Extraction of ethyl alcohol from the shells of anachishypogaea linn

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ABSTRACT

Ethanol or Ethyl Alcohol is another fuel with future potential to supplement, if not totally replace gasoline or diesel. Fermentation is the most common method of producing ethanol which is a process in which sugar is changed to alcohol by the action of yeast. Amidst the biggest challenge of the century - the climate change - many other energy sources are being considered for our future.

Extraction of ethyl alcohol from the shell of ***Anachis hypogaea Linn*** *is so important that alcohol is a possible food source (beverages), possible energy source (as a fuel) and a possible source of medical treatment (disinfecting material).In a country like ours, Ethyl alcohol from peanut shells can also be used to sustain the Philippine government legislation in 10% Ethanol in gasoline in support of the advocacy of the Climate Change Commission-reducing of Carbon emission.*

This study aims to prove that peanut shells can be a source of ethyl alcohol by means of simple extraction method.

The Iodoform test done sought to identify the kind of alcohol produced from peanut shells. The extracted material from such shells produced a yellow precipitate with antiseptic odor, a positive result indicating the presence of ethyl alcohol.

Keywords
Ethyl Alcohol, Hydrolyzate, Fermentation, Climate Change, Iodoform

Introduction

Background of the Study

July 2014 proved to be a challenging month for the researchers because it was the month when the team of Charmaine Etruiste of Shell eco –marathon Asia 2015 started her personal visits to various schools and universities. In behalf of Shells, Philippines, she said that their main objective is to increase the technical challenge and opportunities to discover and explore new fuel technologies. Shell's energy strategy is to grow their position as a competitive and innovative energy company. Through Shell Eco-marathon, more students would be more challenged to design, build and test ultra-energy-efficient vehicle. Obviously, the event intends to spearhead the future of mobility to inspire and motivate the upcoming engineers to push the boundaries of fuel efficiently in line with the mission and vision of the CDIO framework (Conceive, Design, Implement and Operate) of PASUC.

With these in mind, the researchers wanted initial findings on the possibility of using *Anachishypogaea Linn* as a source of ethyl alcohol to run a vehicle. With the tremendous production of the aforesaid crop in the country, waste utilization is an attractive option to consider that peanuts are cash crops.

Everybody agrees that energy is vital to daily existence. These days, humans are already experiencing the benefits of using alternative energy if only to lessen Carbon emission. It is in this context that the researchers made this study to increase more sources of energy that will not jeopardize the

environment and that more energy are needed to spur economic developments in the country.

It is more economical to mix alcohol with fuels in order to conserve petroleum products. This scheme has been carried out quite intensively in Europe and United States of America and in some tropical countries, including the Philippines where from 10% to 20% alcohol are added in the car fuels .Car engines can burn pure alcohol or gasohol , an alcohol-gasoline mixture (10%EtOH in gasoline. In fact gasohol is gaining popular in the US. A fuel called E85 (85%Ethanol and 15% gasoline) is widely available for cars with the flex-fuel –engine. (Zumdahl, S.S., Zumdahl, Susan A.; Chemistry, an Atom First Approach, 2012)

One mitigation technique done by the government to lessen Carbon emission in the air was the promulgation of 10% EtOH in fuels to reduce, if not totally eradicate carbon emission in the air which is the basic concern of the Climate Change Commission.

Ethanol or Ethyl alcohol is another fuel with the potential to supplement or replace gasoline (Zumdahl, S.S., Zumdahl, Susan A., Chemistry, An Atom First approach, 2012)

Alcohol plays second to water as a universal solvent and is employed in drugs and medicinal preparations. It is also being utilized in preparing beverages such as beer and wine, it serves as an essential component of alcohol producing substances used in fermentation. Most of all, as a raw material, it helps in making hundreds of other chemicals, butadiene and styrene (needed for the synthetic fiber production) as good examples.

Why *Anachis hypogaea Linn* shells? Because peanuts are ideal climate change mitigating crop. It has a Nitrogen – fixing property and has the ability to reduce the emission of greenhouse gas emitting nitrous oxide. The Philippine government is trying its best, particularly in the agricultural sector to make peanuts a cash crop. So, finding other ways and uses of this plant would both boost economic progress and help the environment.

Another breakthrough in the use of ethyl alcohol lies in the fuel cell industry where it is used as a source of Hydrogen.

Research Question

This study aimed to extract ethanol from peanuts shells (*Anachis hypogaea Linn).* Specifically, it sought to answer the following problems:

1. Can peanut shells be a source for the production of alcohol?

2. Can the presence of alcohol be detected through simple extraction?

3. Can peanuts be considered a future cash crops and a climate mitigating crops?

Literature Reviews

Ethanol as an Alternative Fuel from Agricultural, Industrial and Urban Residues

This study focuses on ethyl production as an alternative fuel from agricultural, industrial and urban residues. In recent years, ethyl alcohol has emerged as most important alternative resource for liquid fuels, if not attracted many researchers in ethanol fermentation. Research in improving ethanol production has been accelerating because it is environment friendly and has economic worth. Various researches on field crops have proven potential because of its genetic diversity, climatic adaptation, and biomass and sugar production.

Production of ethanol from renewable lignocellulosic resources proved to decrease air pollution and diminish atmospheric Carbon Dioxide emission, as compared to petroleum based fuels.

This study also emphasizes waste utilization.

Pre-treatment Technologies for an Efficient Bioethanol Production Process based on Enzymatic Hydrolysis

Investigations on biofuel production from lignocellulosic material show the economic and environmental advantage in the comparative study of biofuel and bioethanol. Physical and chemical barriers caused by the close association of the major components of lignocellulosic biomass were highlighted to prove that the barriers can hinder the hydrolysis of cellulose and hemicellulose to fermentable sugars. Mainly, the main objective of pre-treatment is to increase digestibility of cellulose. The study points out, too, that key properties targeted must assure a low –cost and efficient pre-treatment process.

Characterization of Agricultural and Agro – Industrial Residues

This study focuses on the characterization of agricultural and agro – industrial residues including peanut shell. The data revealed that the Carbohydrate fraction for peanut is 349g/kg.

Presence of starch was demonstrated in an additional sulphuric acid hydrolysis. Cellulose fraction for peanut was found to be w=225 g/kg. Klason lignin was determined as the solid residue of the acid hydrolysis. In this study the hydrolysis residue was incinerated and the obtained ash subtracted from the mass of the residue which gives a good idea about lignin fraction, as proven very high in peanuts. For the ash fraction, which is 69g/kg, this may be a drawback for ethanol production. In this study, an approach to the quantification of the fraction of acetyl group was made. The results are useful for comparing the relative fraction of acetyl groups in the analysed amounts. Peanut shells recorded 27g/kg which is higher than that of rice hulls. The highest volume fraction of ethanol extraction was detected in peanut shells. Considerable contents of mannose and galactose were also detected in dilute –acid hydrolysates of peanut shells.

To give an approximate assessment of the suitability of the investigated material for ethanol production, the potential ethanol yield can be calculated. These materials; rice hulls, rice husks, peanut shells, cassava stalks and corn stalks are the most promising material for ethanol production. It also conveys that those materials are the most appropriate for industrialization since they are produced in very high amounts and are available.

Ethanol Production from Dilute –Acid Pre – treated Rice Straw by simultaneous Saccharification and Fermentation

Investigation leading to ethanol production from rice straw by simultaneous saccharification and fermentation with *Mucor Indicus, Rhizopur oryzae* and *Saccharomyces cerevisiae*.

Saccharomyces cerevisiae was investigated and compared with pure cellulose, Avicel, as a reference. The straw was pre-treated with dilute acid. The experiments were carried out aerobically and anaerobically at 38 deg. Celsius, 50g/L decimeter. Solid substrate concentration and 15or 30 filter paper unit /g of a commercial cellulose. The study ended for seven (7) days.

Governmentt allots 5000 hectares for Peanut Plantation

MANILA, Philippines –A major broadsheet told that the government allocated 5,000 hectares in Cagayan Valley for planting to protein-rich peanut. They believed, through the Department of Agriculture, that peanut is an ideal climate change-mitigating crop with its nitrogen-fixing property.

The Department of Agriculture (DA)-Cagayan Valley Integrated Agricultural Research Center (CVIARC) targets a 43 percent increase in peanut production in Region 2 in three to five years. The department expressed its support for peanut breeding and production because peanut remains to be a minor crop rather than a cash

crop even if farmers have an opportunity to make money from it by replacing our big import. After all, the country imports an estimated 30,000 to 50,000 metric tons (MT) of peanut yearly out of a total supply of 60,000 to 70,000 MT.

The DA sees peanut production as a climate change-mitigating crop with its ability to reduce the emission of greenhouse gas-emitting nitrous oxide. Also, peanut is drought-resistant having an average irrigation water requirement ranging from four to 50 millimeter per application.

Making Money out of Peanuts

Another major broadsheet in the country mentioned ISABELA, Philippines and its peanuts are making money through *Magsasaka Siyentista* (MS) Roger Salvador when he made money out of his *mani* or peanut production.It all started in 2007 when the Science and Technology-based farm (STBF) on peanut production was implemented in his farm in Barangay Arubdub, Jones, Isabela.

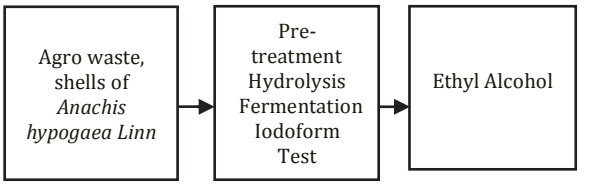
STBF is an innovative concept under the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) Techno Gabay Program whereby an MS farm or enterprise is used to showcase the effectiveness of S&T (science and technology) intervention(s) in improving the productivity and income of farmers on specific commodity and products. Roger devoted ha of his farm for his STBF plot and the other half for his MS practice (traditionally managed) plots. The first cropping cycle alone, earned him P20, 551/ha more from his STBF plots than his traditionally managed plots. While the use of technology interventions upped his production cost by P8, 000/ha, these interventions were able to bring in more than a three-fold increase in added returns of P28, 625.

Cropping cycles later brought him more. STBF plots yielded an average of 3,048 kg/ha equivalent to 36 percent increase, while MS plots yielded 2,237 kg/ha. This means that an additional yield of 811 kg/ha/cropping cycle is possible with the use of S&T interventions. Despite the added costs of about P7,084/ha/cropping cycle in using the S&T interventions, added returns averaged P24,361/ha/cycle, thereby giving the MS an increased net income averaging P15,357/ha/cropping cycle.

These results in Mang Roger's STBF plot yield 1.1 t/ha which is translated as much as 87-percent efficiency of production based on the potential yield of Asha variety of 3.5 t/ha.

The significant effect of the STBF is the gradual planting of peanut in rotation with corn in about 2,000 ha of corn based areas in Jones. More corn farmers from 25 barangays of Jones have started growing peanut, thus increasing more production expansion and crop diversification in the said municipality. This only shows a tremendous peanut wastes too in the process.

Conceptual Framework



Methods

I. Preparation of Materials (Anachis hypogaea Linn) Shells

1. Shelled peanuts were bought from Paco market. The nuts were removed, their shells washed and dried under the sun for two days.

2. The dried peanut shells were grinded using a low speed blender. The grinded sample obtained was placed in a clean Erlenmeyer flask.

II. Preparation of the Carbohydratesextract from Peanut (Anachis hypogaea Linn) Shells

1. Twenty-five grams of the grinded peanut shells were placed in three Erlenmeyer flasks separately. Then each one was added with 200 ml of Sulfuric acid. These flasks represented samples for Trial 1,2 and 3 of Table 1

2. Each mixture was placed in a hot water bath at a temperature of 100° C for fifty minutes.

3. Each mixture was allowed to cool, then filtered using Whatman filter paper.

4. The wet residue from the filter paper was obtained.

5. The residue was allowed to dry by standing at room temperature.

6. Again, 200 ml of Sulfuric acid was added to the grinded peanut shells in each flask.

7. Later, it was replaced in a hot water bath at 110 deg. C.

8. Then, each mixture was allowed to cool by standing at room temperature.

9. Then, the cooled mixture was then filtered.

10. Each filtrate was neutralized with CaO lime which was used to neutralize the acid and remove the excess SO4

11. Finally, put each filtrate in a bottle.

III. Fermentation of the Carbohydrate Extract from Peanut (Anachis hypogaea Linn) Shells

1. Each filtrate in the bottle was added with 0.5 gram of Ammonium sulphate, 0.3 gram of sodium phosphate and 0.03 gram of Magnesium sulphate. Those additives are the nutrients.

2. Each mixture was stirred and mixed rapidly.

3. To the mixture, 3 grams of yeast, a pinch of sugar and I glass of warm water was added.

4. Each bottle was then covered with cotton loosely to permit the escape of carbon dioxide gas. Let fermentation process take place for one week.

5. After one week of fermenting, each solution was then filtered to remove excess yeast.

6. Each filtrate was ready for testing if it had alcohol.

IV. Chemical Test for the Presence of Ethyl Alcohol

1. One ml of each filtrate was placed in a test tube and then added with 1ml of Sodium Hydroxide solution.

2. A concentrated solution of iodine was added drop by drop to the test tube until the yellow color and antiseptic smell appeared. This indicated the presence of ethyl alcohol.

V. Extraction

The final solution is extracted using a Soxhlet extraction apparatus which yields a colorless and flammable extract.

Results

The results of the experiments showed that peanut shells can be a source of ethanol. The increase in the percentage of alcohol is due to the pre-hydrolysis treatment. The pre-hydrolysis of the sample was carried out at 100° C for fifty (50) minutes using Sulfuric acid.

The filtrate obtained was clear, colorless and flammable liquid. It was tested for the presence of ethyl alcohol through iodoform test. The presence of ethyl alcohol was evident due to the yellow precipitate formed.

Table 1
Iodoform test showing the positive results for ethyl alcohol

Trial	Results
1	Positive – yellow precipitate & antiseptic odor
2	Positive – yellow precipitate & antiseptic odor
3	Positive – yellow precipitate & antiseptic odor

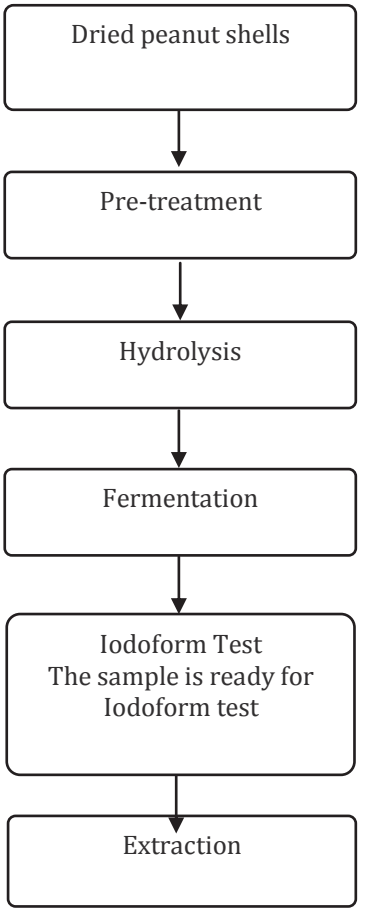
Table 2
Showing the Potential Ethyl Alcohol Yield through Extraction

Trial	Grinded Peanuts Shells	Ethyl Alcohol Yield	% Yield
Bottle 1	25 g	4.1 g	16.4
Bottle 2	25 g	4 g	16
Bottle 3	25 g	3.8 g	15.2

Apparatus and Materials

Erlenmeyer flask
Hot plate
Test tubes
Weighing balance
Blender
Thermometer
Beaker
Sulfuric Acid
Calcium Oxide
Sodium Hydroxide
Iodine
Peanut shells
Whatman filter paper
Ammonium Sulfate
Sodium Phosphate
Magnesium Sulfate
Yeast
Sugar
Cotton
Distilled Water
Soxhlet extraction apparatus

Research Design



Discussion

Twenty-five grams of the peanut shells were weighed and pre-hydrolysed at 100°C for 50 minutes with Sulfuric acid. The mixture of each three (3 samples) was filtered and solids were dried. After prehydrolysis, the solid material was hydrolysed at 110° C for ten (10) minutes. The acid treated material

was filtered in a filter paper. The filtrate from pre-hydrolysis and hydrolysis were combined. Pre-treatment and hydrolysis were done to increase the digestibility of the shells. Then neutralized with CaO and again filtered. The filtrate was pasteurized and added with nutrients such as Ammonium sulphate, sodium phosphate and magnesium sulphate. Yeast with sugar solution was inoculated and the mixture fermented for a week to be able to obtain the Carbohydrates in a form of Glucose and Fructose converted later to alcohol. It was done at aerobic condition at room temperature. After the fermentation, the hydrolyzate was tested for the presence of ethyl alcohol using Iodoform test which was evident in the formation of the yellow precipitate and antiseptic odor.

The potential ethyl alcohol content was calculated as suggested in the review of C. Martin, et al., Characterization of Agricultural and Agro Industrial Residues citing that there is 0.47g ethyl alcohol in every gram of peanut shells; hence percentage ethyl alcohol yield was also calculated.

In the Iodoform test, there is oxidation in the reaction of iodine and sodium hydroxide. This is followed by substitution of Hydrogen by reaction of Iodine in the presence of Hydroxide ions and lastly, breaking of the C-C bond by OH ions.

Conclusions

1. It is possible to produce ethyl alcohol from peanut shells, as manifested in the presence of a clear, colorless and flammable filtrate, a yellow precipitate and an antiseptic odor.

2. Ethyl alcohol can be obtained through simple extraction by using Iodoform test.

3. With the tremendous support of the Department of Agriculture and farmers through their Science and Technology interventions in peanut farming/production, peanuts or *Anachis hypogaeaLinn*is a potential cash crops. Known for its property to fix Nitrogen in the environment, it is also a highly potential climate mitigating crop.

Recommendations

Based on the experimental results, the researchers recommend that the analytical technique using NMR Nuclear Magnetic Resonance spectroscopy be done to determine the purity of the sample product.

Other acids like Hydrochloric acid and a base like ammonium hydroxide be tried in the pre-treatment and hydrolysis to compare which can give higher potential ethyl alcohol yield.

Production of ethyl alcohol from peanut shell be considered in industrial scale to maximize waste utilization of peanuts shells produced by Filipino farmers. Fermentation process using multi –press distillation process integrated with stand-alone evaporation process and molecular sieve dehydration process is also highly recommended for a better yield. Besides, it would be a good source of ethyl alcohol in the manufacture of food and beverages, energy and in medical uses.

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