The Production of Biofuels From Grain Yellow Corn

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Abstract

This research is about processing the sugars found in grains such as yellow corn to ethanol which are used in the laboratory and pharmaceutical purposes, as well as the trend has been to use as fuel for cars as one of the clean energy source that doesn't causes polluting and the large size of the pollution that is caused by fossil fuels.

Processing through the macerating grain with water temperature 55 ° C for a period of 3-5 days and then grinding the grains with the addition of enzyme Zymase for the purpose of processing starches in the grain to sugar glucose as a first stage and then adding the yeast (Saccharomyces cerevisiae) to transform glucose to ethanol.

After the treatment of enzyme and yeast there is a distillation process of the solution containing alcohol for the purpose of separating and assembled and has been the experience of many models of grain maize, the ratio of ethanol output varies depending on the quality of the grain for example, local maize gave the proportion of turning 25% while corn from Argentine gave 32% of ethanol and American corn gave 36% of ethanol because of the difference in these brands of the starch, where the higher the ratio of starch increased the amount of ethanol production. The subject of ethanol is one of the researches that has a great future because of the alcohol, which features the world heading to it as a clean energy.

Keywords: Biofuels; Bio-ethanol; American ; Argentine; Iraq , Starch

الخلاصة

تم في هذا البحث تحويل السكريات الموجودة في الحبوب ومنها الذرة الصفراء الى كحول الايثانول والذي يتم استعماله في الاغراض المختبرية والدوائية وكذلك تم التوجه لاستخدامه كوقود للسيارات باعتباره احد مصادر الطاقة النظيفة التي لا تعطي تلوثا بحجم وكبر التلوث الذي يعطي الوقود الحفري . وذلك من خلال تنقيع الحبوب بالماء وبدرجة حرارة ٥٥ درجة مئوية لفتـــرة ٣-٥ ايام ثم يتم طحن هذه الحبوب مع اضافة انزيم الزايميز لغرض تحويل النشويات الموجودة في الحبوب الى سكر الكلوكـــوز كمرحلة اولى ومن ثم اضافة خميرة الخبز (Saccharomyces cerevisiae) لتحويل الكلوكوز الى كحول الايثانول . بعد المعاملة بالانزيم والخميرة يتم اجراء عملية التقطير للمحلول الحاوي على كحول لغرض فصله وتجميعه ولقد تم تجربة نماذج عديدة مـــن حبوب الذرة الصفراء وكانت نسبة الايثانول الناتج تختلف اعتماداً على نوعية الحبوب فمثلا الذرة المحلية اعطت نسبة تحول ٢٥% بينما اعطت الذرة الارجنتينية ٣٢% ايثانول والذرة الامريكية ٣٦% ايثانول وذلك لاختلاف النشا في هذه النوعيات حيـــث كلمـــا زادت نسبة النشا زادت كمية الايثانول المنتج . ان موضوع الايثانول يعتبر من البحوث التي لها مستقبل كبير بسبب ميزة الكحول الذي يتجه العالم اليه كطاقة نظيفة .

الكلمات المفتاحية: الوقود الحيوي .الإيثانول الحيوي .الأمريكية ؛ الأرجنتيني .العراق، نشا

1- Introduction

Energy is the engine of human development and services are important sources of energy for the operation of economic sectors and Population Activities. However often Systems based energy source of environmental problems. It's access by less developed society on clean energy that can be purchased as an important element for poverty reduction through the provision of heat, light and energy in addition to a set of other benefits such as income generation and the development of rural infrastructure and improve health in cities and the countryside. While fossil fuels are the most commonly used types of fuel, it is the most polluting of the environment, which when burned produces first gas and carbon dioxide,which is involved in a large share of global warming, a so-called global warming (Global warming) and this phenomenon, which increases the water level in seas and oceans due to melting the

ice poles of Consequently sinking large areas of the continents, but there is an alternative that can be used at the present time, a bio-fuel (Food outlook,2006).

Biofuel is extracted from plants and takes two forms, the first is the ethanol extracted from sugarcane and sugar beets or grain can be added to gasoline. The second is bio-diesel extracted from oilseeds or palm trees. The globally volume trade of ethanol is about 5.5 billion dollars in 2006. The United States is the world's first productive country of ethanol and relies mainly on corn for ethanol production, while Brazil comes in second place of ethanol industry on sugarcane, followed by China and India. While biodiesel is considered the second most important source of bioenergy and Germany is the first country in the world for the production of bio-diesel produces more than half the world's production of bio-diesel production, which relies on the rapeseed, followed by France. We will focus our research on ethanol, biodiesel without being produced mainly from grains, such as yellow corn (Licht,2007).

Currently, most American cars and producing companies GMC, Ford, Chrysler used fuel is a mixture of 10-15% ethanol (produced from grain yellow corn) with motor gasoline produced from crude oil and there is a plan to increase the proportion of mixing in the future of ethanol by the increase in production of the present materiality, which is expected to reach the limits (7.5 billion) dollars a gallon in 2012 is equivalent to 28 million cubic meters (Licht, 2007).

With concerns over high energy prices, volatility of oil source and greenhouse gas (GHG) emissions, energy derived since biological sources and in particular biofuels has expected considerable attention. In particular, wild growing oil importing economies such as India and China are exploring biofuels to curb oil dependency. But to grow biofuel crops extra land and water will be needed. Together China and India already suffer from water scarcity difficulties that will only worsen as their food demand continues to grow with rising populations and incomes.China is implementing a costly transmission project to bring water from the water-abundant south to the water-short north. India is exploring the possible implementation of a controversial multi-billion dollar project of inter-basin water transfers, to meet future demands.

2- Theoretical Basis

It is known that alcohol manufacturing yeast by the Sumerians and Babylonians before six thousand years considered that ethanol is a byproduct which has been developed and used in the industry and the expansion of its spread dramatically as used in the manufacture of medicines, cosmetics and perfumes in the production of alcoholic beverages and the purposes of sterilization and cooking, heating and lighting, and the generation of steam and electricity. In addition to what was mentioned in the introduction of its major uses currently in biofuel substitute for crude oil in the conduct of transport where the improved performance of the internal combustion engine the fact that ethanol will burn without residues, as well as used as a deterrent in the freezing of cars radiators.The alcohols are hydroxylase hydrocarbon derivatives by replacing a hydrogen atom or more in part hydrocarbon root of hydroxyl radical (OH) or more. And the general law of unilateral hydroxyl radical alcohols derived from paraffin's (saturated hydrocarbons) R-OH, where R root for any measurement.

For example, methane CH3-H is derived from methyl alcohol CH3OH.

Ethane C2H5-H is derived from ethanol, C2H5OH, and so on .

3 - Materials and research methods

3-1 Materials Used

A- Grain yellow corn

B- The enzyme Zymase

C- Yeast
D- Water

3-2 Equipment Used

A- A Water Bath
B- Electronic Scale
C- Glassware (Picrate with cylinders and test tubes and various beaker sizes)
D- To intensify laboratory system

Methods for preparation of ethanol: C2H5OH

Prepares with a large scale of (Fermentation) of sugars by yeast(Matthew,2006).

Alcoholic fermentation of sugar by yeast gets the effect of material behave as a catalyst, and this is one of the enzymes called (Zymase) Zymase which is found in yeast cells, which transfers glucose (sugar berries) into ethanol and carbon dioxide, as in the following equation (Babcock,2010)

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

4- Preparation and manufacturing ethyl alcohol

1- The starch in yellow corn or wheat or potatoes in sugar from sugar turns to complex binary(malt sugar maltose), where it works on the enzyme decomposition of starch hydraulically as in equation:

$2(C_6H_{12}O_5)\ n + n\ H_2O \rightarrow n\ C_{12}H_{22}O_{11}$

Two Molecules of starch N water molecule N molecule malt

After adding yeast the work of enzyme Maltase which is in it starts to hydraulically process the malt sugar as in equation(Pavlov,1971).

(Maltose) (Fructose) (Glucose)

$C_{12}H_{22}O_{11} + H_2O = C_6H_{12}O_6 + C_6H_{12}O_6$

While the enzyme transfers these two Zymase saccharin are being produced to ethyl alcohol and carbon dioxide:

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

2- Ethyl alcohol can be obtained by boiling the emulsion of starch with diluted mineral acid such as H_2SO_4 and works as an adjunct to hydrolyse starch hydraulically:

$(C_6H_{10}O_5)n + n\ H_2O \rightarrow Nc6h12O6$

Glucose turns by resulting with the help of an enzyme Zymase into ethyl alcohol and carbon dioxide:

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

3- Manufactured in a manner of synthetic ethylene resulting from the crushing process turns petroleum where smoke by sulfuric acid ethyl sulfate to hydrogen degradation that turns water into ethanol and sulfuric acid(Babcock, B.A., 2010).

$C_2H_4 + H_2SO_4 \rightarrow C_2H_5 - HSO_4$

$C_2H_5OH + H_2SO_4 \rightarrow C_2H_5 - HSO_4 + H_2O$

4.1 - Properties of ethyl alcohol

Ethanol is a colourless liquid and smelly acceptable. A volatile boil level at 78 degrees Celsius and freezes at -112° C and it can be blended in any proportion, ignites in the air with clearly blue flame component CO_2 and water and then reacts with sodium distillates of hydrogen gas(Baier, 2009).

$C_2H_5OH + 2Na = 2C_2H_5ONa + H_2$

It also reacts with organic acids forming Ethers

$C_2H_5OH + CH_3COOH = CH_3COOC_2H_5 + H_2O$

4.2 - The scientific aspect

Many scientific experiments were conducted for the productions of ethanol-scale laboratory were as follows:

4.3- Method of lab experimenter process in how to obtain ethanol

1- An amount of (2 kg) of yellow corn where it has been macerating after filtered and cleaned from impurities and crumbed in Baker size 3-liter glass where the water is added to the enzyme and yellow corn in order to assist in the turns of starch in corn to the sugar glucose and the added enzyme is called amylase and the quantity of 3 grams. With temperature is raised to 55°C for a period of 3-5 days in a water bath.
2- The adding of yeast (Saccharomyces cerevisiae) of 1 gram to the sugar which is formed for the purpose of conversion of sugar to alcohol ethanol.
3- The distillation stage of alcohol for the purpose of separating from the rest of materials resulting from the fermentation process.

4.4- The steps that are followed in manufacturing ethanol on the industrial level

The following steps were globally followed in the production of ethanol from grain yellow corn:

1- By mixing water with the grain with the enzyme and with raised temperature up to 55°C and modify the function to pH (5.5 -6) for 20 minutes in order to process. To break the links between the molecules of starch and sugar production and prepare for the fermentation process (Austin,2002).
   Water + Grain + Enzymes
2- By adding the yeast (Saccharomyces cerevisiae) to the mixture and allowing the mixture of fermentation to produce alcohol.
   Grain + Enzymes + yeast + Water
3- Distillation stage of alcohol:
   Ethanol separates from the rest of the material (The remains of grain yellow corn) through a process of distillation, as for the rest of the other materials utilized in the production of corn profits and poultry nutrition, as well as its use as a fertilizer for agriculture.
4- The stage of water removal from the alcohol (Dehydration) where alcohol passes the resulting from the third step on the sieves (molecular sieves) to remove the remaining water with alcohol.
5- Then the procedure of the process (Denaturing with gasoline) ethanol is produced in order to suitability for human consumption and stores to be ready for shipment.
6- After obtaining ethyl alcohol the solids material is being separated, which is a yellow corn products. This is where the drying of the solids material is being in processes, which is rich in protein and to be sold as feed for poultry and animals, as well as used as an agricultural fertilizer.

5- Economic feasibility calculations

As the price of 100 kg of dried maize grain globally = $ 30 and the amount is added to the price of $ 5 for enzyme and yeast and manufacturing wages where the totally amount is = $ 35.

The proportion of the global transition is 40 kg of ethanol per 100 kg corn and can be sold per kilogram of ethanol at a price of $ 1.5

So revenues are when using local corn = 25×1.5 = 37.5 dollars

Profit = revenue - cost

= 37,5 – 35

= 2,5 dollars by using local corn

= 13 dollars by using an Argentine corn

= 19 dollars by using American corn first class. In addition to that it could benefit from the sale of the remaining profits of corn and the non-transformed to ethanol sold in feed for poultry for good prices where they can cover the costs of other unseen issues.

6- The test

1- The detection of Alcohol

Test tube was taken out by silica material saturated with dichromate potassium acidified with sulfuric acid. Then we passed the alcohol vapor through it where we noticed the change of potassium dichromate colour inside the tube of orange to green to signify the existence of the alcohols.

2- The detection of Alcohol type

The purpose of classification of alcohol or methanol, where it has been taking 1 ml of alcohol and was placed in a tube and then we added a salicylic acid, we noticed the lack of escalating of any scent (in case of escalating scent FKS, than it's methanol). Then we took another model 1 ml of alcohol in the test tube with the added acetic acid and the model was heated with the addition of sulfuric acid, where we noticed the escalated scent of apples and this signifies the existence of ethanol.

7- The discussion and the results:

It has been obtained the amount of 500 ml of ethanol from the amount of 2 kg of grain yellow corn an increase in production of 25% while the global ratio is 40% and that the difference is due to several reasons, the most important of the difficulty of adjusting the distillation process. As well as lack of control of enzyme addition and effectiveness decrease of the enzyme which has been found through the research, where 100 kg grain Yellow corn of local ethanol gives 25 kg. In the case of the use of Argentine corn, the proportion of shift 32 kg ethanol per 100 kg corn, but by the use of American corn, the proportion of first class shift is 36 kg per 100 kg ethanol corn.

1- There is a global trend for the production of ethanol from grain yellow corn and The United States is the first country in the world in the field, where its production will reach up to 28 million cubic meters in 2012 resulting from the use of nearly 70 million tons of grain yellow corn in this domain. Note that it is the first of the global production of yellow corn in terms of its production in 2009 reached up to 325 million tons (see Figure.1),this shift in the global production of ethanol being considered one of the clean energy sources that do not contaminate the environment when used as a fuel for cars.

2- In addition to what is mentioned in paragraph (1), the trend for the production of ethanol from grain yellow corn as a good process and initial calculations it gives good financial returns in the case of exploitation in this matter and can be used in multiple domains, including industrial and medical, considered in addition to the nucleus of a future project for the production of ethanol.

3- The reason for the high proportion of conversion to ethanol is the proportion of high starch content of corn imported to local corn, where the proportion of corn starch in the local limits (67%-70) while the proportion of corn starch in Argentine up to 75%. As for first class American corn starch content is up to 78%,(Figure 2 (FTIR TENSOR 27).Explain the FTIR Spectrum for Ethanol , and it's clear from this Figure for each types of ethanol the peaks for starch is more intensity in American corn) in addition to ease of extracting starch from imported corn. Being dried with moderate temperature not-high, reverse to Iraqi corn that is dried to varying high thermal up to 100°C,causing complexity in cooking ingredients from corn starch and protein, making it difficult to separate them during the manufacturing process.

- **Conclusion :**

Biofuel systems employing energy crops can provide for energy diversification. Herbaceous energy crops have seen a surge in interest in recent years because they deliver opportunities for reducing dependence on fossil fuels. Conventional row

crops, such as maize,are currently serving as biofuel feed stocks, but they have inherent weaknesses (Barr,2005).They need large annual inputs of energy (and emissions of GHG (A greenhouse gas)) in planting and fertilization (Barnes,2007), and using grain (food and feed) for fuel has economic and ethical repercussions for many(AAFC,2010).

Knowledge to translate cellulosic biomass into ethanol is perhaps close to a commercial stage, though we will not know until a large scale plant turns a profit. The prize will be large. Agriculture has an immense capacity to create energy.Before sustainable biofuel systems can be deployed, however, challenges have to be met. Specific of those challenges include resolving issues of economy of measure, developing infrastructure and providing appropriate incentives.

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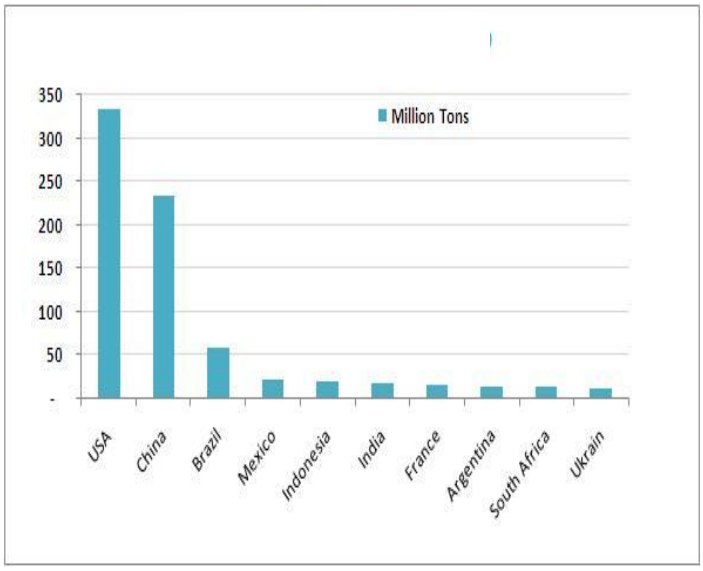

Fig.1: Top Ten Corn / Producers 2012 (http://www.agricorner.com/world-top-ten-corn-producers-2009.(21/2/2015).

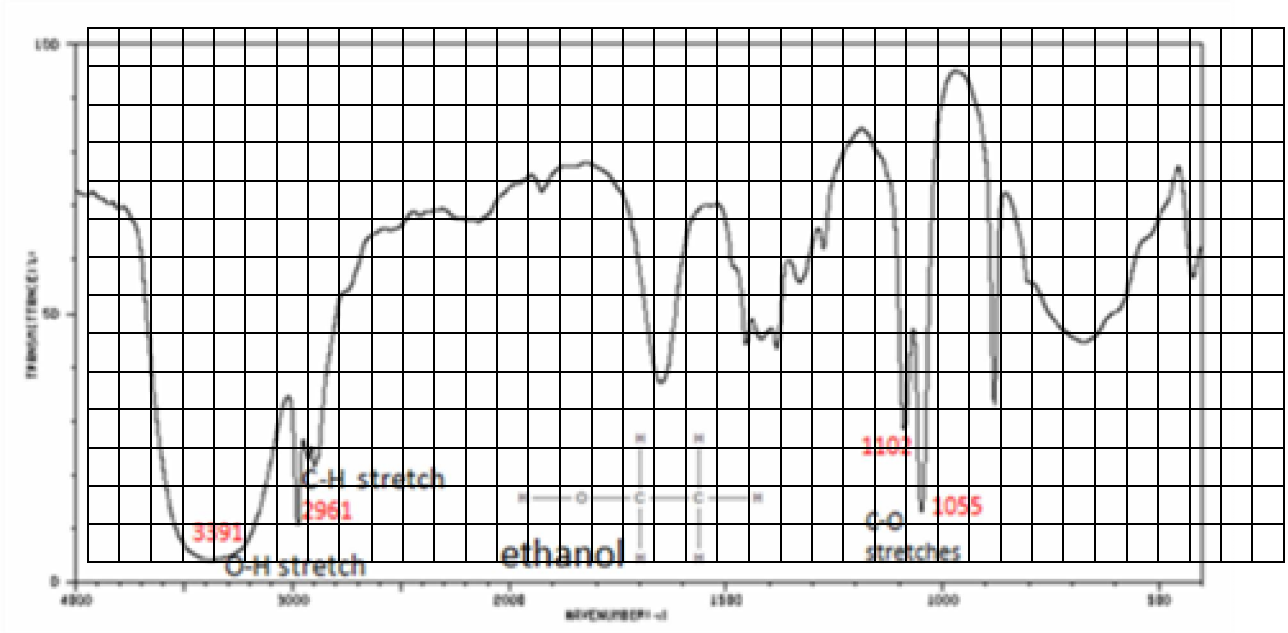

Fig.2: The FTIR spectrum FOR Ethanol