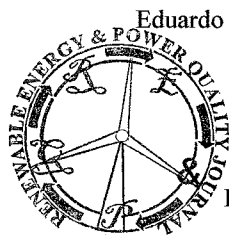


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## Comparative study of Biodiesel Production from Ethanol and Babassu oil using Mechanical Agitation and Ultrasounds

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**Abstract.** Babassu oil is a vegetable oil extracted from the seeds of the babassu palm (*Attalea speciosa*), which grows in most areas of South America. Brazil is the world's largest exporter of ethanol; the advantages of this alcohol are concerned to its renewable origin and low toxicity. In this work ethyl esters of babassu oil were synthesized by alkaline catalysis in homogeneous medium. The experimental design was used as a tool for optimization of the transesterification reaction and also in identifying key factors influencing the conversion into ethyl esters. The transesterification reactions were performed using two methods - the traditional mechanical agitation and agitation promoted by ultrasound waves. The nuclear magnetic resonance spectroscopy was used to quantify the conversion of all reactions of transesterification. According to the model obtained for mechanical agitation, conversions above 99% are obtained when the stoichiometric ratio is set at 6:1, with 1.0% KOH, under stirring at 400 rpm, in 60 minutes. Alkaline transesterification assisted by ultrasound waves produced the best results with respect to time of reaction and phase separation of glycerin and ethyl esters. The experimental model showed that conversions above 99% can be obtained in 10 minutes after adjusting the other independent variables.

### Key words

Biodiesel, Babassu oil, Transesterification, Ethanol, Ultrasound

### 1. Introduction

The transesterification of vegetable oils is still the most viable and immediate alternative to reduce the high viscosity of vegetable oils [1]. However, the reaction produces a mixture of esters, free glycerol and non reacted alcohol, catalyst, mono-, di- and triglycerides.

Achieving high conversions in mono-alkyl esters and ensure the removal of contaminants in biodiesel are the main challenges to be overcome. On the other hand, the fatty acid composition of vegetable oils is also a

significant factor related to the performance of biofuels, and saturated carbon chains of vegetable oils are particularly desirable [2].

The babassu is a promising feedstock, which kernel is constituted of 66% by weight of oil of predominantly saturated composition (83%), factors that makes of this oil an excellent candidate for biodiesel production.

In fact, in Brazil many oilseed crops can be used in biodiesel production; currently the greatest part uses soybean oil as the raw material. However, soybean oil is preferably used by the food industry and other oilseeds have been researched to produce biodiesel. In this sense, non edible crops, as the babassu oil which presents annual productivity and a good yield per hectare, have become excellent alternative.

This work aimed to study the production of biodiesel from babassu oil and ethanol. The use of this alcohol is beneficial because it results in a 100% renewable biofuel in synergy with the growing international market for ethanol. The technological route used was alkaline homogeneous catalysis. Mechanical agitation, the most accessible technology, was used and compared with the use of ultrasounds in the reaction.

### 2. Material and Methods

Refined babassu oil was kindly provided by the company COGNIS Brazil Ltd. NaOH (99%), KOH (85%), anhydrous ethanol (99.8%) were used as received from supplier.

The influences of the major controllable variables of the transesterification reaction were evaluated using the experimental design, with Taguchi orthogonal arrays. The levels of controllable factors were chosen based on