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Production of Biodiesel from Rubber Seed (Hevea Brasiliensis)

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Abstract
In light of the decline of resources that are not renewable and their negative effects on the environment, this article emphasizes the significance of sustainable energy sources. As practical substitutes, renewable energy sources including biomass, geothermal, hydroelectricity, solar, tidal waves, and wind are suggested. Biodiesel manufacturing from vegetable oils obtained from biomass is a viable alternative, and these oils are thought to be an affordable and easily available source of renewable energy. But using edible oils to produce biodiesel puts the food and pharmaceutical businesses in rivalry, which results in a food-fuel problem. Vegetable oils that are not edible, such those from the tree that produces rubber (Hevea Brasiliensis), provide a more environmentally friendly way to produce biodiesel. The seeds of rubber trees are underused and are already planted for the manufacture of latex. With the use of a leftover rubber kernel shell catalyst used, this study looks at the process of conversion of the oil from rubber seeds to biodiesel and shows encouraging findings. It is anticipated that using non-edible oils in the manufacturing of biodiesel will lower prices and make it more competitive with petro-diesel.
Keywords: *Biomass; Biodiesel; Hevea Brasiliensis; Renewable Energy; Rubber Seed*

1. Introduction
The synthesis of biodiesel from the oil of rubber seeds by transesterification is a relatively new field of study that has attracted a lot of attention lately because of the rising demand for sustainable energy sources. Modern technology has made it necessary for continuous energy needs to exist everywhere in the world. Global study for substitute sources of energy has been spurred by the depletion of fossil fuels that are not renewable, such as gas, coal, and oil, as a result of their continuous use, price volatility, energy uncertainty, and environmental concerns. As low-cost and environmentally friendly substitutes, renewable energy sources like biomass, hydropower, solar, wind, tidal waves, and geothermal energy have been suggested (Dwivedi and colleagues, 2013; Thanh et al., 2012). Biomass seems to be the most affordable and accessible of these choices, and its application is anticipated to lead to swift and durable economic growth in many African developing nations (Onoji and colleagues, 2016a; Thanh et others, 2012). The usage of vegetable oils produced from biomass as a raw material for the generation of renewable energy is growing. Recent studies have [1] demonstrated the suitability of vegetable oils for the generation of biodiesel. Oils from vegetables, animal fats, including other oils and fats with basic alcohols are transesterified to create biodiesel, the mono-alkyl methyl ester of fatty acids (FAME). [2] (in this case, methanol) in the midst of appropriate catalysts, including enzymes, homogeneous, and heterogeneous catalysts. Because biomass has the potential to solve energy security, environmental issues, and economic growth, it has gained a lot of interest recently, as has the process of producing biodiesel from vegetable oils. According to the most recent research through Mofijur and colleagues, (2014), Portet-Koltalo and Machour (2013), Jaya and Ethirajulu (2011), as well as Kumar & Purushothaman (2010), the selection of biodiesel is impacted by its being biodegradable non-toxicity, emissions reductions, absence of sulfur, and low amount of polycyclic aromatic hydrocarbons, also referred to as PAH and n-PAHs. But the bulk of biodiesel generated now comes from plants that

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produce edible oil, such rapeseed, soybean, palm oil, and According to Onoji et al. (2016a), Ahmad et al. (2013), Asuquo et al. (2012), and Ma & Hanna (2012), sunflower competes with usage in food, medicine, and cosmetics, causing a food-fuel crisis and high biodiesel costs. According to Dharma et al. (2016), non-edible vegetable oils may be a good substitute for edible oils in industrial applications in order to avoid this problem. Researchers have recently become more interested in the rubber plant (Hevea brasiliensis), a multipurpose bioenergy crop containing non-edible oil (Ng et al., 2013). The main reason Hevea brasiliensis is grown is to produce latex, which is used to make a variety of rubber goods all over the world. In the meanwhile, this plant's seeds are not used very much. Still, after latex, the most important commodity is oil extracted from the seed (Banković-Ilić et al., the year 2012). In the twenty-first century, as the use of fossil fuels is gradually reduced, it is projected that the manufacturing of synthetic rubber would decline in line with the objectives of environmentally friendly development under the Paris Climate Agreement (UNFCCC, 2015). Many African countries that are struggling with poverty might benefit economically from the development of rubber plants for the manufacturing of latex for rubber that is natural and the use of seeds for the manufacture of biodiesel. When trans esterifying edible vegetable oils with low free fatty acid content (FFAs), homogenous base catalysts like sodium hydroxide (NaOH), potassium hydroxide (KOH), and sodium methoxides are usually used. potassium. However, challenges like soap creation, low-grade by-product glycerol, reactors corrosion, difficulty separating the catalyst from the end product, high initial catalyst cost, and the need for large amounts of washing water have prompted additional studies into environmentally benign mixed catalysts for the production of biodiesel from non-edible oils which are rich in FFAs. Furthermore, the high FFA content of the oils limits the use of homogenous catalysts during the transesterification of non-edible oils since the catalyst may react with the oil and reduce the production of biodiesel. According to Uprety et al. (2016), heterogeneous catalysts may be repeatedly employed to produce high-quality products by being simply filtered out of reaction mixtures. Glycerol. In considering this, this study looked into the use of a heterogeneous catalyst to convert non-edible oil from rubber seeds into biodiesel. [3-10]

2. Method

The process for making the rubber seed powder, which is how the oil was extracted, is depicted in the flowchart below. After checking to make sure the rubber seed were new, they were cleaned three to four times in distilled hot water in order to get rid of any dust or solid contaminants. After that, the seeds were dried for 48 hours at room temperature in order to get the moisture content down to 15%, which is necessary in order to produce more oil. The sample's weight differential prior to and subsequent to oven drying was used to calculate the moisture content following conditioning. To find the ideal particle size for oil, a piece of the treated rubber seeds kernel was ground and sieved into a total of five sizes (0.5, 1, 1.5, and 2.5 mm). The following are the primary industrial parameters of the process that affect oil extraction. Figure 1 shows the Rubber seed. [11]

- Sort of solvent
- Particle size of the kernel
- Ratio of seed to solvent
- Time spent extracting
- The temperature [12]

Figure 1 Rubber Seed

potassium. However, challenges like soap creation, low-grade by-product glycerol, reactors corrosion, difficulty separating the catalyst from the end product, high initial catalyst cost, Figure 2 shows the Plantation of Rubber Seed Trees. [13]

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Figure 2 Plantation of Rubber Seed Trees

3. Results and Discussion

3.1 Results

50 g of ground rubber seed kernels were wrapped in muslin fabric for each size of particle that was taken into consideration, and they were then put in an opening of the Soxhlet apparatus extractor. The 500 ml round-bottom glass was securely fastened to the extractor's end and filled with n-hexane solvent. A heating mantle set at sixty degrees Celsius for a forty-five-minute period provided the setup with heat. Whenever the initial drop of the solvent used to extract was recycled again into the thimble, the extraction period was deemed to have ended. Every experiment was carried out in triplicate, and the extracted oil was recovered by centrifuging the mixture in a rotary evaporator while it was under vacuum at 65 degrees Celsius. The following equation was used to calculate the oil yield gravimetrically: Using conventional techniques as outlined by ASTM and AOAC, the extracted oil from rubber seeds was examined for density, specific gravity, API, the saponification value, acidity value, percentage free fatty acids (FFA), iodine significance, peroxide significance, kinematics viscosity, refractive index (RI), and pH. The results obtained from this investigation align with the findings reported by Menkiti et al. (2015), which also obtained oil from Terminalia s cata. Compared to the other diameters (1, 1.5, 2, and 2.5 mm) investigated, the separation of Catappa seeds with oil employing n-hexane solvent produced a yield of 60.45 wt% from the lowest kernel particle diameter of 0.5 mm. Because of the increased surface area produced by the smaller particle size, the seed powder's solvent diffusivity is improved, increasing oil output. [14]

3.2 Discussion

Rubber seed oil has a low calculated moisture content of 1.73 weight percent when compared to castor oil's 8 weight percent and shea nut oil's 10 weight percent. Excessive levels of moisture cause oxidation reactions that shorten the oil's lifespan. This oil's low value suggests that it may be kept for a long time without experiencing a noticeable loss in value. Rubber seed oil's ash content (0.001 weight percent) is less than the recommended ASTM ash limit (0.01 weight percent maximum), as well as that of Afzelia Africana oils (0.006 weight percent) & Hura crepitans oil (0.004 weight percent) (Ogbu & Ajiwe, 2016). The oil's low ash value suggests that it is deficient in trace metals, which can promote oxidation processes leading to rancidity, excessive acidity, and other unwanted effects. features when being stored. Although greater than other vegetable oils like sunflowers (0.03 wt.%), rapeseed (0.05 wt.%), & olive (0.09 wt.%), the carbon residue (0.4 wt.%) is still quite near to the American Society for Testing and Materials limit of 0.35 wt.% max of diesel fuel. (Dermirbas, 1998). (Anastopoulos et al., 2009). The oil's high volatile content raises the possibility that it may be used as a raw material to synthesize biodiesel for internal combustion engines. The high residue of carbon (0.4 wt%) is nearly in line with the maximum 0.35 wt% ASTM requirement for diesel. Due to its high content of unsaturated acids, particularly oleic & linoleic acids, rubber seed oil is vulnerable to oxidizing (Dermirbas, 1998). But it's got a lower freer fatty acid than olive, rapeseed, and sunflower oils, among other oils made from vegetables (Anastopoulos et al, 2009). The oil's volatile constituents imply that it may be an appropriate starting material for the production of biodiesel, which is a fuel for internal engines with compression ignition. Rubber seed oil was liquid at ambient temperature and had a dark brown hue in terms of its physical and chemical characteristics. Its pH of 6.0 is comparable to castor oil's, suggesting that there are some free fatty acids present and that the oil is being used for a good purpose. Low temperatures were used to study the oil's flow characteristics, and the pour point was the The lowest temperature where the oil loses its flowability and gels, turning semi-solid (Verma et al, the year 2016). According to Anastopoulos et al. (2009), the oil's pour point of -6°C suggests that it can be utilized as a raw material for a lubricating oil formulation in cold climates. The cloud point (CP) is the temperature at which, when chilled under precisely regulated conditions, a cloud or haze first forms in a liquid. Rubber seed oil's measured CP of 5.5°C proved to be lower than Jatropha oil's claimed CP of 11°C (Mazumdar et al., 2012). This implies that, in contrast to Jatropha, rubber seed oil is mostly unsaturated and a suitable feedstock material for biodiesel production in cold climates. Rubber seed oil's boiling point was found to be 119°C utilizing a Stanhope-Setastill device. This suggests that moisture may be eliminated at 105°C before using it in industrial processes like the manufacture of lubricants and biodiesel without compromising its characteristics. The Stanhope-Set a cloud & pour point refrigerator, calibrated to -51°C, was used to determine the oil's freezing point, which was found to be -18°C. Stanhope-Seta pensky-marten's equipment was used to determine the fire and flash points, which were found to be 240.3 and 256°C, respectively. This implies that room temperature storage of the oil is safe. [15-20]

Conclusion

The generated rubber seed oil biodiesel's chemical characteristics were discovered to fall within the range that rubber seed oil researchers have previously described. Although the fuel consumption for brakes is affected by the lower energy content of biodiesel, this is offset by increased combustion efficiency and reduced emissions of smoke, carbon monoxide, and total hydrocarbons when compared fossil diesel.[21]

Acknowledgements

It is advised that more research be done on things like:

- To forecast the engine's performance characteristics while utilizing biodiesel made from rubber seed oil and rubber seed shell catalyst, a zero-dimensional computational model should be used; [22]
- To ascertain the degree of component wear, an endurance test should be conducted to examine the effects of the biodiesel on engine parts such as the plunger, injection devices, cylinder head, valves, piston, and rings. [23-24]

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