Extraction and Characterization of Velvet Tamarind (*Dialium Guineense*) Seed

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DOI: https://doi.org/10.51584/IJRIAS.2024.910005

Received: 30 September 2024; Accepted: 04 October 2024; Published: 04 November 2024

ABSTRACT

Velvet tamarind (*Dialium guineense*) fruit is usually consumed fresh and the seed discarded. The pulp has a unique sour taste due to the natural occurrence of sugars and plant acids together. There is an increase in the demand for juice and juice type beverages. This study aimed at determining the physicochemical properties of velvet tamarind seeds. The velvet tamarind seeds were extracted by Accelerated Solvent Extraction (ASE). The results showed that the sample contained the following physicochemical properties: Specific gravity (0.790), Refractive index (1.690), acid value (16.55mg/KOH/g), Saponification value (330.7mg/ KOH/g), Iodine value (14.10mgI_2/100g), Peroxide value (4.200mg Equiv.O_2/kg), Free Fatty Acid (0.200%) and Specific Gravity of 0.790 g/cm^3. It can be concluded that velvet tamarind (*Dialium guineense*) has good quality oil making it suitable for culinary purposes due to its acid value, and in making shampoos and leather shaving creams due to its saponification value.

Key words: Velvet tamarind, Physicochemical, Seed, Oil, Characterization

INTRODUCTION

Velvet tamarind (*Dialium guineese*), is a woody plant that grows in West Africa's rain forests and is a member of the *Fabaceae caesalpinioidae* family. It has dark green glossy leaves that can reach a height of 15 meters, each measuring 6 to 8 centimeters long and 2.5 centimeters wide at its widest point [1]. Young leaves are occasionally chewed for their tart flavor. From January to May, you can find ripe fruits, although March and April are the busiest months for harvesting. Depending on the region or tribe, different names for velvet tamarind are used in Nigeria. It is called '*Tsamiyar kurmi'* in Hausa's, '*Icheku'* in Igbo, '*Awin'* in the Yoruba and '*Amugen'* in Edo language. The velvet tamarind is a significant, prospective, multipurpose, non-timber agro-forestry crop [2]. Due to its cooling qualities and delicious taste, velvet tamarind pulp is consumed throughout most of Nigeria.

The leaves are leathery, sunken mid-ribbed, roughly oval, coarsely hairy, and blunt at the apex. Its branches are horizontally spread, and its blossoms have a white appearance. Typically, fruits have a stem that is 6 mm long, are spherical and flat, and have a black hue. The fruits are used in non-alcoholic beverages, as flavors in snacks, as a source of vitamin C, and in medical treatments [3]. High levels of micronutrients like salt, magnesium, and potassium are present in fruit pulps. Several ailments, including malaria, are treated using the bark and leaves. It is possible to make a drink to treat dysentery and upset stomach by soaking the velvet tamarind pulp in water. The leaves can be squeezed and apply on wounds [1]. The pod of velvet tamarind

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume IX Issue X October 2024

contains the seed and sweet sour juicy pulp that can be used to flavor a variety of foods.

It has been demonstrated in the past that the fruit may be processed into syrups, concentrates, jams, soft drinks, and alcoholic beverages [4]. Fiber, sugars (including fructose, glucose, sucrose, and maltose), acids, polysaccharides, minor amounts of protein, and fat are all present in fruits [1]. Although many of these plants have been found, the possibility of their use has been constrained by the lack of information regarding their chemical makeup. Numerous investigations on several lesser-known seeds and fruits suggest that these could be beneficial nutrient sources for both people and animals [5]. Velvet tamarind fruit is most valued for its high ascorbic acid content, minerals and sugar. However, not much literature exists about its seeds. This led to the objectives of this work, which is the extraction of oil from velvet tamarind seed and characterization into physical and chemical properties.

MATERIALS AND METHODS

Study Area

This study was carried out in Ikere. Ikere is the second most populous and principal city of Ekiti State, Nigeria. The area lies between latitudes 70 30' North of the equator and longitudes 50 14' East of the Greenwich meridian. The city has an area of 262 km2, of which 52.2% of the population are females, while 47.8% are males. Compared to the entire Ekiti as a state and Nigeria as a country, Ikere is densely populated, with a population density of 778.3/km^2. Ikere-Ekiti is essentially an agrarian and mining community. According to 1991 and 2006 census, the population of was 114,780 and 147,355 respectively. There are three major types of religion in Ikere; Christianity, Islam and traditional religion [6].

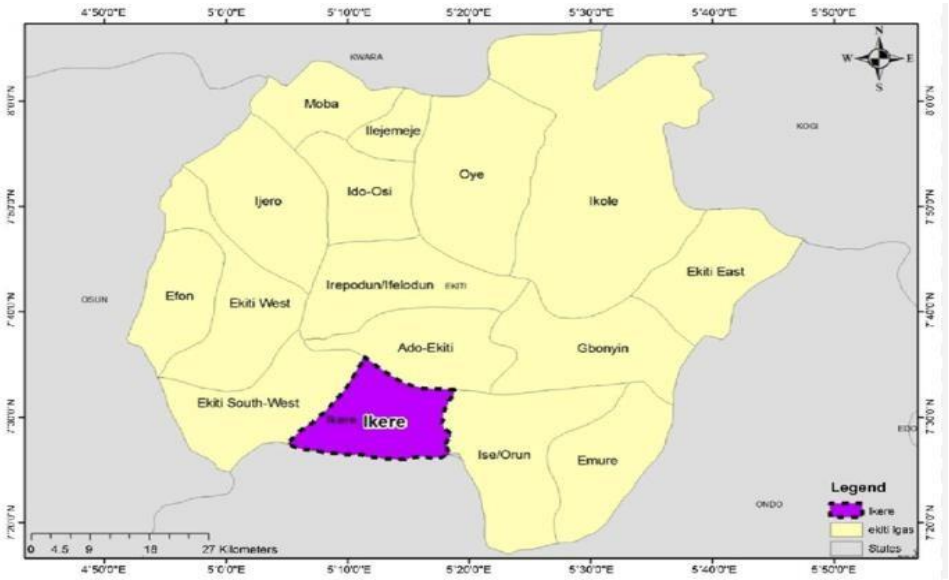

Figure 1. Map of Ekiti State showing Ikere-Ekiti

Sample Collection

The velvet tamarinds were purchased from the King's market in Ikere-Ekiti, Ekiti State. The plant was identified and authenticated by a botanist, Department of Botany, Ekiti State University, Ado-Ekiti.

Extraction

The velvet tamarind seeds were obtained from a garden in Ise-Emure, Ikere-Ekiti were extracted by Accelerated Solvent Extraction (ASE) instrument: DIONEX/USA, model ASE350, USA [7].

Sample Preparation

The velvet tamarind seeds with pulse tissue, were separated; their pulse from the seeds by hand. The seeds

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume IX Issue X October 2024

were washed by tap water and dried in oven, 100^0C for 30mins. The seeds were allowed to cool down in room temperature and were slightly ground in 0.5-1 min. by a blender to separate the brown peels from the kernel seeds. The kernel seeds were grounded into powder in a mortar and pestle and sieved through a 0.5mm sieve. The powdered sample was stored in plastic containers and the samples were placed in a refrigerator at 4^0C until it was used [7].

Physicochemical Characterization

Determination of Saponification Value

A 2.0g of the sample was added to 20ml of ethanolic potassium hydroxide in 500ml round bottom flask. The flask with its content was refluxed for 30 minutes. 2ml of phenolphthalein indicator was added and the hot solution was allowed to cool and later titrated against the 0.5M hydrochloric acid. A blank titration was carried out using the same procedure [7].

$$\text{Saponification value} = \frac{56.1N\ (V_1 - V_2)}{W}$$

Where:

N = molarity of hydrochloric acid.

V_1 = volume of HCl used in the test.

V_2 = volume of HCl used in the blank.

W = weight of sample oil.

Determination of Peroxide Value

A 2.0g of the sample was weighed into the 200ml conical flask containing 20ml of petroleum ether and heated for 30 seconds in a water bath. 20ml of 50% aqueous solution of potassium iodide and 25ml of distilled water were added. The resulting mixture was titrated with 0.002M sodium thiosulphate solution. During the titration a milky white precipitate was observed and the total disappearance of the precipitate indicated the end point of the titration. The peroxide value of the sample was estimated on the basis of the equation below. The same procedure was repeated for the blank[8].

$$\text{Peroxide value} = \frac{100\ (T_B - T_S)}{\textit{Weight of sample oil}}\ \text{MEq } O_2/\text{kg}$$

Where:

N = molarity of thiosulphate

T_S = volume of thosulphate used in the sample test.

T_B = volume of thiosulphate used in the blank.

Determination of Acid Value

A 5g of the sample was weighed into a 250 ml conical flask. 50 ml of hot neutralized alcohol was measured into the flask. The content in the flask was boiled on a water bath, after which 5 drops of phenolphthalein indicator was added into the content of the flask. The mixture was then titrated with 0.1M sodium hydroxide using a burette until a pink color was observed, indicating the end point[8].

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume IX Issue X October 2024

$$\text{Acid value} = \frac{N \times T_B - T_S}{\text{Weight of sample oil}}$$

Where; N = molarity of sodium hydroxide

T_S = Titre value of the sample.

T_B = Titre value of the blank

Determination of Iodine Value

0.2g of the sample was transferred into a flask containing 10ml carbon tetrachloride. 25ml of Wijs solution was added into the flask containing the sample (Wijs solution consists of iodine monochloride in glacial acetic acid). Blank was prepared. The mixture was stored in a dark place for 30 minutes at temperature of 25ºC after which 15ml potassium iodine solution was added along with 100ml of distilled water. The resulting mixture was titrated with 0.1M sodium thiosulphate solution using 2ml of 1% starch indicator. The titration was continued until the blue colour just disappeared, indicating the end point[8].

The iodine value was calculated on the basis of the following equation[7]:

$$\text{Iodine value} = \frac{12.692\ (T_B - T_S) \times N}{\text{Weight of the sample oil}}$$

Where; N = molarity of the solution.

T_S = Titre value of the sample.

T_B = Titre value of the blank

Determination of Ester value

The ester value (EV) is calculated from the saponification value (SV) and Acid value (AV) using the formula below[7]

EV = SV - AV

Determination of Specific Gravity

The sample (40ml) was homogenized and poured into a 500ml measuring cylinder gently to avoid air bubbles. The temperature was controlled to avoid drifting in the temperature value. Hydrometer was dipped into the oil carefully to avoid resting on the wall of the cylinder and the reading was then taken[8].

Determination of Refractive Index

The sample was dried to make it free of moisture. Two drops of the oil was put on the lower prism of the equipment and the prism was closed up. The water was passed through the jacket at 45°C, the jacket was adjusted until the equipment read temperature of 40°C. The light was adjusted and the compensator was moved until a dark border line was observed on the cross wire. The reading on was recorded[8].

Determination of Fatty Acid

The fatty acid profile was determined using a method described by AOAC[7]. The fatty ester was analyzed using a PYE Unicam 304 gas chromatography fitted with a flame ionization detector and PYE Unicam computing integrator. Helium was used as carrier gas. The column initial temperature was 150^0C rising at 5^0C

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume IX Issue X October 2024

min^{-1} to a final temperature of 200^0C respectively. The peaks were identified by comparison with those of standard fatty acid methyl esters.

Statistical Analysis

The results were presented in a table as mean ± S.D (standard deviation).

RESULT

Table 1 showed the physicochemical parameters of Velvet tamarind seed. The results obtained showed that the colour was dark green, while the state at room temperature was liquid. The specific gravity was 0.790±0.23, the Refractive index was 1.690±0.35 and the Acid value (mg/KOH/g) was 16.55±2.35. Furthermore, the Saponification value (mgKOH/g), Iodine value (mg I_2/100g) and Peroxide value (mgEquiv.O_2/kg) was 330.7±10.50, 14.10±2.00 and 4.200±0.50 respectively. The % free fatty acid (FFA) and Ester value (EV) of Velvet tamarind seed was 0.200±0.02 and 314.15±14.00 respectively.

Table 1: Physicochemical parameters of Velvet tamarind Seed

PARAMETERS	**Values**	**NIS[9]**
Colour	Dark green	
State at room temperature	Liquid	
Specific gravity	0.790±0.23	0.900-0.913
Refractive index	1.690±0.35	1.50
Acid value (mgKOH/g)	16.55±2.35	0.60
Saponification value (mgKOH/g)	330.7±10.50	245-255
Iodine value (mg I_2/100g)	14.10±2.00	7-10
Peroxide value (mgEquiv.O_2/kg)	4.200±0.50	10.0
% free fatty acid (FFA)	0.200±0.02	0.30
Ester value (EV)	314.15±14.00	285-320

*Values are in Mean ± Standard deviation

DISCUSSION

The physiochemical properties of velvet tamarind seed was presented in table one. The colour of velvet tamarind was dark green. The state of the oil at room temperature was liquid. The specific gravity was 0.790 g/cm^3. The specific gravity of the oil was lower than those of bottle gourd oil (0.940 g/cm^3) and calabash seed oil (0.900 g/cm^3) [10]. The refractive index of 1.690 showed that it is thicker than most drying oil whose refractive indices fell between 1.475 and 1.485[11]. The value of the refractive index for velvet tamarind was higher than the range of 1.475-1.485 reported for linseed oil, soy bean oil and cod liver oil [12]. Refractive index is the measure of the thickness as well as purity or clarity of the oil. The value of the specific gravity was higher compared with those of kidney bean oil (0.900), *Citrullus colocynthis* (0.910) and bottle gourd oil (0.940) [10].

Free fatty acid is the characteristic that is required for the confirmation of identity and edibility oil [13]. The kinematic viscosity is a metric for the resistance of fluid to deform under shear stress. It is frequently

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume IX Issue X October 2024

interpreted as the thickness or resistance to pouring. Viscosity can be viewed as a measurement of fluid's internal resistance to flow and may be thought as a measure of fluid friction [14]. From the study, Velvet tamarind seed oil had acid value of 16.55mgKOH/g. This value was in close agreement with those reported for castor oil (15.00mgKOH/g) and palm kernel oil (16.60mgKOH/g) [15] but the value was higher than those of *Plukenetia conophora* (11.5mgKOH/g)[16] and melon seed (l1.40mgKOH/g)[15]. The oil's high acid value suggests that it would work well as a resin in the commercial production of paints. [17]. The acid value represents the amount of free fatty acid in an oil due to enzymatic activity, serving as an indicator of oil spoilage. *Dalium guineense* seed oil is resistant to spoilage, making it suitable for culinary use since both the pulp and seed are edible.

The saponification value is inversely proportional to the average molecular weight of the fatty acids present in the oil. Therefore, oils with a high saponification value contain a higher amount of lower molecular weight fatty acids. The saponification value of 330.7mgKOH/g was lesser than the values reported for some oil seeds such as coconut (338.20mgKOH/g) and groundnut (360.20mgKOH/ g)[18] but higher than that of *Terminalia catappa* (207mgKOH/g)[19]. The mean molecular masses of the oil and the saponification value have an inverse relationship. In the production of soap, lather, shaving creams, and shapoo, it has been noted that oils with a high concentration of fatty acids with low mean molecular weights can be used[20-21].

The iodine value and oil components have an inverse relationship. The iodine value gives a proximate value of the unsaturated fatty acids in any sample oil thereby, giving a comparative idea of the constituents of fatty acid[17]. The iodine value of 14.10mgI_2/100g was lower than those of *Citrullus vulgaris* oil with the value of 38.50mgI2/100g and *Citrullus colocynthis* (153mg Iodine/100g)[18], castor oil with the value of 38.70mgI_2/100g[22] and palm kernel oil (33.32mgI_2/l00g)[15]. According to their Iodine values, oils are divided into drying, semi-drying, and non-drying categories. Iodine values in drying oils are above 100[18]. Since Velvet tamarind oil's iodine value was under 100, it qualified as a non-drying oil. The oil's low amount of unsaturated fatty acids is shown by its low Iodine value. The low iodine value of this oil also makes it less prone to oxidation and polymerization, especially when heated. This makes it very safe for cooking and it can likely be used in industries for the production of vegetable-based ice cream. However, it may not be commercially viable due to the low oil yield of the seed.

The Peroxide value was 4.200mg Equiv.O_2/kg. This value was higher than those of coconut oil (4.00 mgEquiv.O_2/kg)[18], castor oil (2.270mgEquiv.O_2/kg)[15], melon seed (2.021mgEquiv.O_2/kg)[23], kidney bean oil (2.90 mgEquiv.O_2/kg)[24] and quinoa (2.44 mgEquiv.O_2/kg)[8]. Oil has a high peroxide value, which prevents rancidity from occurring readily. It can be inferred that velvet tamarind oil would keep in storage for a very long time without degrading. The low peroxide value of *Dialium guineensis* seed oil suggests that the oil is resistant to lipolytic hydrolysis and oxidative deterioration. According to the "Codex Standards for Fats and Oils from Vegetable Sources", the maximum peroxide value for an oil suitable for human consumption is ten milliequivalents of active oxygen per kilogram of oil. Therefore, the peroxide value of velvet tamarind seed oil is satisfactory indicating that the oil can be stored for a longer time without deterioration. Furthermore, the low peroxide value of this oil is expected since its iodine value is quite low at 13.96 mgI2 per 100g indicating a lower proportion of unsaturated fatty acids.

The Free Fatty Acid of velvet tamarind oil was 0.200%. This value was lower than that obtained for groundnut seed oil (0.250%)[15]. It has been shown that it is desirable to ensure that free fatty acid content of cooking oil lies within the limits of 0.0-3.0%[24]. Therefore, the low level of % free fatty acid indicates that the sample oil is edible and would not spoil easily via oxidative rancidity. The oxidation of oil is influenced by the fatty acid composition of the oil. Oils that contain more unsaturated fatty acids are oxidized more readily than those with fewer unsaturated fatty acids.

CONCLUSION

It can be concluded that velvet tamarind (*Dialium guineense*) seed has good quality oil. The iodine value provides an estimated number of unsaturated fatty acids in the oil. Knowing the percentage of unsaturated components by looking at the iodine value has always given an understanding of the composition of the saturated fatty acid components. As a result, oil with a high Iodine value also has a high level of unsaturated

fatty acids. Low Iodine values in Velvet tamarind oil indicate a high level of saturated fatty acids and low levels of unsaturated fatty acids. This indicates that, contrary to what the Peroxide value had previously indicated, velvet tamarind oil would be less susceptible to oxidative rancidity.

Conflict of Interest

The authors declare no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

Funding

The author's did not receive any funding and/or grant from individuals, government or cooperate Organizations for this research work.

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ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume IX Issue X October 2024

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