Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2016; 5(6): 43-47
Received: 07-09-2016
Accepted: 08-10-2016

Mbonu OF
Department of Science Laboratory Technology, Akanu Ibiam Federal Polytechnic, Unwana, Afikpo

Udeozor PA
Dpt of Chemical Sciences, Evangel University, Akeze, Ebonyi State

Umoru GU
Dpt of Chemical Sciences, Evangel University, Akeze, Ebonyi State

Uti DE
Dpt of Chemical Sciences, Evangel University, Akeze, Ebonyi State

Correspondence
Mbonu OF
Department of Science Laboratory Technology, Akanu Ibiam Federal Polytechnic, Unwana, Afikpo

Production of Bio-fuel from sweet corn (food to fuel)

Mbonu OF, Udeozor PA, Umoru GU and Uti DE

Abstract

From this work, it is evident that there is much money lying around the waste both Agriculturally and Chemically, only when we realize this and tap from our Locally available Food stuffs, that we can appreciate this fact.

This research carried out on the production of bio-ethanol as bio-fuel from Sweet corn was successively completed and the bio-ethanol was produced using simple distillation apparatus and was properly analyzed.

The Sweet corn was hydrolyzed for 72 hours. Fermentation took about 96 hours (4 days). The weight of sample (sweet corn) used for the production was 885g. This large amount of corn sample used was to ensure that an appreciable quantity of ethanol was distilled. The mass of yeast (*saccharomyces cerevisae*) used was 52.2g. This large amount of yeast used was to help facilitate the rate of fermentation of the corn sample. The percentage of ethanol produced is 11.8%. This low yield of ethanol from corn shows that corn has a lower quantity of ethanol when compared to other locally available raw materials. Such as potatoes that have an ethanol percentage yield of 38 to 45%. The percentage purity of the alcohol produced was determined to be 96%. This result suggest that ethanol was of high purity when compared to others sold in the market that had the highest percentages purity of 98% and also to that from potato that has a parentage purity of 96%.

From the quality test of the alcohol, the temperature of the alcohol was 29 ^{o}C which is approximately to that of room temperature which is 27 ^{o}C. The p^{H} value was 9.2 indicating very low basicity.

Keywords: Bio-ethanol, Sweet Corn, Extraction, Alcohol, Bio-fuel.

Introduction

Maize (/ˈmeɪz/ *MAYZ*; *Zea mays*. *mays*, from Spanish: known in some English-speaking countries as corn, is a large grain plant domesticated by indigenous peoples in Mesoamerica in prehistoric times.

The leafy stalk produces ears which contain the grain, which are seeds called kernels. Maize kernels are often used in cooking as a starch. The six major types of maize are dent, flint, pod, popcorn, flour, and sweet.

Bioethanol is a form of quasi–renewable energy that can be produced from agricultural feedstocks. It can be made from very common crops such as corn, potatoes, cassava, sugar cane and rice. There has been considerable debate how useful bioethanol is in replacing gasoline food process due to the large amount of available land required for crops.

As well as the energy and pollution balance of the whole cycle of ethanol production especially from corn (Dudley, A.A *et al*, 2004) [4].

Ethanol is commonly referred to simply as alcohol or spirit; ethanol is also called ethyl alcohol and drinking alcohol. It is the principal type of alcohol found in alcoholic beverages produced by the fermentation of corn by yeast, it is a neurotoxin.

Psychoactive drug produced from alcohol is one of the oldest recreational drugs used by human which can cause alcohol intoxication when consumed in sufficient quality.

Alcohol is used as a solvent, as an antiseptic as a fuel and the active fluid in modern (post – mercury) thermometers. Alcohol is volatile, flammable, colorless liquid with the structural formula CH_3CH_2OH, often abbreviated as C_2H_5OH, C_2H_6O or EtoH and the general formula $C_nH_{2n+1}OH$.

This research work takes a critical look at the hydrolysis, fermentation, distillation and rectification process. (Arnett, E.M *et al*, 2000) [1]

A variety of sugar and starch containing local raw materials which could be used for the production of alcohol are: corn, potatoes, cassava, yam, plantain etc.

Fruit like oranges, grape etc could also be used for the production of alcoholic beverages but a large quality of these would be required to obtain a reasonable amount of sugar and these are usually not abundant in supply. Aspergillus – Oryzae organism, which produces enzymes for hydrolysis and yeast (for fermentation) could be cultured locally. Of course yam peeling and plantain peelings are considered as a by-product for alcohol production which was previously seen as a waste product. Raw materials like yam, cassava, rice plantain etc are going to be deleted for this purpose because apart from the fact that they are expensive they are also consumed in large quantities as a staple food for our growing population. Corn is going to be used because due to the extent that it is cheap and more readily available and for some other economic reasons, in which case, the cost – benefit ratios from research work are considered.

About N360 million is spent for the importation of barely yearly. The use of these local raw materials like Aspergillus orizae instead of malt plus the local cultural yeast help to conserve foreign exchange by minimizing importation costs.

Aims Of The Study

The main aim of this work is to produce Ethanol from starch and sugar as well as comparing the quality of the product with standard alcohol.

Objective Of The Study

The specific objective of this research is to produce ethanol locally from corn as well as to compare the quality with imported ethanol.

Brief Literature Review

The use of alcohol for fuel has a damaging impact on food markets, especially in developing countries like Nigeria. In the United States, alcohol is mostly made from yellow corn, and as the market boomed for alternative fuel, yellow corn went up in price. Many farmers saw the potential to make more money, and switched from white corn to yellow corn. White corn is main ingredient of tortillas in Mexico and as the supply dropped, the price doubled, making the base of most Mexican foods unaffordable.

Many people see this as unacceptable, and want no overlap between food crops and fuel crops. (Polasky, 2008) [12], others point out that the earth is thought to be able to support double the current human population and press that the resources available such as unused farmable land should be better handled (Thomas K. 2004) [3].

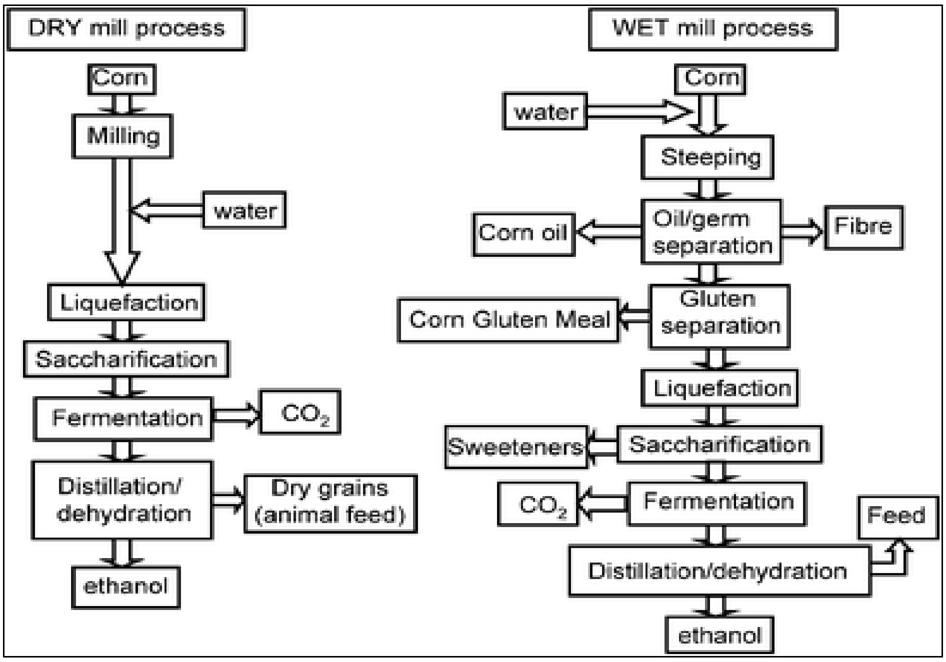
The renewable Fuel Association (RFA), the alcohol industry lobby groups claimed that alcohol production does increase the price of corn by increasing demand. Renewable Fuel Association claimed that alcohol production has positive economic effect for U.S farmers, but it does not elaborate on the effect of other populations like Nigerian where field corn is part of the staple diet. And Renewable Fuel Association lobby document states that “In January, 2007 statement, the USDA chief economist stated that farm program payment were expected to be reached by some of $6billion due to the higher value of a bused of corn.(Dudley A.A, 2004) [4]

Economic importance/Uses of Alcohol

Alcohol has a long history of several uses worldwide. It is found in alcoholic beverages sold to adult, as fuel, and also has many scientific medical and industrial uses. The term alcohol free is often used to describe a product that does not contain alcohol. Some consumer of some commercially prepared product may view alcohol as an undesirable ingredient, particularly in products intended for children.

- As alcoholic beverages
- As antifreeze
- As antiseptics
- As fuels
- As preservatives
- As solvents (Cao, W. *et al*, 2012) [15]

Simple Flow Chart For Processing Alcohol From Starch (Corn)



The Nigerian yellow Corn

Materials and Methods

Chemicals Used/Make

- Yeast
- corn
- Distilled water

Equipment Used/Model

- 1000ml beakers (2)
- 250ml volumetric flask
- Measuring Cylinder
- Thermometer
- Oven
- Gridding Machine
- Automatic weighing balance (make Gilbertini, Model Tm1600 Serial No 54992).
- Winchester bottle
- Simple distillation apparatus
- Hot plate – (Gallankamp England)
- Refractometer (Brand – karl kolb Germany)
- PH meter
- Spatular
- Stirrer
- Funnel
- Filter cloth (sieve)
- Autoclave

Methods

Sample Collection and Preparation

Sample Collection

The maize grains were brought form Eke Market in Afikpo North L.G.A Ebonyi State. The dried active yeast (Sacharomyces Cerevesiae) used for this project practical was obtained from the chemical room in chemistry Laboratory in the science laboratory department in Akanu Ibiam Federal Polytechnic Unwana Afikpo Ebonyi State.

Sample Preparation

Maltin:

Exactly 885g of dried maize grains were properly washed and steeped with distilled water over night. A thick jute bag was soaked in water and spread on a flat basket. The steeped maize grains were spread on it. It was kept on a cool area and the viable seeds sprouted after three (3) days at the room temperature of 27 °C. On the 5^{th} day the plumule and the radicals of the sprouted seed were removed and the seed were dried in an oven at the temperature of 60 °C for 3 hours. The malted maize grains were milled to powdery form using electric grinding machines. (Polasky, K.K. 2008) [12].

Mash or Mush

The mush was made by adding water to the corn meal and was kept warm. The much was transferred to a fermentation bottle with label and was sterilized by autoclaving at the temperature of 121 °C (249 °F) for 30 minutes after stylization it was allowed to cool. Then the sugar concentration, temperature and P^H meter reading of the fermentation mush were determined.

Activation of dried active yeast (*Saccharomyces Cerevisiae*)

Exactly 10g of D glucose was dissolved in 50ml of distilled water in a sterile conical flask. The temperature of the solution was raised to 35 °C.

Exactly 52.2g of active dried yeast was introduced into the warm solution. It was left for about 30 minutes for the activation of the yeast cells. (Fagiones, G.O. *et al*, 2008) [7]

Fermentation

At the process of fermentation, 52.2g of dried active yeast was added to the mash. With yeast, fermentation lasted for 4 days and without yeast fermentation lasted for 10 days which shows that yeast acted as a catalyst that fasting the rate of reaction process. The mash was ready to "run" once it stopped bubbling. The mash was converted into carbonic acid and alcohol. It was called "wash" or bear or sour mash. Piemnel, D.D. (2001) [11].

Distillation

After a couple of days, the fermented mixture was filtered, with the washing of the solid residue from filtration with water and the resulting filtrate (fermented mash), was then distilled. The distillation apparatus with antibumping granules was placed in the heating flat bottom flask to prevent bumping of the liquid. All the joint of the apparatus were greased and closed tightly to present the escape of vapors. The distillation was stopped at a temperature of 80 °C to collect as much of the condensate containing alcohol as possible and to reduce the of amount of water and other low volatile component in the condensate to temperature is above 96 °C would increase the amount of water 80 °C would increase the amount of water and low volume.

Component in the condensate or distilled was then collected in a collector.

After distillation the condensate is placed in a flat bottom flask and

Subjected to re-distillation. (Fagiones, G.O.*et al*, 2008) [7]

Results

The following results were obtained during the preliminary experiments carried out from grain (corn) starch at room temperature. And the percentage yield of the Bio-ethanol was calculated as shown below.

$$\therefore \%\ \text{yield} = \frac{\text{weight of sample (corn) used}}{\text{weight of distillate (ethanol)}}$$

Where:

Weight of sample (corn) used = 885g

Weight of beaker = 55.1g

Weight of distillate beaker = 129.72g

:. Weight of distillate = 129.72 – 55.1g

= 74.62g

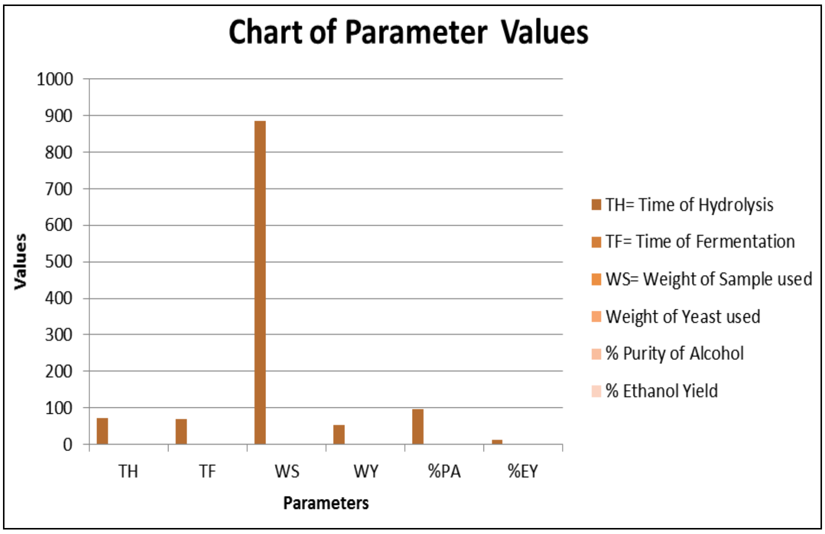
:. yield = <u>weight of sample (corn) used</u>

weight of distillate (ethanol)
% yield = 885

74.62
% yield = 11.86%

4.1 Table of Value

Parameters	Values
Sample used	African Sweet corn
Time of Hydrolysis (hr)	72
Time of fermentation (hr)	96
Weight of sample used (g)	885
Weight of yeast used (g)	52.2
% Purity of alcohol	96
% Ethanol yield	11.86



4.2 Specific Gravity

Weight of specific gravity bottle = 7.9g
Weight of specific gravity bottle + H_2O = 27.7g
Weight of specific gravity bottle = 23.6g

:. S.G of ethanol = weight of ethanol / weight of H_2O
S.G of ethanol = 23.6g / 27.7g
S.G of ethanol = 0.851
:. S.G of ethanol = 0.85

4.2: Table Of Value For Quantitative Test Of Alcohol

Parameters	Values
Temperature (^{o}C)	29
P^H	9.2
Refractive index	1.35
Specific gravity	0.85
Relative density	0.73
Boiling point (^{o}C)	783.7
Melting point (^{o}C)	1114^{o}C
State at 25^{o}C	Liquid
Colour	Colourless
Odour	Characteristics

Parameters	Standard Values (A)	Experimental (B)
Temperature (^{o}C)	27	29
P^H	9.20	7.30
Refractive index	1.40	1.35
Specific gravity	0.79	0.85
Relative density	0.80	0.73
Boiling point (^{o}C)	780-787	783.70
Melting point (^{o}C)	-1150	-1114
Colour	Colourless	Colourless

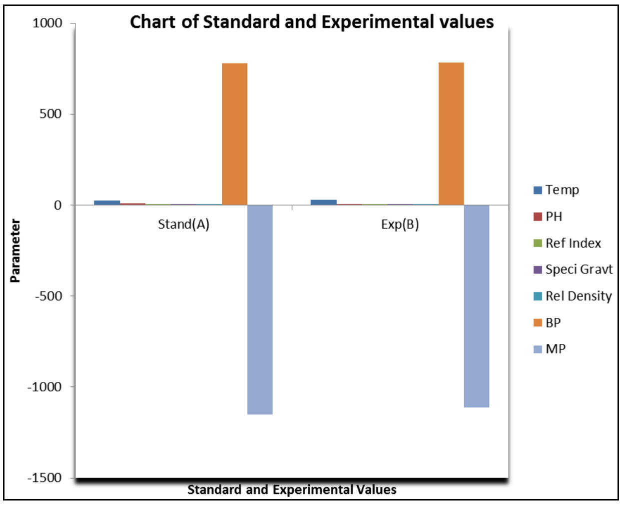


Chart of Standard and Experimental Values

Discussion

This research carried out on the production of bio-fuel from corn was successively completed and the bio-ethanol was produced using simple distillation apparatus and was properly analyzed.

The locally available raw material used is and corn which was hydrolyzed for 72 hours which is 3 days. The long period used was to totally convert all the starch present to maltose. The time for fermentation was 96 hours (4 days). This time was to totally convert all the glucose, fructose and sucrose into cellular energy and thereby to produce ethanol and carbon dioxide as metabolic waste product. The weight of sample (corn) used for the production was 885g. This large amount of corn sample used was to ensure that an appreciable quantity of ethanol was distilled. The mass of yeast (saccharomyces cerevisae) used was 52.2g. This large amount of yeast used was to help facilitate the rate of fermentation of the corn sample. The percentage of ethanol produced was determined to be

11.8%. This low yield of ethanol from corn shows that corn has a lower quality of ethanol when compared to other locally available raw materials. Such as potatoes that has an ethanol percentage yield of 38 to 45% though corn can also be used as a raw materials for ethanol production but is not economical due to its low percentage yield. The percentage purity of the alcohol produced was determined to be 96%. This result suggest that ethanol was of high purity even when compared to others sold in the market that had the highest percentages purity of 98% and also to that from potato that has a parentage purity of 96%. This result also makes the ethanol produced from corn to be of high quality.

From the qualities test of the alcohol and as shown in from graph, the temperature of the alcohol was 29 ºC which is approximately to that of room temperature which is 27 ºC. The pH value was 9.2. This shows that the ethanol is highly basic and can be used as an organic base. The alcohol has a refractive index of 1.35 which complete favorably with the refractive index of water which is 1.5. This result shows that, light or any radiation sources can be propagated through the medium very easily. The specific gravity of 0.85 suggests that water is 0.85 times heavier than alcohol. This result also shows that alcohol is miscible with the water. The boiling point was qualitatively determined to be 78.37 ºC. These results suggest that alcohol (ethanol) will boil at 78 ºC and it also shows that the alcohol is partially volatile. The melting point was also determined to be 114 ºC. The physical state at 25 ºC was liquid. This suggests that ethanol is liquid at 25 ºC that is at room temperature. The colour was also determined to be colourless. The colourless bio-ethanol produced indicated that it was of high purity. The ethanol was observed to have a characteristic odour which is choking when inhaled directly. This property makes the ethanol produced from corn to be of high quality bio-ethanol.

The results from this research work suggest that ethanol can be produced from a locally source materials (corn) which is of high quality and meets local and international market standards.

Conclusion

Conclusively, we can actually convert food to Fuel. Bio-fuels are hidden in some food substances we eat and thus, it is evident that there is much money lying around the waste both agriculturally and chemically, only when we realize this and tap from our locally available Food stuffs, that we can appreciate this fact.

References

1. Arnett EM, Velcatabramaniam KG. Thermo chemical acidities in the superbased system. J Org. Chem. 2000; 489(10):1569-1573.
2. Ballinger P, Long FA. Acid Ionization constant of Alcoholic. 11 Acidities of some substituted methods and Related complex 1,2. Journal of the American chemical society 2004; 82(4):795
3. Thomas K. Biofuels – solids, liquid or gas fuels made form biomass. Alternative – energy-News, 2004. info. Retrieved 2010/04/04.
4. Dudley AA, Robert AE. Ethanol fruit Repening and the Historical origins of Human Alcoholism in primate frugivory integrative comparative Biology 2004; 44(4):315-323.
5. Ethanol facts: Agricultural www.ethanol fa.org.12 January 2010. Retrieved 15/07/2016.
6. Forbed RJ. A short History of the art of distillation from the beginnings up to the death collier Blumenthal, Beill 2002; 57:89. ISBN 978- 90-04-00617-1. Retrieved 12 July, 2016.
7. Fagiones GO, Hill J, Tilman D, Polasky SA, Hwathrone, P. Land clearing and the Biofuel carbon Dept. sci 2008; 319(5867):1235-1238.
8. 18258862 Retrieved 12/07/2016. Originally published online in science express on 7 February 2008.
9. Friar IL. Organic Chemistry 1. 6th ed. Long man group Ltd. 2011, 176.
10. Graber AA, Cythia EA. Fact or Fiction: Animal like to Get Drunk" scientific American. Journal of American Chemical Society. 2008; 8(4):10-16.
11. Piemnel DD. CRC Handbook of Energy Utilization in Agriculture. Boca Raton: CRC Press. 2001; 22(14):20-26.
12. Polasky KK. The World Food Crisis in Perspective opinion, Alternative Fuels. Welcome mind in Motion. Journal of American Chemical Society. 2008; 82(4):555-559.
13. Maniatis K, Chiaramonti D, Thornley P. Framework and prepestives of industrial lignocellulosic ethanol development: Introduction to the 1st International Conference on Lignocellulosic Ethanol. Biomass & Bioenergy, 2012; 46:1-4.
14. Karagoz P, Rocha IV, Ozkan M, Angelidaki I. Alkaline peroxide pretreatmentof rapeseed straw for enhancing bioethanol production by Same Vessel Saccharification and Co-Fermentation. Bioresource Technology, 2012; 104:349-357.
15. Cao W, Sun C, Liu R, Yin R, Wu X. Comparison of the effects of five pre-treatment methods on enhancing the enzymatic digestibility and ethanol production from sweet soghum bagasse. Bioresource Technology, 2012; 111:215-221.
16. McFeeters RF, Thompson RL, Fleming HP. Liquid chromatography analysis of sugars, acids and ethanol in lactic acid vegetable fermentation. Journal of the Association of Official Analytical Chemists, 1984; 67:4.