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Review Paper

Rubber seed: an orphan agricultural produce

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Abstract

The geometric population increase poses huge pressures on energy, food and better lifestyle. The nation's petroleum resource which has been predicted to be decreasing in volume, price and is also hazardous to the environment have directed research to other forms of energy source. One potential source is the rubber seed oil. Hevea brasillensis is an important tree popularly known for its latex production which is useful in the rubber industry. Little attention is given to its other parts like the seed. Rubber seed is high in oil, essential, non-essential amino acids and fat content and can also be a source of energy as bio diesel. It is a cheaper alternative sources of feed and can be a source of diversification of the Nigerian economy. The objective of this paper was to encourage the full harness of the Para rubber tree so as to serve as a means of income for farmers and Nation at large.

Keywords: Rubber, rubber seed, latex.

Introduction

Description of rubber seed: Rubber seeds have different shape, texture and patterns on their surface[1,2]. It can be large, ovoid, shinny, grey or brown with irregular brown dots[3]. The seeds are enclosed in a 3- capsule[4] (Figure-1) which is about 2–5 cm long[5]. The testa is derived from the female parents while the seed shape is determined by the pressure of the capsule. White endosperm is observed in viable seeds while they are yellow in older seed[3].

Production scale

Hevea brasiliensis is an important tree in the world especially for the rubber industry. However, in Nigeria the production and utilization of its seed has been given little or no consideration [6] where about 100-150kg/ha is estimated[7]. The Malaysian Rubber Board 2009 placed its estimated production at nearly 1.2 million tons, and other countries estimated production is as shown in Table-1. Meanwhile, seed production is influenced by disease (abnormal leaf and *phytophora*), species and atmosphere[8].

An approximation of 40% kernel with 20-25% wetness is present in rubber seed. However, an estimated 40-50% of oil existing in the dehydrated kernel add up to 20 million liters of oil every year[9].

Utilization of rubber seeds

The rubber tree is beneficial in the production of rubber and other raw materials meant for the downstream rubber industry. The seed is part of the raw material. Rubber seeds are available and abundant with only small proportion used for propagation while the remnant is mostly disposed as waste.

Table-1: Estimated Countries Rubber Cultivation and Seed Production[10].

Countries	Rubber area harvested (Ha)	Estimated rubber seed production (T)
Cambodia	36,051	55,994
Bangladesh	59,054	91,722
Myanmar	198,364	308,097
Sri Lanka	127,000	197,255
Philippines	161,565	250,941
Viet Nam	459,948	714,387
India	485,665	754,330
China	597,770	928,450
Malaysia	1,117,392	1,735,522
Thailand	2,042,502	3,172,394
Indonesia	3,456,100	5,367,980
Southeast Asia	7,476,192	11,611,947
Asia	8,745,681	13,583,704

Figure-1: Three (3) - capsuled rubber seed.

The processes of rubber seed utilization begins with its picking, shelling of fruits and detoxification. Major seed collection takes place between August and September while between December and January a minor collection is done.

Rubber seed fresh weight varies between 3 to 5g containing about 25%, 35%, 40% of moisture, shell, and kernel respectively[11]. In the Amazon basin of South America the Indian cook the seeds and drain it for food purposes[12]. Oil and cake are the main products obtainable from rubber seed, which yield about 44% and 50% respectively. While the remaining 6% accounted for other wastes, with the cake containing about 8 - 15% oil[12]. Its oil is however comparable to the soya-bean oil[12].

The oil from rubber has yellow colour with a typical semi-drying oil[13]. It is made up of saturated and unsaturated fatty acids. The unsaturated fatty acids are monounsaturated (oleic 18:1) and polyunsaturated such as (linoleic 18:2), or (linolenic 18:3) carboxylic acids[13]. The dried kernel oil content ranges from 35 to 45%[14,15].

It has been revealed in several studies that the oil extracted from the rubber seed are useful in many ways which includes; lubricant[16], printing ink, foaming agent in latex foam[17], fatice[18], biodiesel[19, 20], paints and coatings[21], partial carrier replacement to mineral oil for copper fungicide in the control of abnormal leaf fall disease[22], and soap production[23].

Rubber seed oil (RSO) had been studied in Bangladesh as a potential means for biodiesel production. It has free fatty acid (FFA) which has tendency to increase as the seed storage increases. Morshed[24] had reported a 43% weight increment of FFA in seed for 2 months of storage at room temperature. The biodiesel properties have been found to be comparable with the conventional diesel[24]. Higher viscosity[25,26], biodegradability, environmental friendliness, non-toxicity, replenishable agricultural source, reduced harmful exhaust emissions and lower fire risk all put biodiesel at an advantageous position over the conventional diesel[27,28]. The technical repercussion of using biodiesel of higher viscosity is that it reduces the leakages of fuel in a plunger pair and which alters the parameters of a fuel supply process.[29].

Biodiesels are regarded eco- friendly since they lack sulphur in their oil component[30]. Sulphur been one of the main pollutants in transportation fuel is emitted during the gasoline combustion which is deleterious to the umbworld. In addition,, some of the sulphur dioxide compounds emitted react with steam to form an acidic and corrosive gas that can wear and destroy the combustion engine and its exhaust system.

Edible oil, non-edible oil and micro algae are the major sources of oil for biodiesel production[31,32]. However, due to the competition of land for agriculture and food crop, edible oil is not a viable option. Also, high cost of micro algae production on a large scale have also exempted micro algae leaving non edible oil as the top substitute for biodiesel production[32,33]. Thus, Rubber seed oil is an excellent alternative with great potentials useful as a bio diesel[20,34].

Using non-edible oil for the production of biodiesel over edible oil sources have proven to have many advantages, of which is minimizing the economic and food shortage impacts resulted from using edible oils, added importance to the relevant agricultural industry, and contribution to the gross domestic product (GDP) while reducing expenditure over imported fuels[35]. It also leads to the reduction in deforestation rate, decrease in the amount of carbon dioxide, and more efficient in productive utilization for the current plantation[36].

Furthermore, the possibility of it been able to be introduced straight into an internal-combustion engine [37] or blending it directly with fossil fuel[38] also places it high above others. In addition, Satyanarayana and Muraleedharan[39] reported that some rubber seed oil has a lower carbon dioxide and nitiate dioxide emission than other vegetable oil.

Livestock feeds (cattle and poultry feeds) and nitrogen fertilizer can be formulated from the seed cake Amritkumar[40], Nadrajah[41]. Madubuike[42] conducted a cost-effectiveness analysis on rubber seed cake and found it to be cost-effective and of higher weight gain than the conventional groundnut cake mostly been used for weaner pigs feed. Thus it is a cheap alternative to livestock feed. This is supported by the findings of Ijaiya[43] who specified that rubber seed meal can be up to 50% in broilers diet composition to increase weight without any deadly effect.

Nurtional values

Oluyemi[44] described the Nigeria rubber seed as rich in oil content (49.49%), phosphorous (0.82%) and essential amino acids like L-Lysine (3.60%) and Methionine (1.4%). Vogt[45] also reported that the kernel contains 40 to 50% of highly

unsaturated vegetable oil, 20% protein and 40 to 50% carbohydrates. Also, Eka[46] reported that the rubber seed is rich in essential, non-essential amino acids and fat content.

Udo[47] also reported that the seed cake which are formed following the removal of oil from the seeds are high in protein and Njwe[12]also stated digestible nutrient.

Constraints and solutions

The constraints to the full harness of the product are collection cost, bulkiness of the fruits comprising of the seeds, seed mouldiness tendency, and the seasonality of the seed[12]. Also, the primary constraint to biodiesel production is the insufficient feed stock available on a large scale[31]. These constraints can however be surmounted.

In spite of its abundance in nutrients, toxic compound like hydrogen cyanide (HCN) and cyanogenic glucoside is present in rubber seed[46]. The toxicity compound is high in fresh seeds with an average of 200mg/100g of seeds[48]. In a slightly acid medium or in existence of an enzyme (limarinase), cyanogenetic glucoside are converted into hydrocyanic acid which is very deadly, and when the hydrocyanic acid merges with hemoglobin forming a cyanohemoglobin complex which is unable to carry oxygen. Other indicator of poison include pulse rate rise, no reaction to impulse and spasmodic muscular motion[49].

The fear of anti-nutritional features like Tannin, trypsin inhibitor, and phytate have also hindered its usage. Anti-nutritional features are those elements produced in foodstuffs from the breakdown of species and by different mechanisms (e.g. inactivation of some nutrients, reduction of the digestive process, or metabolic consumption of feed) which utilise effects that is different from the optimal nutrition[50]. Some other commonly used products like soybean have these factors yet its utilization has not been hindered over the years.

However, in the presence of heat, the hydrogen cyanide (HCN) in the cake will be neutralized during the extraction of oil from the seed[51]. Other methods reported by Fuller[52] to eliminate these toxic compounds includes roasting at 50°C for 15min, storage for 4 months in dark condition, soaking in boiling water, soaking in ash solution for 12hours after which it is rinsed. Sharma[53] also stated that the application of iso-proteinous and iso-caloric diet also reduces these compounds.

Conclusion

Demand is a major driving force for crop production and also rubber production. With an increase in the funding of research in the usage of rubber seed oil for bio diesel, this will increase existing rubber farmers income and also motivate new plantation cultivation. This will reinvigorate the country's economy, tackle the food versus fuel battle, reduce environmental hazards caused by emission of greenhouse gases, encourage farmers who have left their plantation as a result of low demand of rubber latex to return to its cultivation and reduce waste accumulation. The enlightenment and training of farmers on the utilisation of rubber seed oil for bio diesel production should be encouraged to harness the full utilization of *Hevea brasiliensis.*

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