Praise Worthy Prize

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Vegetable Oils for Biodiesel Production as Friendly Energetic Alternative: the Case of Mexico

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Abstract – *Among the current cited biofuels, biodiesel production using vegetable oils as raw materials exhibits technical, social and economic advantages. Some crops exhibit untapped potential as source-alternatives for satisfying the increasing energy demand; therefore, it is important to study the feasible reaction routes to transform triglycerides, mainly, into biodiesel. Mexico has been taken into account as case of study, in order to estimate the potential utility and economic impact of vegetable oils in its development. It is noticed that about 90% of the Mexican territory exhibits favorable climatic characteristics to crops able to produce vegetable oils useful in biodiesel production.*

***Keywords**: Biodiesel, Energy Alternative, Mexico, Vegetable Oils*

I. Introduction

I.1. Energy Use and Demand in Mexico

Since the man appeared on the planet, energy consumption was imminent to realize all kind of works that would allow surviving and, eventually, comforts for a more pleasant life.

Therefore, over time energy needs have increased and, in Mexico, this demand has reached higher levels each year and is being covered by the use of petroleum based fuels, mainly.

Unfortunately, the use of oil as energy source in the case of Mexico will become very expensive in the future. According to the data presented by the Mexico's Ministery of Energy (SENER) (Fig. 1), the proved inland oil reserves in January of 2010 amount to a total of 14,000 million barrels of oil and the current daily demand is 3 million barrels. It means that proved oil's lifetime of 12.8 years. Hence, it is necessary to replace petroleum fuels by those obtained from renewable sources.

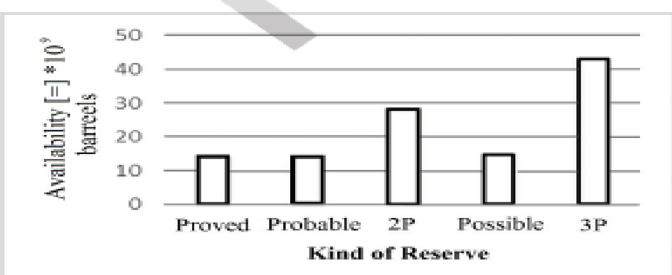

Fig. 1. Mexican reserves of oil (SENER, 2010)

I.2. Biodiesel

Biodiesel is now one of the proposed transition energies of greater global importance. Biodiesel is a synthetic liquid biofuel derived from natural fats such as vegetable oils, new or used, by the industrial processes of esterification and transesterification.

Its main contribution is partial or total substitution of gasoil (obtained from oil) in heating processes and engines.

In particular, it is very easy to replace diesel by biodiesel in internal combustion engines because:

- No modifications are required by an old diesel engine to switch to biodiesel.
- Biodiesel exhibits higher cetane number than diesel (51 *versus* 42, respectively). Since this is an indicator of the engine knock at start-up, an engine that switches to biodiesel will start-up softer than previously using diesel [1].
- Biodiesel exhibit better solvent properties with respect to diesel, such as cleaning effect on the engine parts.
- Biodiesel provides better lubricant properties with respect to diesel; therefore engine parts will last longer.
- A liter of biodiesel might replace between 0.90 and 0.95 liters of diesel, in relation to calorific values; therefore there is no need to replace the fuel reservoir.

The first technical tests with biodiesel were held in Austria and Germany in1982, but only until 1985 the first pilot plant producer of rapeseed methyl-esters was built in Silberberg, Austria.

Some years later, biodiesel production becomes more important and larger quantities of raw materials were processed. Table I shows the main European biodiesel producer countries.

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Optimization of Particle Size for Hydrolysis of Pine Wood Polysaccharides and its Impact on Milling Energy

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Effect of Rates of Aeration and Agitation on the Volumetric Coefficient of Oxygen Transfer in the Production of Bikaverin

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Abstract – *The volumetric mass transfer coefficient and the power number are some of the most important parameters in engineering; they are needed to scale up the equipment and/or processes. Besides, the volumetric mass transfer coefficient (k_La) for the different operational conditions (aeration and agitation rates) were obtained in the culture medium free of microorganisms and for the fermentation, such conditions were found for the most production of bikaverin. The Reynolds number and the power were determined for different treatments in bioreactor. The results in the bioreactor showed that high speed of agitation and low aeration rate favor bikaverin production, the highest production was 112.23 mgL^{-1} with the condition of 0.1 vvm and 500 rpm was found on the average k_La during the fermentation of 41.42 h^{-1}, whereas, to the culture medium without microorganisms the k_La increases proportionally to the increase of the agitation and aeration rates.*

***Keywords**: Aeration, Agitation, Bikaverin, Power Number*

I. Introduction

I.1. Bikaverin

Bikaverin is a secondary metabolite produced by several species of fungi, was isolated from mycelium of *Gibberella fujikuroi*. It has also been isolated from the fungus *Gibberella fujikuroi*, also known as *Fusarium fujikuroi*.

Bikaverin, is of great economic importance biotechnology and mainly by their properties as antibiotic (specifically against *Leishmania brasiliensis*) and anticancer (fifty percent of the dose is effective for Ehrlich ascites carcinoma (EAC), leukemia and sarcoma) [1]. In relation to nutrient requirements, some substrates have been extensively studied as source of carbon, nitrogen and some minerals which affect the growth and/or production of the compound cell synthesizes of this fungus [1]. Because of its multiple applications, bikaverin has high commercial value, so it is a clear need to produce this compound on larger scale. In aerobic fermentation (as in this work) oxygen uptake rate is considered the limiting step, mainly because of the low solubility of oxygen in aqueous media. Oxygen, unlike other substrates, has to cross several barriers to become consumed by the cells (since it is a gas).

Most studies to produce bikaverin at flask scale [2], have been used *airlift* bioreactors, evaluating the effect of the aeration rate on bikaverin production; such bioreactors are characterized by high mass transfer rates, however they are often difficult to manipulate for viscous fermentations type (as in the case of fungal fermentations) and tend to hinder the operation by plugging.

The oxygen transfer rate is defined as the product between the volumetric oxygen transfer coefficient (k_La) and the difference of the saturation concentration in the gas-liquid interfase and the concentration in the liquid medium. The volumetric oxygen transfer coefficient (k_La) is a parameter characterizing the transfer of oxygen into bioreactors and its magnitude depends on bioreactor design, physical properties of the liquid and operating conditions. The parameter k_La is constituted by the liquid film coefficient (k_L) and the specific interfacial area (a).

It is common to correlate k_La with operating variables of the system (agitation, aeration, applied power, and so on), fluid properties (density, viscosity, specific gravity) and geometry (stirrer diameter/diameter of the fermenter) among others; also it can be evaluated experimentally [3]. In this paper, experimental evaluated values of k_La for different operating conditions in both, free medium for the fermentation microorganisms and wherein the operating conditions favoring the production of bikaverin using *Gibberella fujikuroi* strain CDBB-H984, are reported. Additionally, changes of viscosity and density of the fermentations with respect to time were related to dissolve oxygen in the medium.

Fluid properties such as density and viscosity are also used to evaluate the Reynolds number, the power for agitation and aeration with respect to time and the mixing time for different agitation speeds.

II. Materials and Methods

II.1. Microorganism

The strain CDBB-H984 of fungus *Gibberella fujikuroi* (strain collection of the Department of Biotechnology

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