

INVESTIGATING THE INFLUENCE OF PINHÃO MANSO (*Jatropha curcas*) SEED ENDOCARP ON THE ACIDITY INDEX OF THE EXTRACTED OIL

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Abstract

Biodiesel is a clean and cyclical energy resource that is derived from animal and/or vegetable fat. As it blends well with petrodiesel, biodiesel is added to Brazilian commercial diesel. The main raw materials used to produce biodiesel in Brazil include soybean, corn, and sunflower oils. However, these are also used for human consumption and hence, have a high market value. Therefore, pinhão manso oil, which exhibits high productivity at low cost, is a promising alternative. However, the high acidity index of this oil results in a low transesterification yield and the produced biofuel does not meet the requirements imposed by the ANP. Thus, this study intends to demonstrate that a large part of the free fatty acids in pinion oil are present in the seed endocarp. For the development of the project, the oil was extracted by hot solvent, using the soxhlet equipment and the hexane solvent, to determine the acidity index, the titration technique was used, the titrant used was sodium hydroxide. So the acidity index of the oil extracted from the seed with its shell is 10.9 mgKOH/g, while the lipid obtained without the shell exhibits a value of 0.95 mgKOH/g, proving the influence of the endocarp.

Keywords: Endocarp. Extraction. Fatty acids. *Jatropha curcas*. Neutralization. Seed.

1. Introduction

The various oil crises combined with the progress of the sustainable development concept has led to the formulation of policies to reduce fossil-fuel dependence. This in turn resulted in increasing attention to biofuels, such as biodiesel—that is derived from biomass, which is not only a renewable and clean energy source but also a substitute for petrodiesel (Kohlhepp 2010).

The Brazilian biodiesel market, in association with the National Biodiesel Production and Use Program (PNPB), proposed to mix a small percentage of ordinary diesel with biodiesel, which in the near future is intended to reach 20%. The main oils used for this purpose include soy, corn, sunflower, cotton, and canola, which are also used for human consumption; hence, these raw materials are expensive and sometimes, scarce (Osaki 2011).

Pinhão manso, which is an oleaginous plant native to Brazil, is a promising source, as it is extremely resistant, adaptable to poorly fertile and sandy soils, highly productive, and involves a low production cost. The oil extracted from its seeds is of high quality; moreover, it exhibits toxicity and a structure similar to that of petrodiesel; hence, it would be a suitable and affordable biodiesel raw material (Portela 2011).

However, the main obstacle to the incorporation of the pinhão manso oil is its high acidity index, which reduces the transesterification yield; moreover the extracted biodiesel does not meet the

requirements imposed by the ANP. Therefore, the objective of this work is to study the influence of the seed shell on the amount of free fatty acids in the extracted oil (Lima 2012).

2. Material and Methods

The present study investigated 10 samples of physic nut seeds, each weighing approximately 100 g.

First, the pinhão manso seeds were placed in a ventilated stove for 10 h at a constant temperature of 50 °C: the lower temperature drying procedure was chosen to avoid thermal damage and thereby preserve the oil quality (Garcia et al. 2004).

After, the dried seeds were fragmented in a knife mill, half of the samples was completely fractionated, while the other half was subjected to partial fragmentation, for manual removal of the endocarp. Finally, the hoarder returned to the mill to complete the disintegration (Faria et al. 2012).

The Soxhlet equipment was used to extract oil from 100 g of dry and crushed physic nuts mixed with 120 mL of hexane. The procedure lasted for 5 h at a constant temperature of 70 °C. As a result, a homogeneous mixture of oil and solvent was obtained, which was placed in a stove at 70 °C for 4 h to ensure the complete removal of hexane (Melhorança et al. 2010).

The acidity index was determined by titration: first, 2 g of oil was weighed, and then diluted in 25 mL of neutral and impurity-free ethyl alcohol in the proportion 1:2 v/v; this mixture was titrated with 0.1 mol/L sodium hydroxide solution using 1% phenolphthalein as the indicator. All analyses were performed in triplicate (Santos 2017).

After determining the acidity index of the extracted oil, the oil was neutralized from the seeds without husk. The following proportion was used: for 100 g of oil, 20 g of sodium hydroxide was collected, which was diluted to obtain an alcoholic solution of 0.1 concentration. This mixture was gradually added to the oil under slight agitation. Next, the mixture was centrifuged at 2000 rpm for 15 min to remove the formed soap; the oil was then placed in a funnel for washing to remove the impurities (Itokagi 2017).

3. Results and Discussion

Table 1 lists the acidity index values obtained for all samples. No significant variation is observed in the values of the three analyses.

Table 1. Acidity index of pinhão manso oil samples.

Samples with husk	Acidity index (mgKOH/g)	Shelled samples	Acidity index (mgKOH/g)
Sample 1	10.98	Sample A	0.96
Sample 2	11.01	Sample B	0.91
Sample 3	10.89	Sample C	0.97
Sample 4	10.96	Sample D	0.95
Sample 5	10.94	Sample E	0.95

The results presented in the Table 1 show that the acidity index of the oil samples with the peel is extremely high, making it impractical for biodiesel production without prior treatment; because with this content the catalyst would be consumed being diverted to soap production, and the yield would be very low (Silva and Neto 2013).

In addition, there is a significant difference in the acidity index of the raw materials; overall, the acidity index of the oil extracted with the peel is 11.41 times higher than those extracted without the endocarp. These values demonstrate that the wrap is rich in free fatty acids and impacts the quality of the oil produced. However, the rate of acid in the oil without the husk is still high, demonstrating a need for treatment.

As shown in the Figure 1, the acidity neutralization process reduces the average acidity index from 0.948 to 0.45 mgKOH/g, which facilitates high yields, and the obtained biodiesel would satisfy the ANP requirements.

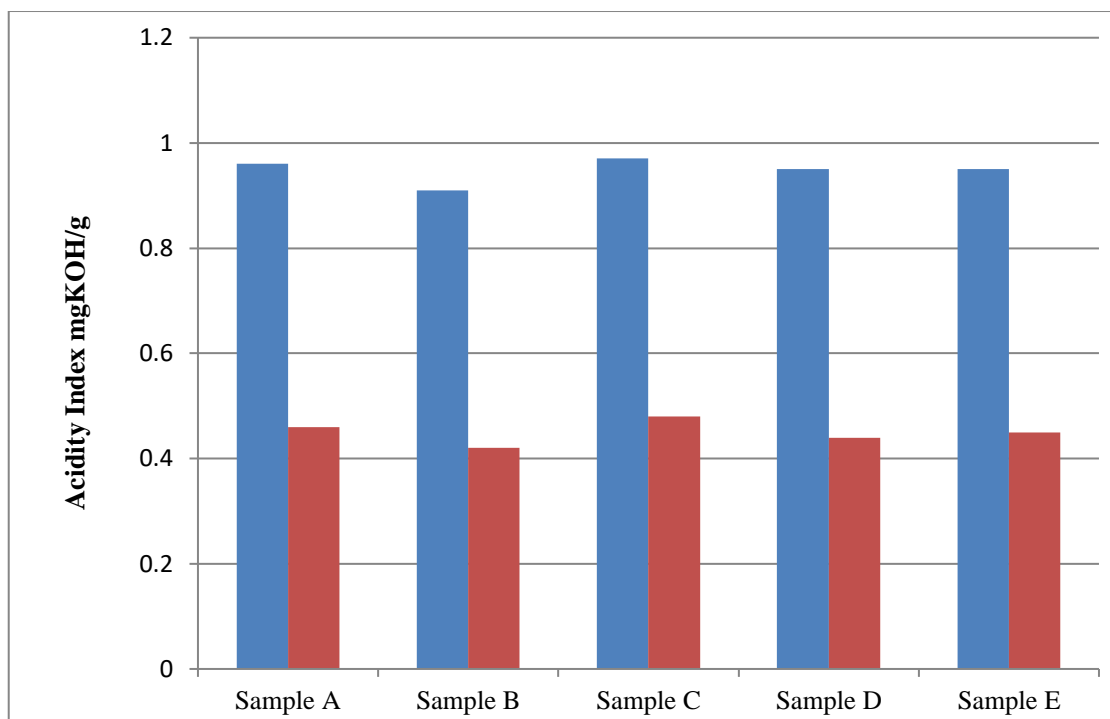


Figure 1. Comparison between the acidity index before and after oil Neutralization.

4. Conclusions

The results of the investigations performed in this study show that extracting oil from a seed with its endocarp results in a higher acidity index of the yield.

Besides, the oil extracted from the seed without the shell also has a relatively high acidity index, demonstrating the need for a treatment before the transesterification process.

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