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EFFECT OF TEMPERATURE ON THE PRODUCTION OF ETHANOL FUEL FROM SELECTED AGRICULTURAL RESIDUES

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ABSTRACT

The possibility of producing ethanol from agricultural residues like corn cobs peels, groundnut shells and plantain peels was investigated. Ethanol was produced from 500.0 g each of the grinded residues collected at a dump site in Ogbomoso at different temperatures (25, 30, 35 and 40°C by using acid hydrolysis, fermentation and distillation. The results show that the volume of ethanol produced from the three residues increases with temperature up to 35°C and begins to decrease with temperatures. The highest volumes of ethanol (21.50, 14.50 and 14.50 ml) were obtained at a temperature of 35°C from plantain peels, groundnut shells and corn cobs respectively and the lowest volumes (16.0, 13.0 and 10.0ml) were obtained at 25°C from plantain peels, groundnut shells and corn cobs respectively. It was also observed that plantain peels out of the three residues produced the highest volume of ethanol at all temperatures. With this result importation of ethanol can be reduced if substantial energy is devoted to the production of ethanol from agricultural residues at a temperature of 35°C.

KEYWORDS: Ethanol, Fuel, Energy, Residue, Biomass and Temperature

INTRODUCTION

Energy is defined as the capacity of a physical system to perform work. Without energy, no work can be done; energy is thus an indispensable factor for progress and development. At the heart of every enterprise, innovation and breakthrough, energy remains the inevitable essential that galvanizes practical ideas or concepts into realities. Life itself is sustained by continuously obtaining energy from the environment in the form of essential nutrients without which no life can exist. Cities, nations, continents cannot achieve economic, social-cultural and technological independence if essential forms of energy are lacking.

The progressive expansion of civilization and the related ever-developing science and technology have put more pressure on the use of energy. In short, there is problem of energy shortage worldwide (Oladeji, 2011).

Ethanol, which is a liquid fuel as well as renewable form of energy has long be in existence and can to a greater extent complement the use of fossil fuels. Over the course of time, it has been a flexible substance that performed a variety of functions. As a beverage, it has been called many things by various world cultures, but this study concentrates on its modern day role as a substitute for petroleum based fuels. In fact, Blottnitz and Curran, (2007) states that Ethanol derived from biomass is often advocated as a significant contribution to possible solutions tour need for sustainable transportation fuel.

The large quantities of agricultural residues produced in Nigeria can play a significant role in meeting her energy demand. The availability of these residues is important, but the techniques of their efficient utilization are of more importance **(**Oladeji, *et al*. 2009). Most of these solid residues are biomass, which contain enormous amount of energy (Wilaipon, 2008). However, it is unfortunate that in Nigeria, the current farming practice is to burn these residues or they are left to decompose. This burning, not only results in health risk to both human and ecology, but more than that, it is a waste of available energy. This work is therefore, on one of the techniques of converting agro-residues into improved or higher-grade biomass energy, which is in form of liquid fuel. This is because there is the need to improve and supplement liquid fuel at cheaper and more affordable cost.

Apart from providing a suitable alternative to fossil fuels, ethanol forms the major raw material in most industrial sectors of every economy including pharmaceutical and entertainment establishments. Furthermore, the use of agricultural residues would also improve our waste management as well as improve the economy of rural dwellers as these wastes will be a source of income for them.

The practice of mechanized farming has led to extensive discharge of agricultural wastes that have had negative effects on the environment. The utilization of such wastes has been a source of concern to many researchers (Oyenuga 1959; Akpan 1999; Amosun 2000). Therefore, this work was designed to look into the possibility of converting some of such wastes like corn cobs, groundnut shells and plantain peels into liquid fuel. Ethanol is one of such fuel. In this work, agricultural wastes, which are readily available, were used for ethanol production.

METHODOLOGY

Plantain peels, groundnut shells and corn cobs which are agricultural residues that were used to produce ethanol at different temperatures were collected at a dump site from a local market, Arada in Ogbomoso, Oyo state. The choice of these residues was based on their availability and abundance supply. Also, the reagents that were used are Tetraoxosulphate (VI) acid (H_2S0_4) and Di-ethyl ether.

About 700 g ofeachof these residues were sundried for three days and later oven-dried at a temperature of 70^{o}C for 15 minutes. It was then grinded by using grinding machine (Hammer mill model 200, U.K) incorporated with 2 mm sieve. Five hundred (500) g of each residue were measured using weighing balance.1000 ml of di-ethyl ether was mixed with each residue in four different Erlenmeyer flasks in order to remove extractives and the residue left was washed with distilled water.

One thousand (1000) ml of 4 M of H_2SO_4 was added in order to isolate the lignin and the hemicelluloses and celluloses dissolved leaving lignin as a hard precipitate. Then acid hydrolysis was followed by adding 2 M of dilute sulphuric acid (H_2SO_4) i.e. (dilute acid hydrolysis was used to breakdown the molecules into sugar) to the residue that remained after pre treatment in a conical flask (sterilized and was tightly sealed with glass stopper to avoid air entering the reactor medium) which served as a reactor and was allowed to stand for about 4 hours. Acid pretreatment had a greater influence on the sugar released through enzymatic hydrolysis of biomass (Rajesh *et al*., 2008). An increase in acid severity in terms of concentration resulted in higher sugar releases (Rajesh *et al*., 2008).

4 M of H_2SO_4 was used for the hydrolysis and effect of the temperature was examined using thermostatic water bath (Gallenkamp, England) maintained at 25^{o}C, 30^{o}C, 35^{o}C and 40^{o}C and it was later filtered and the filtrate was then obtained with the culture of Saccharomyces cerevisiae added. The reaction was allowed for 4 hours and after which the solution was tested for the concentration of ethanol produced. The ethanol produced was refined by distillation to get a

pure ethanol**.** The volume of the ethanol produced was measured with text tube. The pictorial diagrams of the plantain peels groundnut shells and corn cobs are shown in plates 1, 2 and 3.

Plate 1: Fresh Plantain Peels

Plate 2: Corn Cobs

Plate 3: Groundnut Shells

RESULTS AND DISCUSSIONS

Acid hydrolysis of the three residues at different temperatures showed variation in the volume of ethanol produced with temperatures (Table 1). Figure 1 shows the volume of distilled ethanol extracted at different temperatures from corn cobs, groundnut shells and plantain peels. Corn cobs processed at 35°C produced the highest volume of ethanol (14.5 ml) while the same residue produced the lowest volume (10 ml) at 25°C. It is observed from Figure 1 that the volume of distilled ethanol increased from corn cobs processed at 25°C to corn cobs processed at 35°C and began to decrease thereafter. This shows that the temperature at which maximum volume ethanol was extracted is 35°C and the temperature at which minimum volume of ethanol was extracted is 25°C. Similar trends were also observed for the volume of distilled ethanol from both groundnut shells and plantain peels. The highest volumes of ethanol produced from groundnut shells and plantain peels were 14.5 ml and 21.5 ml respectively at a temperature of 35°C. Similarly, the minimum volumes of ethanol produced from groundnut shells and plantain peels were 12.5 ml and 16 ml respectively at a temperature of 25°C. This shows that plantain peels processed at 35°C produced the highest volume of ethanol out of the three residues while Corn cob processed at 25°C produced the lowest volume. It means that plantain peels has the greatest potential for ethanol production among the three residues.

The reason for the decrease in the volume of distilled ethanol produced from the three residues processed at a temperature of 35°C could be that most of the micro-organisms required for the fermentation of ethanol are most effective at temperature of 35°C. The effectiveness of these organisms continued to decrease until a particular temperature was reached when these organisms were inactive.

Table 1: Volume of Distilled Ethanol Extracted From the Three Residues at Different Temperatures

Parameter Determined	Sample A (25^{o}C)	Sample B (30^{o}C)	Sample C (35^{o}C)	Sample D (40^{o}C)
Distilled Ethanol Yield (ml) from corn cobs	10.00	11.00	14.50	12.00
Distilled Ethanol Yield (ml) from Groundnut shells	13.00	12.5.00	14.50	13.50
Distilled Ethanol Yield (ml) from Plantain peels	16.00	18.20	21.50	17.50

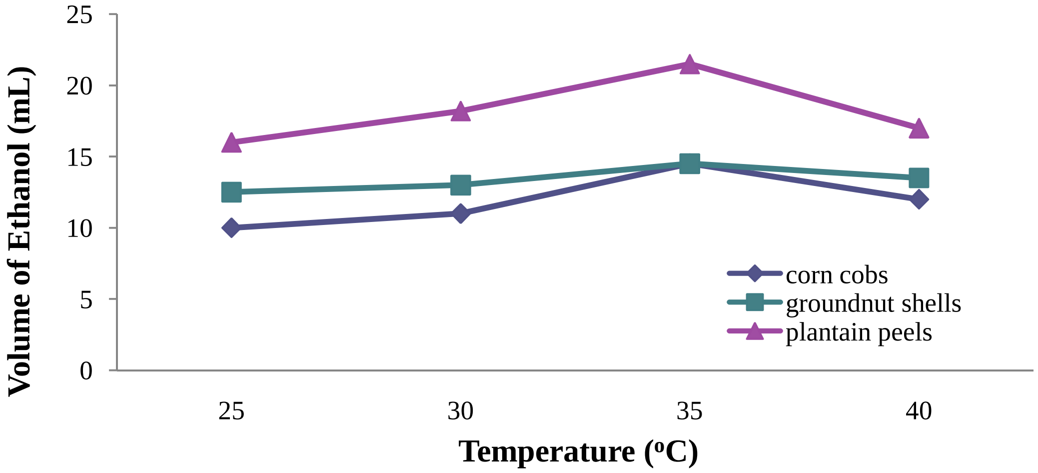

Figure 1: Effect of Temperature on Ethanol Yield from Corn Cobs, Groundnut Shells and Plantain Peels

CONCLUSIONS

The experimental results obtained reveal that Plantain peel which is one of the agricultural residues has potential for the production of ethanol. Reasonable amount of ethanol is present in plantain peel. The results show that the volume of ethanol produced from plantain peels, groundnut shells and corn cobs increases with temperature up to 35^{o}C and begins to decrease with temperatures. The highest volumes of ethanol, 21.50, 14.50 and 14.50 ml were obtained from plantain peels, groundnut shells and corn cobs at a temperature of 35^{o}C and the lowest volumes of 16.0, 13.0 and 10.0 ml were obtained from plantain peels, groundnut shells and corn cobs at 25^{o}C. With this result importation of ethanol can be reduced if substantial energy is devoted to the production of ethanol from agricultural residues, particularly from plantain peels. This will also have a multiplier effect such as jobs for the unemployed youths in Nigeria.

REFERENCES

1. Blottnitz, H. and Curran, M.A. (2007) “A review of assessments conducted on bio-ethanol as a transportation fuel from a net energy, greenhouse gas, and environmental life cycle perspective”. Journal of Cleaner Production Vol. 15 Pp 607-619
2. Oladeji, J.T, Enweremadu, C.C and Olafimihan, E.O (2009) “Conversion of Agricultural Residues into Biomass Briquettes” IJAAAR vol. 5 (1-2) Pp17-21
3. Oladeji, J.T. (2011) “The effects of some Processing Parameters on Physical and combustion characteristics of Con cob Briquettes” An unpublished Thesis in the Mechanical Engineering Department, LadokeAkintola

University of Technology, Ogbomoso.

4. Wilaipon, P., (2009), "Density Equation of Bio-Coal Briquettes and Quantity of Maize cob in Phitsanulok Thailand" American Journal of Applied Science, Vol. 5(12) Pp 1808-811 Akpan, U.G. (1999) Acid demethylation of agricultural waste (citrus peel). Paper presented at the 8th Annual Sci. Conf. Nigeria Society for Biol. Conserv., University of Uyo, Uyo Nigeria.

5. Amosun, A.O. (2000)"Gasification of biomass for methanol production" An unpublished B. Eng Chemical Engineering Department, Federal University of Technology Minna, Nigeria

6. Oyenuga, V.A. (1959). Nigeria Foods and Feeding Stuffs, 2nd ed. Revised. Univ. Press, Ibandan, Nigeria pp. 56-7, 71