Production and quality characterization of biodiesel produced from green coconut Pulp

Producción y caracterización de la calidad del biodiésel producido a partir de pulpa de coco verde

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ABSTRACT

Brazil is one of the largest producers and consumers of green coconut in the world, with thousands of units harvested and destined for retail, wholesale and mainly for the bottling industries and fresh consumption in the beach regions, as its water basically represents the greatest source of interest. According to consumers, coconuts, after being consumed in water, are mostly destined for dumps and sanitary landfills that accumulate material annually, with a very voluminous shell and a decomposition time of up to 10 years. Note the possibility of obtaining oil and biodiesel from the pulp, thus being able to obtain a low cost oil for the production of biodiesel. The project in question seeks to carry out characterization tests of the density and specific mass and oxidation time of the Biodiesel obtained from the residual oil. The extraction of oil from the coconut pulp was performed using hexane from the Soxhlet extractor. Thus, it was verified that the percentages of extractive yield between 35 and 37% in oil mass, the results of acidity 0.37 mg KOH/g, density 0.887 kg/dm3 and specific mass 75.78%, meeting the ANP parameters for oils,

coconut oil was later used for the synthesis of biodiesel from transesterification with a basic catalyst (KOH), at 45ºC, the time of oxidative stability of biodiesel was measured in a rancimeter, obtaining a time of 6h, being considered average, necessary the addition of stabilizers, while the dry coconut biodiesel exceeded the maximum analysis time of 12 hours, being even more stable.

Keywords: Cocos nucifera, co-product, biodiesel, green coconut, biofuel.

RESUMEN
Brasil es uno de los mayores productores y consumidores de coco verde del mundo, con miles de unidades cosechadas y destinadas a la venta al por menor, al por mayor y principalmente a las industrias embotelladoras y al consumo en fresco en las regiones de playa, ya que su agua representa básicamente la mayor fuente de interés. Según los consumidores, los cocos, después de ser consumidos en agua, son destinados en su mayoría a vertederos y rellenos sanitarios que acumulan material anualmente, con una cáscara muy voluminosa y un tiempo de descomposición de hasta 10 años. Cabe destacar la posibilidad de obtener aceite y biodiesel a partir de la pulpa, pudiendo así obtener un aceite de bajo costo para la producción de biodiesel. El proyecto en cuestión pretende realizar ensayos de caracterización de la densidad y masa específica y tiempo de oxidación del Biodiesel obtenido a partir del aceite residual. La extracción del aceite de la pulpa de coco se realizó utilizando hexano del extractor Soxhlet. Así, se comprobó que los porcentajes de rendimiento extractivo entre 35 y 37% en masa de aceite, los resultados de acidez 0,37 mg KOH/g, densidad 0,887 kg/dm3 y masa específica 75. 78%, cumpliendo los parámetros ANP para aceites, el aceite de coco fue posteriormente utilizado para la síntesis de biodiesel a partir de la transesterificación con un catalizador básico (KOH), a 45ºC, el tiempo de estabilidad oxidativa del biodiesel fue medido en un rancimetro, obteniéndose un tiempo de 6h, siendo considerado medio, siendo necesaria la adición de estabilizantes, mientras que el biodiesel de coco seco superó el tiempo máximo de análisis de 12 horas, siendo aún más estable.

Palabras clave: Cocos nucifera, coproducto, biodiésel, coco verde, biocombustible.

1 INTRODUCTION

Brazil has about 280 thousand hectares of coconut plantation area (Cocos nucifera), having produced in 2010 about 1.9 billion units of green coconut. Of this immense amount of green coconut produced/consumed we have that, from 70 to 90% of its mass corresponds to its fibrous physique (epicarp, mesocarp and endocarp), and the water itself, consumed mainly on the coasts of Brazil, corresponds to a little more than 10 to 30%. This causes a good part of this fibrous material to be sent to giant piles of coconuts in landfills and dumps, causing a series of environmental and phytosanitary problems, since it has a degradation time of around 8 to 10 years. In some cases they are used for making soles, tree fern fibers, decorative materials, cosmetics, among others, but even today they are still not significant in relation to the amount in tons of this "waste"

generated annually ALEGRIA, A. ARRIBA, M. J. R. CUELLAR, J. APPL CATAL, 2012).

Biodiesel obtained from green coconut oil, although more difficult to obtain (from the pulp), presents great advantages, both environmental and physicochemical (ALMEIDA, T. M., 2013), being possible its use together with soy biodiesel, through blends, contributing to the reduction of part of the waste mentioned above and still attributing value again to this coproduct generated by the beverage trade BRAMÉ, D. B, 2018).

The production and use of biodiesel today as an alternative fuel to conventional fossil fuels are becoming increasingly evident in Brazil and worldwide, due to governmental incentives for its consumption on a national level, being introduced together with Diesel in gradually increasing concentrations over the years. This is presented as an interesting energy alternative, due to its great similarity to conventional Diesel (MENDOW, G. VEIZAGA, N.S. SÁNCHEZ, B.S. QUERINI, C.A., 2019).

Biodiesel presents very positive points in relation to Diesel and others not so much, as is the case of its easy degradation, in the presence of humidity, heat, presence of free radicals among others, however of the positive points we can mention its great lubrication capacity of the internal components of the engine and emission of lower concentrations of pollutants and be of renewable origin (RAMOS, L. P.; SILVA, F. R.; MANGRICH, A. S.; CORDEIRO, C. S, 2011).

The objective of this project was to use part of this generated residue, more specifically the coconut pulp and its oil, with analyses of acidity, specific mass and density of the green coconut oil and oxidative stability of biodiesel in order to ascertain the quality of the final product.

2 MATERIAL AND METHODS

The analyses were performed in the laboratories of IFSP - Matão Campus, as well as the extractions, syntheses and other experiments. The coconuts used in the experiments were of residual origin collected from local sales points in the city of Matão.

The oil was extracted using a Soxleht extractor in 500mL flat bottom flasks, where a proportion of 10ml of Hexane solvent was used for each 1g of previously dried and ground pulp, and extracted at 65ºC.

The density and specific mass of the green coconut oil were analyzed under the following conditions: Temperature of 20 ºC in DDM 2911 Automatic Density Meter device, brand Rudolph Research Analytical, performed in duplicates.

The transesterification of green coconut oil was performed using Methyl Alcohol (MeOH) and Potassium Hydroxide (KOH), separated and washed with 0.5 solution according to ANP (National Petroleum Agency) Resolution No. 734, dated 28.6.2018, and ASTM D6751 standard.

The conditions of the Rancimat analysis of both green coconut and dry coconut in duplicates were 12 hours, temperature of 110.9 ºC according to the standard EN14112 - 2003 for Biodiesel, the Model of the equipment used was a 893 Professional Biodiesel Rancimat of the brand Metrohm, the software used was StabNet 1.0.

3 RESULTS AND/OR DISCUSSION

From the extractions performed, extraction yields between 35 and 37% oil/pulp by mass were obtained.

Table 1. Specific mass and density analyses of the green coconut oil, performed in duplicate.

	Residual green coconut oil
Acid value	0,37 mg KOH/g
Specific mass	75.78%
Density	0,887 g/cm^3

After the analysis, it can be noted that the oxidation time is about 6 hours, and can be implemented together with soy biodiesel adding up in volume of biodiesel produced, but can be further improved with the addition of antioxidants for better preservation of the quality of the final biodiesel. In other words, it is possible to use biodiesel in blends.

Figure 1. Biodiesel from residual green coconut.

Figure 2. oxidation time of green coconut biodiesel at 110°C and 12h of analysis.

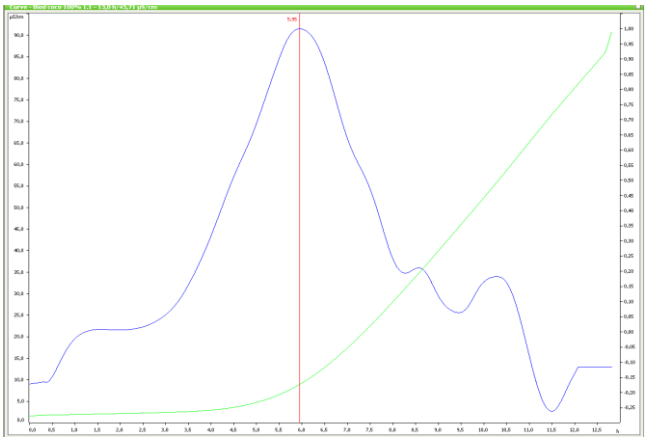
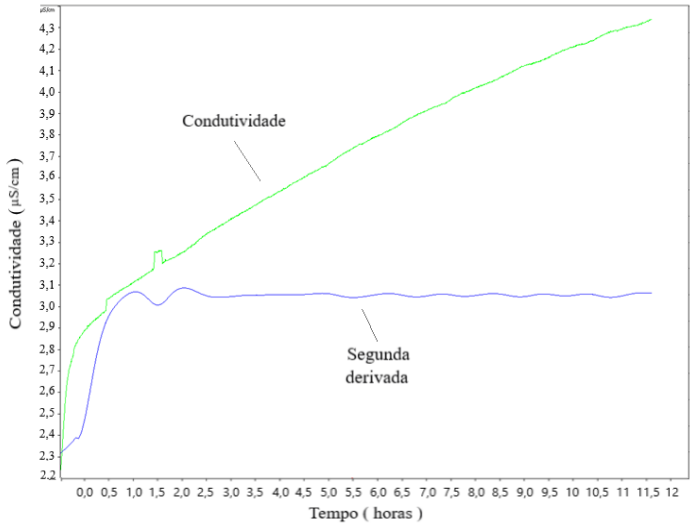


Figure 3. oxidation time of dry coconut biodiesel at 110ºC and 12h of analysis.



4 CONCLUSION

We can conclude that the analyses of acidity, specific mass and density, as well as the oxidation time analysis were satisfactory for the national parameters, but should be considered for future studies the implementation of the use of antioxidants to further increase the time in which the fuel can be stored. Thus, it can be considered a promising alternative for fuel production in coastal regions where its frequent accumulation occurs. Due to the close characteristics between this and soybean oil for example, which is currently the most used for the production of biodiesel, it is thus a possible way to reuse part of a discarded raw material as an automotive fuel that uses Diesel as an energy source.

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