PRODUCTION OF BIOFUEL FROM PLANTAIN

A RESEARCH PROJECT PRESENTED TO
THE DEPARTMENT OF CHEMICAL
ENGINEERING
FEDERAL UNIVERSITY OF TECHNOLOGY,
MINNNA, NIGER STATE

BY
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2001/11481EH

IN PARTIAL FULFILMENT OF THE
REQUIREMENT FOR THE AWARD OF
ACHELOR OF ENGINEERING DEGREE (B. ENG.)
IN CHEMICAL ENGINEERING

OCTOBER 2008

DECLARATION

I, Ameh Emmanuel (2001/11481EH) declare that this research project report is my original work and has not been presented elsewhere to the best of my knowledge

....   06/11/2008..................

Ameh Igoche Emmanuel   Sign/Date

DEDICATION

This project is dedicated to God the father, son and the Holy Spirit and to my prents, Mr. and Mrs. Vicent O. Ameh.

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commercial gains.

1.1 Aims of the Study

The aims of the project include:

1) To produce ethanol from plantain fruit.
2) To characterize the ethanol produced.

1.2 Scope

This report is limited to the production of ethanol from plantain. It also focuses on its characterization and is compared with standard ethanol.

1.3 Justification

Fossils, the source of most of the world energy is depleting. by the day. This poses serious danger to the economy which relies heavily on the availability of energy to power industries, transportation and space heating and cooling. The environment is daily polluted by compounds related to fossil fuels as they are produce or used. The need to seek alternative source of energy to conventional fossil fuel justifies this project.

The use of plantain is due to the availability of simple sugar in its tissue, their soft texture which makes them easily biodegradable and since they are plant crop, they can be renewed.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Renewable Energy

Renewable energy has contributed greatly to global supplies for millennia and a number of these technologies may continue to make significant contributions in the future. These include hydro power, wind, biomass and solar energy. Biomass has historically contributed the most to global energy supplies.

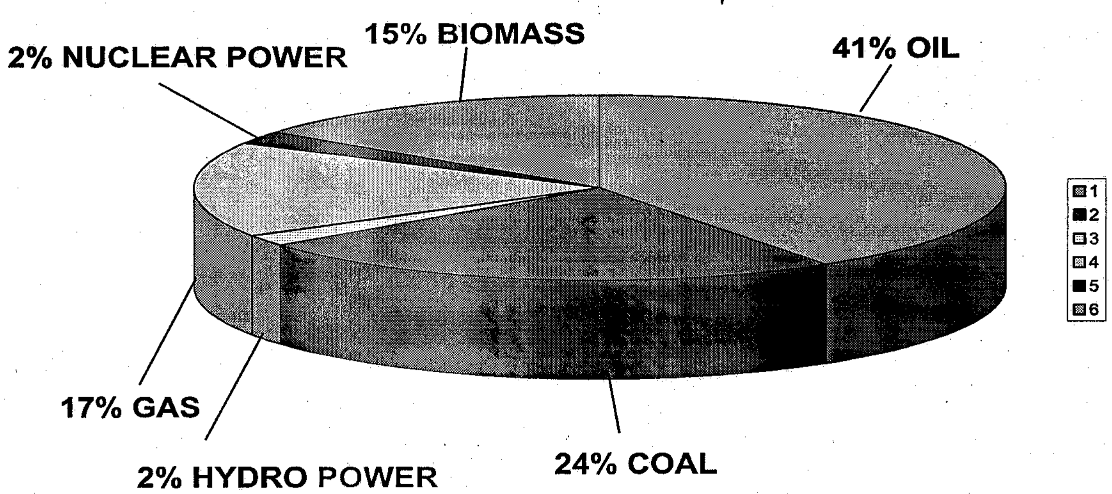


Fig. 2.1 A PIE CHART SHOWING THE PERCENTAGE OF GLOBAL ENERGY SHARES

2.2 Biofuels.

The growing of trees and plants for direct use as fuel or for subsequent processing to provide energy in a more useful form is not new. These were in common use before man turned to more convenient fossil fuel. They still provide about 15% of world energy supply, although their use is not well documented because they are not classified as commercial and are used mainly in poor rural areas of third world countries. However, potentials for biofuels are of increasing interest and involves more complex route than the simple growing and burning of timber. The conversion of residue and refuse like animal waste as well as specially grow crops into gaseous and liquid fuels has feature prominently as have aspect of their subsequent utilization

2.3 Potentials of Biofuels

Many third world countries are faced with energy crises because their energy supplies depend on increasingly expensive imported oil.

With any increase in oil price, their progress in economic development is severely affected.

Also, the effect of the use of these fuels over time manifested in the forms of oil pollution, spillage, and formation of grand level ozone of oil depletion compounds during the process of exploitation, production and use. Environmental issues especially from the use of fuel have become a world critical issue. The world is thus in search of clean fuel which will eliminate the problems associated with gasoline and fossil fuels. Bio-fuels offers very good qualities that make them an interesting substitute for convectional fuels and in particular, as potential fuels (Twidell, 1981).

2.4 Biofuel Conversion

Agriculture residues could be burned directly to supply heat. Biomass could also be converted to synthetic gas and charcoal by pyrolysis at high temperature which can be burnt to produce mechanical or electrical energy.

Biomass could also be converted to methane biologically at normal temperature. Also, agricultural residues have being found to be readily digestible, giving high yield of methane and good overall efficiency of energy. This process converts carbon in the biomass to gas and leaves the nitrogen and other minerals in the form suitable for re-application to the land as fertilizers.

Liquid fuels like methanol and ethanol could also be produced from agricultural waste and specially grown crops. (Twidell, 1981)

Table 2.1 Common biomass feedstock for biofuels production

Agricultural based	Forest products	Urban Waste	Dedicated energy crops
Harvest residual	Logging residual	Residential	Grasses
Wheat straw	Gill tree	Refuse derived fuel	Switch grasses
Rice straw	Tops	Mixed paper	Native grasses
Flax straw	Dead woods	Yard waste	Tree
Corn Stover	Small diameter stock	Demolution wood waste	Willow
Processing residual	Primary processing residual	Rail road ties	Cotton wool
Potato waste	Saw dust		Hybrid popular

Source (Anyakora, 2006)

2.5 Ethanol

Ethanol is an organic compound belonging to the group, alcohol and is the second member of the series. It is a colourless liquid with a limpid taste and pungent odour. When in high concentration, it is none corrosive but its pure form readily attacked rubber and plastic material and so cannot be used in unmodified engine. It is called by many names which include ethyl alcohol, grain alcohol, industrial alcohol, fermentation alcohol, cologne spirit, ethyl hydroxide, methyl carbinol, alcohol.

Ethanol could be produced from any biological feed stock that contain simple sugar or any material that can be converted to sugar. Because it can be produced from crop materials, they are classified as renewable fuels.

2.5.1 Physical properties of ethanol

Ethanol is a colourless, limpid and volatile liquid which is highly flammable and toxic and has a pungent taste. Other properties are given in the table below;

Table 2.2 Physical properties of ethanol

Properties	Ethanol
Molecular formula	C_2H_5OH
Condensed formula	CH_3CH_2OH
Boiling point temperature	78.5°C
Melting point temperature	-114.1°C
Density at 20°C	$0.785g/cm^2$
Viscosity at 20°	1.17 centipoises
Flash point temperature	14° centigrade
Solubility	Soluble in water and most organic solvent

2.5.2 Chemical properties of ethanol

i. Ethanol burns readily in air with an almost colourless flame producing carbon dioxide and water. $C_2H_5OH + 3O_2 \rightarrow 3H_2O + 2CO_2$

ii. Acidified potassiumm heptaoxodichromate (vi) oxidizes ethanol to ethanol (acetylene CH_3CHO). A molecule of water is eliminated from the CH_2OH group during the reaction $CH_3CH_2OH + [O] \rightarrow CH_3CHO + H_2O$

When further oxidizes with excess heptaoxodichromate (vi) solution, ethanol will give ethanoic acid. $CH_3CHO + [O] \rightarrow CH_3COOH$

iii. Sodium metal reacts with ethanol with effervescence to produce sodium ethoxide liberating hydrogen. The hydrogen atom of the hydroxyl radical is replaced by a sodium atom. $2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$

iv. Concentrated tetraoxosulphate (vi) acid react with ethanol to produce an oily liquid, ethyl hydrogen tetraoxosulphate (vi). The ethyl hydrogen tetraoxosulphate (vi) reacts with the excess acid to produce ethanol $2C_2H_5HSO_4 \rightarrow C_2H_4 + H_2SO_4$

If this reaction is performed with excess ethanol, a different compound ethoxyethane (diethyl ether) is produced. $2C_2H_5OH + H_2SO_4 \rightarrow c_2H_5OC_2H_5 + H_2SO_4$

In both reactions, tetraoxosulphate (vi) acid acts as a dehydrating agent

v. Ethanol reacts with iodine in alkaline solution to give yellow crystals of triiodomethane, CHI_3 or iodofoam. The first step of the reaction had been the oxidation of ethanol to ethanal. $CH_3CH_2OH + [O] \rightarrow CH_3\ C - H + H_2O$

2.6 The Production of Ethanol

Ethanol is a commercial product and is produced by chemical and biological means. The chemical methods for the synthetic of ethanol are;

2.6.1 Catalyst hydration of ethylene (ethene)

The ethane produced from the cracking of petroleum or natural gas is treated with water at high temperature of 500°C to 600°C, and high pressure of 500atm to 1000atm in the pressure of acidic catalyst (K_2O_4) to produce ethyl alcohol.

2.6.2 Sulphuric acid hydration of ethylene

Ethene is treated with 95% sulphuric acid at 80°C and 30atm to produce diethyl sulphate then hydrolyses to ethyl-alcohol acid dilute H_2SO_4

$C_2H_4 + H_2SO_4 - C_2H_5HSO_4$

$C_2H_5HSO_4 + H_2O - C_2H_5OH + H_2SO_4$

2.6.3 Fischere – Tropsch process

Ethanol is a major by product in the synthesis of methanol by the reaction of carbon monoxide and hydrogen over iron catalyst.

2.6.4 Production of ethanol by biological process

Ethanol production from ethylene provides the cheapest method of production but the relative availability of biological materials and its apparent ease of conversion have led to the acceptance of the biological method of ethanol production. This utilizes the process called fermentation. Ethanol is the chemical produced in the largest volume by industrial fermentation. Hexose sugar in biomass material is broken down by yeast according to the overall reaction

$C_6H_{12}O_6 - 2C_2H_5OH + 2CO_2$

The basic step in the fermentation process is where specific enzymes facilitate the anaerobic conversion of the simple sugar (glucose, fructose) to ethanol with accompanying evolution of heat and carbon dioxide. The reaction above is common to all biomass and it is facilitated by the enzymes, diastase, which is mostly produce by yeast and it usually acts on sugar substrate.

Fermentation has been described as the biological reaction mechanism for extracting energy under anaerobic conditions (Ollis and Bailey, 1977).

Yeast is traditionally associated with the production of ethanol. The species saccharomyces and kluyveromyces' families are particularly important. The environment for ethanol production is usually strain dependent. An environment that promotes the growth of yeast or microorganisms usually encourages the production of ethanol.

When simple sugar, the basic substrate for ethanol production is above a concentration of 10 % (wt/vol), strain growth is greatly limited and at 20 percent, for ethanol production.

Zymomonas mobilis has been found to highly tolerant of sugar concentration. It produces up to 10 percent ethanol (wt/vol) from 25 percent glucose medium. Saccharomyces and schizosaccharomyces however, have high ethanol tolerance. (Atkinson and Marituna, 1999).

Yeast also needs some substance which will help them in their growth and hence encourage the production of ethanol. Nitrogen makes up about 10 % of yeast and it's a very important constituent of any growth medium. It may be supplied as ammonium salt. Phosphorous provide phosphate, an ionic factor which determine the rate of fermentation. Although, ethanol is produced in an anaerobic process, oxygen is required at low level for the synthesis of ergo sterol and it is necessary for the synthesis of unsaturated fatty acid.

Optimum pH for the growth of yeast ranges between 2.8 and 8.6. However, ethanol production requires a pH of 4.5

The mesophilic strains of saccharomyces have an optimum temperature range of growth of 28 to 35°C. For thermophilic yeast, it is 40°C. Ethanol is generally produced by fermentation at low temperatures.

2.7 Ethanol Grade

Ethanol that is produced is usually concentrated to different degrees for different commercial purposes. This is done by dehydrating water from their mixture ethanol to obtain the required grade.

2.7.1 Absolute ethanol

Ethanol with high degree of purity is frequent requires in preparative organic chemistry and a concentration of 99.5% purity satisfies most of this purposes. The concentration is obtained by the dehydration of rectified spirit using calcium oxide.

2.7.2 Rectified spirit:

These results from the azeotrope which, ethanol form with water at 95.5% by weight. At this stage, the water can not be removed from ethanol by distillation.

2.7.3 Denatured ethanol:

This is the alcohol that has been denatured by the incorporation of certain toxic additives, e.g. methanol to render it unfit for consumption. It can also be prepared by heating ethanol above the temperature that allows its fermentors (enzymes) to survive. This ethanol constitute the industrial spirit (industrial methylated spirit) which is a suitable solvent for recrystallization.

2.8 Plantain, Musa Paradisiaca

2.8.1 Background

Plantain, Musa paradisiaca, is a perennial crop grown in tropical and subtropical region of the world. Believe to have originated from the Malayans; it is a class of the fruit BANANA (Musa specie) which grows from an underground corm that contains buds. It is of the AAB genomic constitution, a natural interspecific hybridization between the wild specie, M. acuminate, which provides the genome A and M, balbisiana with B (Sutherland 1972).

Plantain fruit is typically yellow when ripe with a slender and angular pointed shape. It is starchy at maturity with an unpalatable raw taste. A test with iodine produces an intense blue colour indicating the presence of simple sugar.

Energy derivable from 100gram edible potion is about 90calories. It is mostly planted in backyards and fields with other food crops.

The average materials composition in 100gram edible portion plantain is produced in the table below.

Table 2.3 Composition of materials in plantain

Main food stuff	Percentage composition
Water	75
Carbohydrate	21
Fat, protein, ash	1
Fiber	3

(King, 1998)

2.8.2 Crop climate relation

The production of plantain is mostly in Africa. About two-third of plantain produced in the World is in tropical Africa.

Plantains are grown in wet, wets and dry and cool tropics. The main determinants of their distribution are rain fall in excess of 1250mm per year (Stovers and Simmonds, 1987). Purseglove 1972 cites 2000 – 2500mm and mean temperature above 15.5°C. They are grown mostly in the lowland wet tropics as seen from the distribution of plantain with 7° of the equator in central and West Africa. They sometimes occupy more than 50% of the cropped land in the wet and dry tropics Western Tanzania (Malima, 1976)

2.8.3 Soil physical properties

The only soil factor common to wide range soils on which plantain is grown is good drainage. And this depends on a favorable soil structure and pore size distribution which is essential for soil aeration. Texturally, the soil varies greatly from coarse to fine volcanic materials (andisols) through sand and loam within various orders, to clays ,within others that include inseptisols, oxisols and vertisols.

2.8.4 Place in cropping system

The cropping system under which plantain are grown may be broadly divided into two groups.

i. Commercial plantations. This involves the production of plantain on a medium (10 – 100ha) or large (100 ha) scale, usually for export to nations with advance economies.

ii. Small scale production. This is of a range of types for subsistence or local marketing.

Plantain (AAB) is the major component in central and West Africa. Both AAA and ABB types are important in East Africa. Plantain is also important in Columbia and Venezuela (Burden and Coursey, 1977).

Plantain is an everywhere crop in the better watered area of the tropics. The reasons for their popularity are summarized by (Rutherberg, 1980) who pointed out that they combine many of the advantage of both annual and perennial crops.

1. Land clearance and cultivation input is low and the latter is well spread through the year.
2. Fruit is produced within a year of planting.
3. Except for markedly sectional climates, fruit is harvestable for most month of the year.
4. Gross return per unit area, whether in money or food energy is high.
5. The crop has many end uses. Fresh and cooked food for humans, feed for livestock, beer, roofing materials, e.t.c.
6. It returns substantial quantities of organic matter to the soil and protects slope against serious erosion.
7. It responds well to fertilizer and animal ,manure (Norman et al, 1996)

2.8.5 Economic importance and distribution

Banana and plantain are the most important fruit in world commerce and are probably the best known tropical fruit. Africa is the major producer of plantain for local consumption, followed by India, Malaysia, Taiwan and the Philippines,.Honduras, Costa Rica and Panama are leading producers for export. (Rice et al, 1986)

Plantain is an important fruit for local consumption in Africa and is grown through out most of the continent. Most villages have several clumps of plantain often growing in refuse disposal areas where they benefit from decaying organic matter. Generally, plantains are not cared for and grow in large, low yielding dumps. In some areas, plantains are an important small holder crop. Some plantains are grown for export in western and southern Africa. (Rice et al, 19860)

CHAPTER THREE

3.0 EXPERIMENTAL PROCEDURES

Table 3.1 List of equipment

NAME	MODEL/MANUFACTURE
Digital weigh balance	CT 1200/OHAUS
Water bath	SEA 105/CLIFTON
Rotary evaporator	
pH meter	3017/JEN WAY
Blender	
Viscometer	Cannon fenske
Thermometer	Sedim
Refrigerator	Thermo cool

3.1 Sugar Test

To know the viability of the use of plantain as a material for ethanol production, it was essential to determine the amount of sugar that is available for conversion.

DNS (dinitrosulicyclic) test was carried out to determine the amount of aldehyde form of sugar present.

The fleshy part of the plantain was sliced and dried in an oven and was weigh after every 5 minutes. When constant weight of the samples was obtained, 2ml of the sample was collected and dissolved in 0.5ml of water. 2ml of DNS was added to the sample and the sample, was thoroughly mixed.

Standard samples of known umoles of glucose/fructose of crude sugar were collected and diluted to 2.5ml of solution. 2ml of DNS were added and the samples were also mixed. ALL samples were heated in boiling water, 100° C for 5 minutes. The sample were cooled in a water bath The measurement of absorbance for each sample in a spectronic 20 or Eel 540mn, zeroing with tube one.

Results were obtained and a calibration curve plotted.

3.2 Production of Ethanol Procedure

The procedure for the production of ethanol is described in their stages namely,

i. Plantain mashing

ii. Fermentation

iii. Distillation

3.2.1 Plantain mashing:

This is the stage where the sugar contained in the plantain is exposed from the sugar bearing tissues. 5 ripe fruits of plantain were peeled with a kitchen knife to remove the outer skin. The fleshy (edible) part was then homogenized using a blender into a soft meal. 125g of the meal was soaked in 250g of water ands allowed to stand for 6 hours to dissolve the sugar content. The mixture was screened using a filter cloth to separate the solution from the undissolved fibrous portions.

3.2.2 Fermentation:

The filtrate, sugar solution was collected and poured into a conical flask. The filtrate was cooled to about 12°C and the pH set at 4.5 using calcium hydroxide ($Ca(OH)_2$). 7g of bakers yeast was added and the solution allowed to stand for 4 days at room temperature

3.2.3 Distillation:

Distillation was carried out to first separate the liquid from the spent materials and then to concentrate the alcohol produced. The apparatus used for this experiment consist of a round bottom flask containing the fermented dirt, and a receiver flask which were connected to the rotary evaporation. The flask with the wort stood on a water bath.

A reflux condenser in the rotary evaporator is attached to a tap and fixed to the rotary evaporator at the topside. Water is collected at the bottom through the hoses so that water enters the upper level and leaves through the tube at lower level thus, ensuring that the condenser is always filled with water to continuously cooling the system.

The wort was heated to 85°C and the distillate received was collected in the receiver flask.

3.3 Characterization Procedure

3.3.1 Viscosity

The fenskey viscometer was used to determine the viscosity of the sample. Some quantity of ethanol sample was put in the viscometer so that it just coincides with the upper mark level.

The time taken for the meniscus of the sample to fall from the upper meniscus of the bulb was noted and the viscosity was calculated as shown in the appendix.

3.3.2 Relative density (R.D)

This was measured using the pignomiter. The pignometer was washed and dried. The weight of equal volume of the sample and water all at 26C were measured and the relative density was calculated by the equation as shown

$$R.D = \frac{\text{mass of sample}}{\text{Mass of equal volume of water}}$$

3.3.3 Boiling point

A boiler in which a thermometer was inserted was used. The ethanol sample was put in the boiler and placed on a heating mantle. The heating mantle was put on and the sample monitored until the ethanol began to boil. The temperature reading was read from the thermometer. The temperature reading was recorded.

CHAPTER FOUR

4.0 Results and Discussion

4.1 Results

The results for the production of the ethanol after 4 days fermentation period are summarized here. The quantity of materials used is given in the table below

Table 4.1 Quantity of materials used

Materials	Quantity
Plantain fruit	
For DNS test	20g
For Fermentation	250g
Water	0.5 liters
Yeast	7.0g
Calcium Hydroxide	60g

The sample analysis are given in the following tables

Table 4.2 pH and temperature observation for fermentation

Parameters	Observed	Expected
pH	4.4 – 4.8	4.5
Temperature	13 – 15	12

Table 4.3 DNS test results obtained

Standard glucose + fructose	Eel rendering	Mole sugar present
0.00	0.00	0.00
0.40	0.20	2 mole g 2 mole F
0.80	0.44	4 mole G 4 mole F
1.20	0.67	6 mole G 6 mole F
Plantain mixture	0.38	

Table 4.4 Ethanol concentration determination results

Mass of ethanol	Mass of 100ml mixture	%wt of ethanol
0	100.0	0.00
5	99.0	5.10
10	97.8	10.30
15	96.2	15.60
20	95.0	21.10
30	92.0	32.60

Table 4.5 Sample characterization observation

Experiment	Experimental value	Standard volume ethanol	Gasoline
Relative density	0.95	0.79	0.59
Viscosity at 25°C	1.36 centipoises	1.17 centipoises	0.503 centipoises
Concentration(%)	17.8 %	99.5%	99.9%

4.2 Discussions and Results

In accessing the importance of plantain in the production of ethanol, 6g of the material was obtained after drying. From the test, 0.39 absorbance was measured which corresponds with a umole glucose/fructose of 0.68 and this reveal 61.2 percent (wt) of sugar present.

The filtrate of plantain was observed to be acidic. Fermentation was carried out for 4 days and the product was ready for distillation.

Distillation was carried out. The condensate obtain was a clear liquid and has a pungent taste. It was observed to be richer in ethanol than the initial starting material and residue in the flask. The relative density of the condensate was 0.95 as measured with a pignometer. 100ml of the distillate weighed 95.51g and this correspond to a concentration of 17.8%

In accessing the fuel potential of ethanol, basic fuel test results shows slight deviation from literature. The boiling point temperature was 83°C as against that from literature which is 78°C.The concentration difference could have resulted in this deviation.

The relative density of the sample at 25°C was obtained to be 0.95 which deviate little from the literature value of 0.799 at 25°C. The difference is accounted for by the concentration of the sample. The viscosity of the sample was found to be 1.36 centipoises at 25.5°C as against the standard of 1.20 centipoises at 20°C. The difference is attributed to the variation in the temperature. The experiment was conducted at 25°C while that of literature is at 20°C.

Minimum energy was use in the production of ethanol from plantain. Except for the energy used for distillation, virtually all other activity was done at normal temperature. This shows the soft texture nature of plantain and the ease with which its material is biodegraded.

The time it took for the material to ferment supports the economics of the process. 4 days of fermentation is a fast reaction period. Continuous production technique can thus be employed.

At the end of the experiment, values obtained in the characterization compare favorably with that of literature. The deviations are as a result of the low concentration of the sample. This shows the reliability of the result and the method employed in carrying out the experiment. However, the concentration of 17.8% ethanol cannot give good performance result in engines and should not be used.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The project was successfully carried out as the aims and objective were achieved. At the end of the experiment, the yield of ethanol shows that plantain is actually a material for ethanol production and the comparison of the characterization values are favorably disposed to that from standard ethanol. This indicates the reliability of the whole experimental effort and also agrees with the potentials of plantain as a reliable source of biofuels.

5.2 Recommendation

In view of experiment carried out in the production of biofuel from plantain, the following recommendations are made;

i. If the sample is to be used in automobile engines, high concentration i.e. purer ethanol should be prepared and octane rating test should be carried out in subsequent research work, since octane rating is a very important characteristic of fuel. However, for the sample, the value was not determined as the facilities to carry out the test were not available.

ii. The experiment should be carried out at different conditions of temperature and pressure to obtain the optimum condition that gives the best yield of the ethanol.

iii. The use of bakers yeast should be avoided if possible. Specially formulated brewers yeast is well suited for ethanol production since they can survive well in higher concentration of the compound during fermentation and should be integrated into the production programme.

iv. The economics of the experiment can be improved by making use of the peels or the stock of the plantain tree. These materials are recommended for future researches.

v. Production of other biofuels such as methane gas, methanol, oil, e.t.c should be performed and compared with that of ethanol to check the most valuable product obtainable.

APPENDIX

The viscosity value of the ethanol sample as determined from the experiment using the cannon fenske viscometer was calculated according to the equation below

Viscosity = stokes constant for viscometer × time of travel of sample

Time of travel =17 seconds

Stokes constant for the viscometer = 0.08

Viscosity = 17×0.08

= 1.36 centipoises

The percentage wt of sugar in plantain expressed as %wt of crude cane sugar per liter of solution is calculated according to the equation

$$\%wt = \frac{\text{mass of sugar in sample}}{\text{Mass of standard crude sugar in equal vol}}$$

Mass per liter of standard crude sugar = 2g

Sugar sample =0.68 umole per ml

Mass of sugar =0.68umole × 180ug per umol

100000ug = 1g

1000ml = 1liter

122.4ug	1g	1000ml	= 122.4ug/l
Ml	100000ug	1liter	

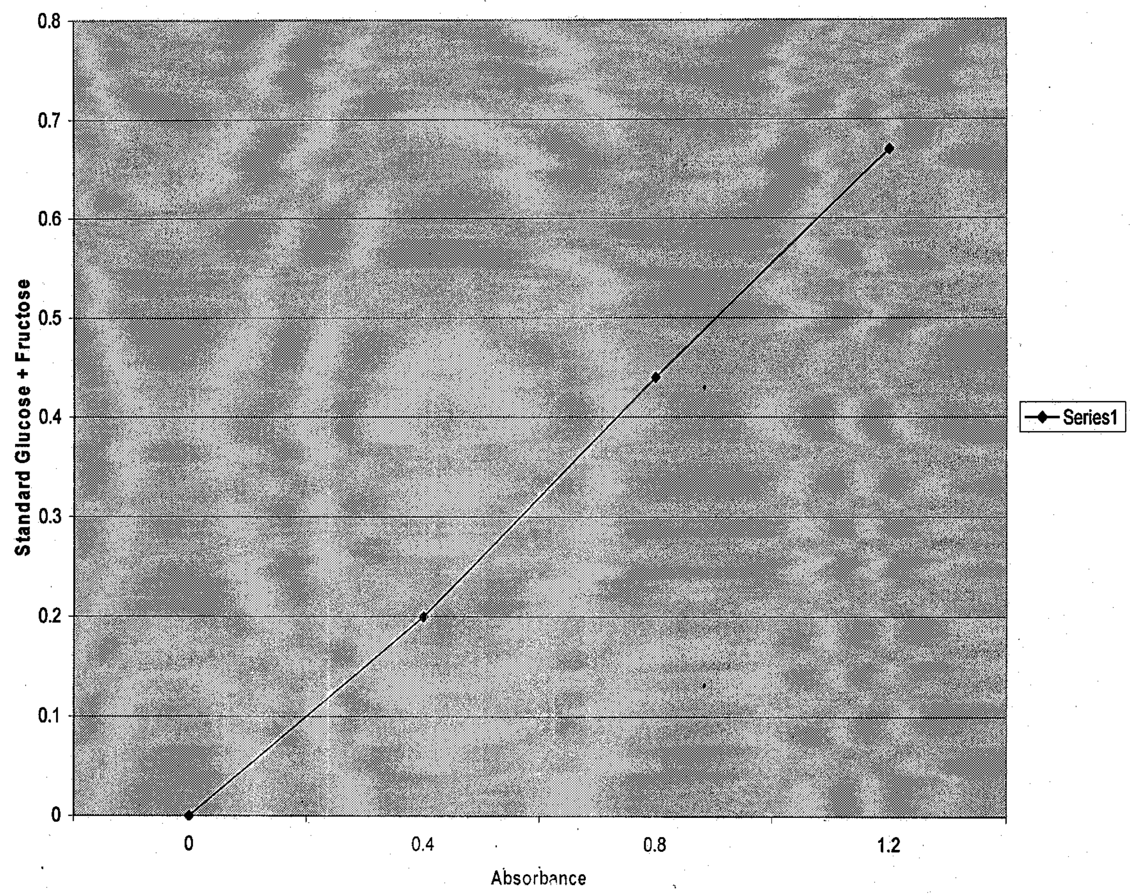
$$\%wt = \frac{1.224}{2} \times 100 = 61.2\%$$

The concentration of the sample as determined from the experiment was calculated according to the expression

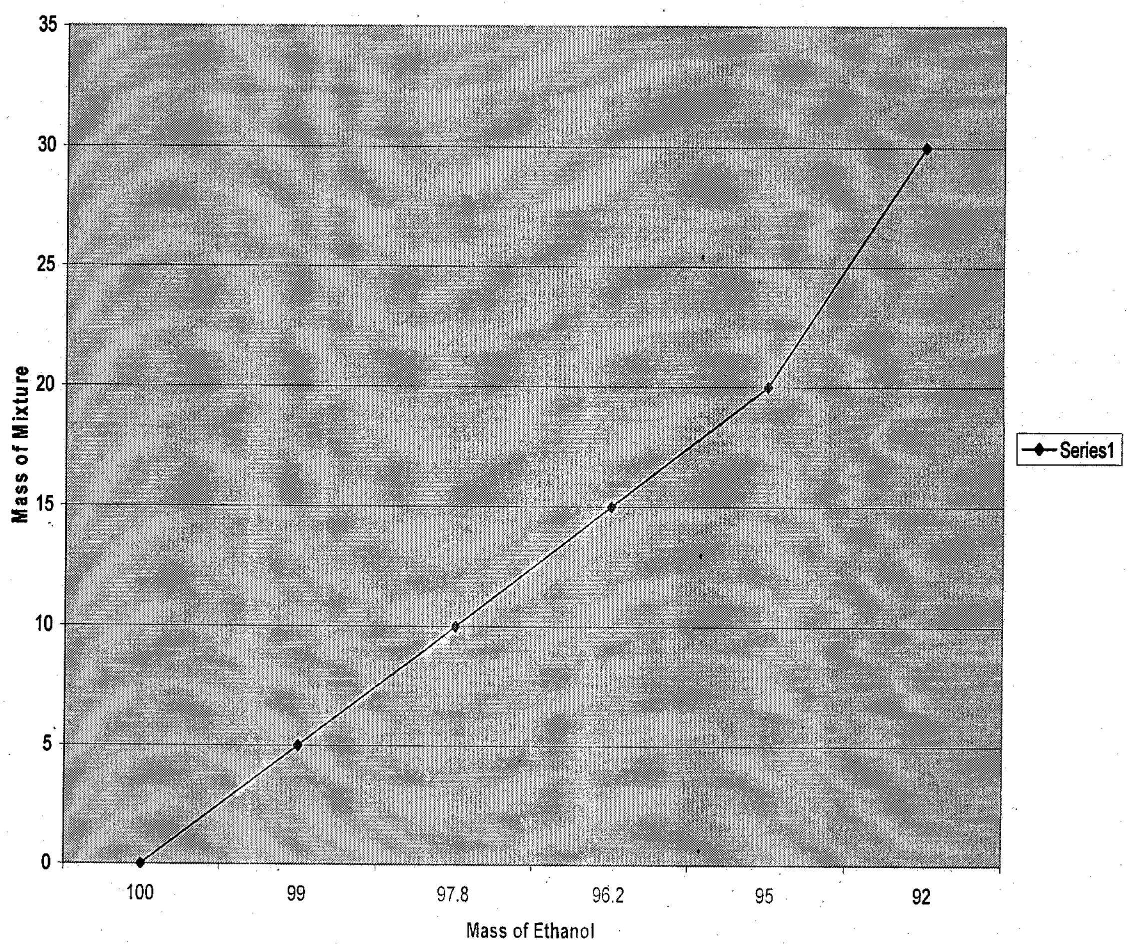
$$\text{Concentration } \% = \frac{\text{mass of ethanol in pignometer}}{\text{Mass of 100ml of the sample}} \times 100$$

From the plot of the mass of 100ml mixture against mass of ethanol, the mass of the mixture which was gotten as 95.7g corresponds with 17g ethanol.

Hence, % conc.= $\frac{17g}{95.5} \times 100 = 17.8\%$



A Graph of Standard Glucose + Fructose Against Absorbance



A Graph of Mass of Mixture against Mass of Ethanol

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CERTIFICATION

This research project by Ameh Igoche Emmanuel (2001/11481EH) has been examined and certified under the supervision of Engr. Uthman Habib to be adequate in scope and quality for the partial fulfillment of the requirement for the award of Bachelor of Engineering (B-Eng) in Chemical Engineering

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Engr. Uthman Habib — Date

Project Supervisor

....

Dr. M.O. Edoga — Date

(Head of Department)

....

External Examiner

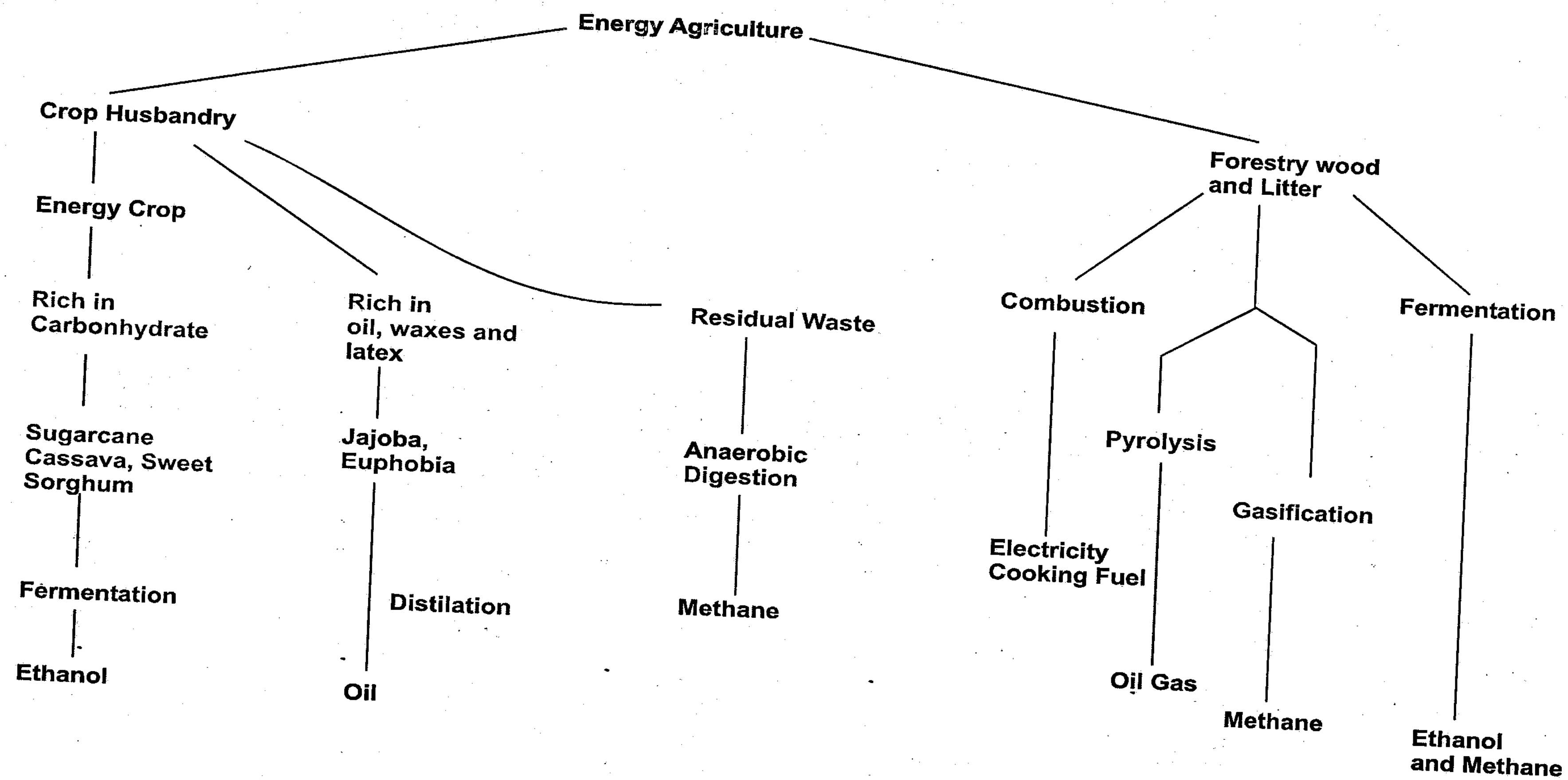

Fig.2 Energy Agriculture: the Processes through which bio fuel can be obtained (Voce, and Blixt, 1984)

LIST OF TABLES

CHAPTER ONE

1.0 INTRODUCTION

No one seek energy for its own sake. Individual nations used energy primary for industries, transportation and space heating and cooling in buildings. Useful energy is sort from several primary energy forms, fossil, nuclear and renewable. The most used energy form is fossil (petroleum, gas, coal) contributing about 80 percent for consumption .their discovery was thought to be the solution to the complex energy problem.

However, the cumulative effect of the use of the fuel over time manifested in the form of oil, pollution, spillage and explosion, formation of ground level ozone depletion compounds from gas flaring and the combustion of hydrocarbon fuel. Also, the conventional fossil fuel is getting depleted by the day since they can not be renewed. The world is this forced to seek alternatives source of energy that would encompass these setback. And this search has being in the direction of biofuels.

The growing of trees and plants for direct use as fuel or for subsequent processing to provide energy in a more useful form is not new. These were in use before man turned to conventional fossil fuel. It provides about 15 percent world energy supplies and usually in the poor rural areas of third world countries. However, their potentials as fuel is gaining interest again and involve more complex route than the simple growing and burning of trees. The conversion of residues and refuse, like animal waste and specially grown crops, into gaseous and liquid fuels has featured prominently as have aspect of their subsequent utilization.

Ethanol, a biofuel, belongs to the group alcohol and is composed of carbon hydrogen and oxygen atoms connected by bonds that contain energy stored during their formation. They are remarkably similar to gasoline despite their different chemical classes. They can be produced synthetically but are mostly, by fermentation of crop materials using enzymes mostly yeast as catalyst in an anaerobic environment. Its use as an energy source is of particular interest as it has very important advantages, when used as an alternative to fossil fuel. It can be renewed since it is produced from renewable crops materials. It possesses physicochemical properties such as high octane number, low volatility, high oxygen content and low toxicity and photo reactivity. Its production from plantain is very significant even for

ACKNOWLEDGEMENT

My heart is filled with gratitude to Almighty God who has given me the life and made it possible for me to have an education.

I seize this opportunity to express my profound gratitude tio my supervisor, Engr. Adeniyi and Engr. Habib who ensured the successful completion of this project, May God continue to bless you.

I will at this point like to specially acknowledge the H.O.D of chemical Engineetign Department Dr. M.O. Edoga and the entire members of staff of the department for their immeasurable contribution to my academic pursuit.

I love you mum and dad, Your full support and relentless prayers has always kept me going. I thank you sister Esther and Anna and my niece Franca my special thanks goes to my uncle, Mr. Anebi Ocheme, you are a pillar of support and to your wife.

This report will not be complete without acknowledging Mallam Dauda and Mallam Diko for their immense contribution to this project.

Lastly I want to appreciate my friends Akala, Francis, Ogbar, Victor, uyiwa and my entire course mate, we will meet at the top.

ABSTARCT

The importance of biofuel as a source of energy had been widely acknowledged. Even before convectional fuel become popular, man from historical time had directly used plant materials as a source of energy. They are again gaining interest as they are seen as a good alternative to convectional fuel, which has possed serious health problem to man and his environment. From the point of availability, the convectional fuels are getting depleted as they are non-renewable. This research work is an overview into the experiment carried out to produce biofuel from plantain. Experimental result gave the presence of simple sugar to be 61.2%. Ethanol was produced with a concentration of 17.8%. Characterization results obtained showed that the viscosity and the relative density of the sample are 1.36 centipoises and 0.95 respectively. Results are favourable when compared with those of gasoline. Subsequent research should make use of plantain peels and other less useful part of plantain.