential feedstock for bioethanol production and this could also be an attractive alternate for disposal of the polluting residues (Wyman, 2011).

## MATERIALS AND METHODOLOGY

### 1. Preparation of Samples (Plantain, Pineapple and Banana Peels) for production of Ethanol.

Plantain, Banana and pineapple fruit were purchased ripe from a neighbouring market in Auchi, Edo State. They were brought to the laboratory where they were properly washed, peeled with a clean knife. The peels of all Samples were individually cut into small pieces and were homogenized using a mechanized blender with sterile distilled water.

### 2. Inoculation and Fermentation

Commercially sold baker's yeast and pure culture of *Aspergillus niger* were used for inoculation of samplers.



Fermentation is carried out using cotton- plugged 1000$cm^3$ conical flasks. Each flask will contain 300$cm^3$ of the fermenting substrate (i.e plantain peel), the medium is sterilized and inoculated with 5% (v/v) of the growth media containing *Aspergillus niger* and *Saccharomyces cerevisae.*

This is done for all 3 samples incubation of flasks is done on a shaker with an agitation rate of 300rpm at $30^0$c for seven days

### 3. Analysis

Analytical procedure was carried out every 24 hours; that is 30$cm^3$ of the sample was collected from each flask. Of these, 27$cm^3$ of each sample was centrifuged at 14000rpm for 5 minutes to remove the cells. The supernatant fluid was then filtered; the filtrate was used to determine ethanol and reducing sugar concentration. The ethanol concentration was determined based on the density of alcohol distillate at 20°c and expressed in weight % (w/w) (Mojo *et at.,* 2006)

## RESULTS AND DISCUSSION

Reducing sugars of substrates i.e. plantain, pineapple and banana were determined Results showed that, for every 24 hours observation during seven days fermentation, the concentration of reducing sugar (mg/cm$^3$) reduced gradually during the period of fermentation. Fig 1 shows a comparism of results obtained during fermentation of plantain, pineapple and banana peels. At the 7th day of fermentation, reducing sugar concentration was highest from pineapple peel (0.91mgcm$^3$), followed by banana (0.80mg/cm$^3$ and then lastly plantain (0.46mg cm$^3$).

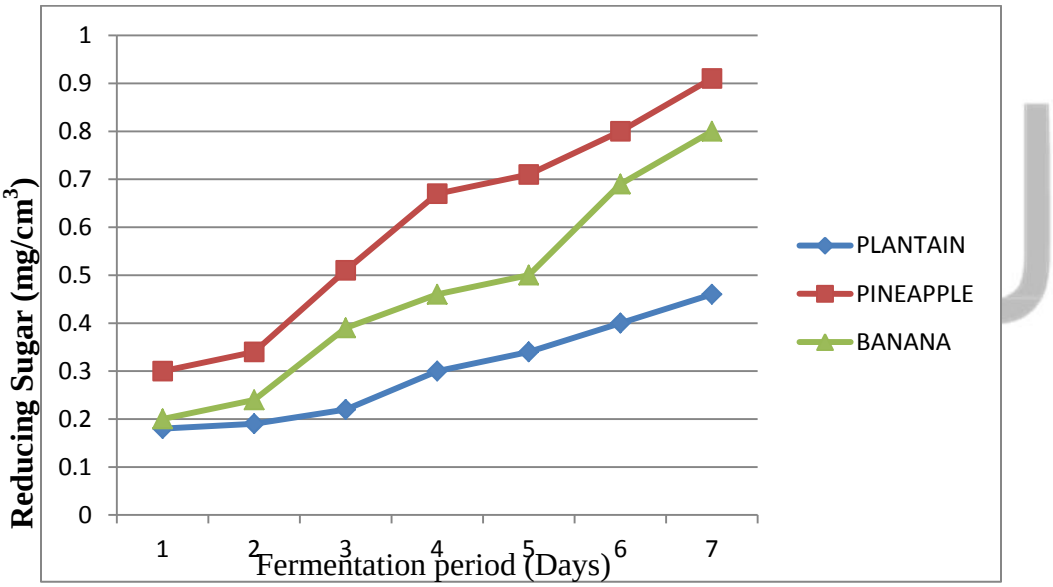


Fig 1: Effect of fermentation on the Reducing sugar concentration of plantain, pineapple and Banana

The result of ethanol production from the three samples is shown in Fig 2. Ethanol yield of the 3 samples increased gradually during the seven days of fermentation. Result ranged from 3.98 to

8.4% v/v at the last day of fermentation with plantain peels having the lowest ethanol yield of 3.98% v/v; followed by banana peels, 7.43% v/v and the highest yield from pineapple 8.40% v/v.

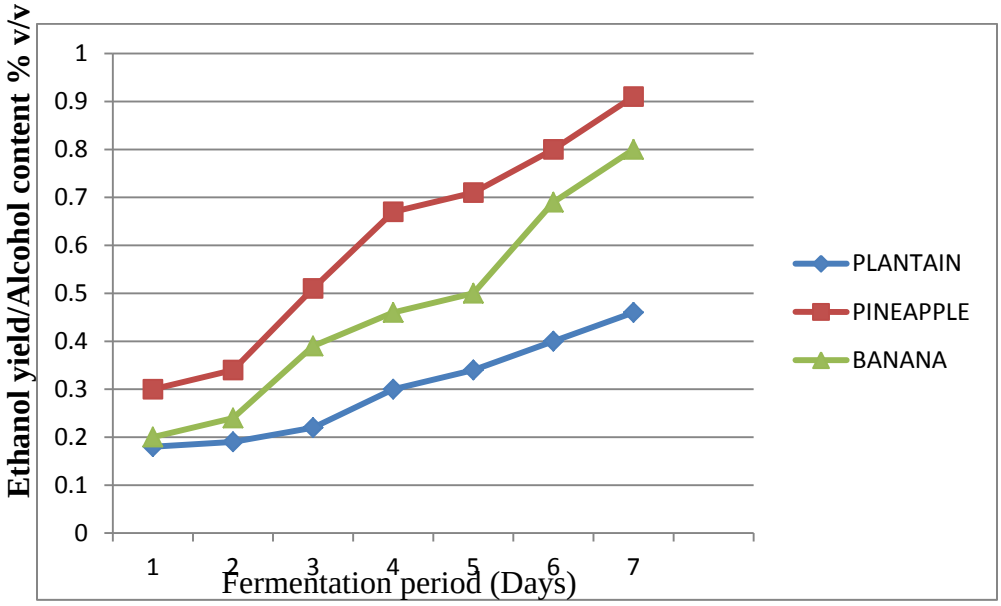


Fig 2: Effect of fermentation on the Ethanol yield of plantain, pineapple and Banana

Waste especially agricultural wastes have been found to be rich in fermentable sugars, thus making these waste good substrates for ethanol production. The availability of reducing and fermentable sugars in the three substrates may be largely responsible to the presence of *Aspergillus niger* that is capable of synthesizing enzymes that will hydrolyze the complex sugars in these substrates into simple sugars (Sun and Cheng, 2002; Keller, 2010).

*Saccharoniyces cerevisae* is largely responsible for alcoholic fermentation of the substrates as it is regarded as a sugar transporter.

Jimoh and Amen., (2003) reported that co-culture fermentation of substrates is best in ethanol production as observed in this research work.

This research work has clearly shown that production of ethanol from Agricultural waste (plantain, pineapple and banana peels) can be achieved by a co-culture fermentation involving a complex sugar hydrolyzer as *Aspergillus niger* and a sugar fermenter as *Saccharoinyces cerevisae*. Thus a cost effective and environmentally suitable production method as fermentation should be encouraged to preserve our agricultural waste by making it available as bio fuel.

## REFERENCES

Campo, I.D, Alegri I, Zapzpe, M, Echeverria, M, & Echeverria, 1 (2006). Diluted acid hydrolysis pre-treatment of agri-food wastes of bio-ethanol production. *Idust crops and prod*..42: 214 221.

Essien, JP, Akpan, E.J. & Essien, E.P. (2005) Studies on mould growth and biomas production using waste banana peel. *Bioresources Technol*,,96:45 1456.

(Food and Agricultural Organisation of the Unites Nations (2003), FAOSTAT statistics data base, Agriculture, Rome, Italy.

Hammond, J.B, Egg, R., Diggins, D., & Coble, C.G. (1996). Alcohol from bananas. *Bioresource Technol*, 56:125139.

Jackson, R.S. (2008) *Wine Science: Principles and Applications* pg. 276. San Diego, California: Academic Press

Jimoh, S.O Ado, and Ameh, J.B. (2013) 'Simultaneous Saccharification and fermentation of S.A Yam peel to Ethanol by *Aspergillus niger* and *Saccharomyces cerevisae*,' *Blol. And J. For the Tropics*, vol 6R & Vulasinovic, no. 1, pp. 69-00, 2009.

Jove Science Education Database (2018) *Biology 1; Yeast, Drosophila and C. elegans*. An Introduction to *Saccharomyces cerevisiae*. JoVE, Cambridge, MA.

Keller, J.B. (2010), Pineapple Wine: Directions for Pineapple Wine Baskets Available from https://www.ehow.com/way-5810589-directions-pineapple-winebeaskets.htm#xzz14Ixaya5s. (Last Accessed: June, 2018).

Mojovic, L. Nikolic, S. Marica, R, & Vulcasinovic, M. (2006). Production of bioethanol from corn meal hydrolyztes. Fuel 85:17501755.

Petersson, A., Thomsen, M.H., Hauggaard-Nielson, H. & Thomsen, A.B, (2007). Potensial bioethanol and biogas production using lignocellulosic biomass from winter rye, oliseed rape and faba bean. *Biomass and Bioenergy* 31:812819.

Prarnanik. K., & Rao, DE, (2005), Kinetic study on ethanol fermentation of grae Waste using *Saccharoniyces cereviasac* yeast isolated from toddy. (ED) Journal 85:5358.

RFA (Renewable Fuels Association). Industrial Statistics, http://www.cthanolrfa. org/industry/statistics2007.

Sun, Y. and Cheng, J. "Hydrolysis of Lignocellulosic Material from Ethanol Production: A review," *Biores. Technol*, vol. 83, pp, 1-11, 2002.

Wyman, Ch.E (2011). Twenty years of trials, tribulations, and research progress in bio- ethanol Technology. *Appl. Bioniass rind Bioechem. Biotech*, 91:521,

Zhang, P. Whistler, R. L BeMiller J.N, & Hamaker, B.R. (2005). Banana starch: production, physicochcmical properties, and digestibility a review. Carbohydrate polymers 59:44345 8.