COMPARISON OF PHYSIOCHEMICAL PROPERTIES OF TWO DESERT DATE (*BALANITE AEGYPTIACA*) SEEDS OIL FOR INDUSTRIAL AND DOMESTIC PURPOSES

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Abstract

The desert date seeds from two different locations were collected, washed, decocted, dried, and pulverized. The seed oil was extracted using soxhlet apparatus with n- hexane as solvent. The percentage yield of the extracted oil was found to be 40.5% and 42%. While the physicochemical analysis of the seeds oil were conducted using standard procedures with the following results; specific density $0.98g/cm^3$ and $0.87g/cm^3$, saponification value 134mgKOH/g and 136mgKOH/g peroxide value 38meq/kg and 36meq/kg, acid value 12.6mgKOH/g and 12.5mgKOH/g free fatty acid value 12.7mgKOH/g and 12.5mgKOH/g. These results indicate that Desert date seed oil have almost the same physiochemical properties and could be a rich source of oil for industrial and domestic purposes if exploited richly.

Key words: Balanites aegyptiaca, soxhlet apparatus, n- hexane, biomass, edible

1.0 Introduction

Plant oils represent one of the key materials that can be obtained cheaply from biomass and be processed readily to supply the appropriate raw material for chemical industries (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018). Plant oils have both edible and non edible applications e.g lubricants, cosmetics, soap production, biodiesel and insulating materials (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018). But in our country Nigeria, oils are produced from groundnut, coconut, moringa, jatropha, castor etc. while there are other potential sources of oil in which the country still is not utilizing. *Balanites Aegyptiaca* plants fruit is one of the sources of oil rich fruit product that must be used in order to increase the oil yield to fulfill the demand of the people and to upgrade the oil quality in order to protect people from health risk.

*Balanites Aegyptiaca*is a species of tree, deep rooted ever green or semi deciduous tree up to 12m high. Classified either as a member of the *zygophyllaceae or Balanitaceae*. It is multi branched and the flowers are small. The plant grows in tropical and desert areas. It can be found in many kinds of habitats, tolerating a wide variety of soil types from sand to heavy clay and climatic moisture (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, 2018). *Balanites Aegyptiaca* is perennial plant used in food preparations, especially in Africa and developing countries. It has multiplicity of uses and almost every part of the plant is useful including, leaves thorns, back of root and fruit. The fruit is used to treat liver disease.

It is very tolerant to drought and thrives with an annual rainfall of 200mm or less where there is an additional water supply e.g banks of Nile in Sudan. It spreads from the margin of the desert to the woody Savannahs with up to 900mm of annual rainfall. It prefers deep sandy loam soils and uninterrupted access to water such as valley floors, riverbanks or the foot of rocky slopes. It can run wild in abundant environments and become a weed. *Balanites Aegyptiaca* seed kernel is considered as an extremely useful edible product. The *Balanites Aegyptiaca* seed oil has been used in many countries as ingredient and substituent to groundnut oil in the preparation of local food (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, 2018).

2.0 Material and Method

2.1 Sample collection and treatment

The desert date fruits were obtained from Gomo in Sumaila Local Government of Kano State and Bura in Ningi Local Government of Bauchi State. After collection they were sundried and their shells cracked using metal hammer to obtain its seeds separately. The dried seeds were crushed separately into cake using mortar and pestle in order to weaken the cell walls to release fat for extraction.

2.2 Extraction of Desert date seed oil

About 200ml n- hexane was measured and then poured into a round bottom flask. Two samples weighing 100g were placed in the thimble separately and then inserted in the centre of the extractor. The solvent were heated to $70^{O}C$ and when the solvent boiled, the vapour rose through the vertical tube into the condenser at the top. The liquid condensate dripped into the filter paper thimble in the centre which contained the solid sample to be extracted. The extract seeped through the pores of the thimble and filled the siphon tube then flowed

back down into the round bottom flask. This was allowed to continue for about 5hours for the two samples so as to maximize the oil yield (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018).

$$\% \, Yield = \frac{Weight\,of\ oil\ extracted}{Weight\,of\ seed\ used} 100\%$$

(1)

Experimental set up of soxhlet apparatus

2.3 Determination of Physical Parameters

2.3.1 Colour

The colour of the extracted seed oil was observed visually.

2.3.2 Determination of Moisture Content of the Seeds

30g of the clean samples were weighed and then dried in the oven at 80^OC for hours and the weights were recorded after every 2hour. The same procedures were repeated until a constant weight was obtained. The samples were then removed from the oven and placed in the desicator for 30minutes to cool then removed and reweighed. The % moisture content in the seeds was calculated using equation (1)

$$\% \text{ Moisture} = (W_1 - W_2/W_1) \times 100 \quad ....1$$

Where W_1 = Weight of the sample before drying and $W_{2 =}$ Weight of the sample after drying.

2.3.3 Determination of Percentage Yield

The percentage yields for the two samples were obtained using the relation of the below equation as reported by (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018). The oil obtained from the extraction was transferred into a measuring cylinder which was placed over a water bath for 30minutes at 70^OC so as to ensure complete evaporation of the solvent and then the volume of the oil was recorded using equation (2)

$$\% \text{ Yield} = (W_1/W_2) \times 100 \quad ....2$$

Where $W_{1 =}$ Weight of oil extracted and W_2 = Weight of sample used

2.3.4 Refractive index

The refractive indexes were determined using the Abbe's refractometer. It measures the index of refraction by measuring the critical angle of total refraction. In this case, a few drops of the samples were transferred into the glass slide of the refractometer. Water at 30^OC was circulated round the glass slide to keep its temperature uniform. Through the eyepiece of the refractometer, the dark portion viewed was adjusted to be in line with the intersection of the cross. The pointer on the scale pointed the refractive indexes at no parallex error.

2.3.5 Determination of Specific Density

Density is the ratio of mass to volume and depends on the fatty acid composition and minor components as well as on the temperature (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018). If an oil has low density, it indicates that it contain low molecular weight fatty acids and it will have high saponification value which means it can be used for soap production (Afolabi, 2008) .

About 25ml of the oils were measured in a pre- weighed measuring cylinder. The weight of the cylinder and the oil was taken; the weight of the oil was obtained by subtracting the

weight of the cylinder from the weight of the oil and the cylinder. The specific density of the oil is obtained using equation (3) (John, 2008).

$$S.D = \frac{W_1 - W_2}{V_O} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots..3$$

Where W_1 = Weight of empty measuring cylinder + oil; W_2 = Weight of measuring cylinder and V_O = Volume of oil.

2.4 Determination of Chemical Parameters

2.4.1 Acid Value

A 2.0 g of the oil samples were placed in 250ml conical flask followed by 25ml of the absolute ethanol and three drops of phenolphthalein indicator. The mixtures were then heated in a shaking water bath for 5 minutes. While hot, titrated against 0.1M KOH until pink colour appeared. Vigorous shaking was done when approaching the end point to ensure thorough mixing. The volume of 0.1M KOH consumed by an acid was recorded. The acid value was calculated as reported using equation (4) (Kyari, 2008).

$$A.V = 56.1 \times V \times M/m \ldots\ldots\ldots\ldots\ldots\ldots.4$$

Where V= Volume of KOH used; M= Molarity of KOH and m= Mass of the sample.

2.4.2 Iodine Value

About 0.25 g of the oil samples in 250ml conical flask was added to 10ml of chloroform followed by 30ml of Hanus iodine solution. The flask was securely closed and the solution was left shaken for 30 minutes in the dark. This was followed by adding 10 ml of 15% potassium iodine solution and then shaken after which 100ml of distilled water were added. The mixtures were then titrated with the iodine solution against 0.1 M Sodium thiosulphate solution till a yellow colour is formed. This was followed by addition of 2-3 drops of starch solution after which a blue solution is formed. The titration continued until the blue colour disappeared while the volume of $Na_2S_2O_3$ at end point was recorded. The iodine values I.V were calculated using equation (5) (AL-Hamdany & Jihad, 2006).

$$I.V = \frac{12.69 \times C(V_1 - V_2)}{m} \ldots\ldots\ldots\ldots\ldots.5$$

Where C = concentration of $Na_2S_2O_3$ used; V_1 = volume of $Na_2S_2O_3$ used for the blank; V_2 = volume of $Na_2S_2O_3$ used for the sample and m = mass of the sample.

2.4.3 Saponification Value

About 2g sample of the oil was weighed into a 250ml glass conical flask, and then 10ml of ehanolether mixture (2:1) was added to the same flask followed by 25ml of 0.5 N ethanolic potassium hydroxide. The flask was then fitted to a reflux condenser and refluxed using a boiling water bath for 30 minutes with occasional shaking. To the warm solution were added 3- 4 drops of phenolphthalein indicator and the warm solution was titrated against 0.5M HCl

to the end point. The same procedure was used for other samples and blank. The expression for saponification values (S.V) is calculated using equation (6) (Kyari, 2008).

$$\text{S.V} = {56.1 \times M \times (B - R)}/{m} \dots\dots\dots\dots\dots\dots\dots 6$$

Where B= volume of the solution used for blank test; R= volume of the solution used for determination; M= molarity of HCl used and m = mass of the sample.

2.4.4 Peroxide Value

Into a 250ml Erlenmeyer flask, 2g of the oil samples, 1ml of potassium iodine and 20ml of solvent mixture (glacial acetic acid/ chloroform, 3/2 by volume) were added and the mixture was boiled for one minute. The hot solution was poured into a flask containing 20 ml of 5% potassium iodine. Thereafter 3 drops of starch solution were added to the mixture and the later was titrated with 0.1 M standardized sodium thiosulphate and the peroxide value was determined following the method reported by (Akpan, Jimoh, & Mohammed, Extraction, Characterization and Modification of Castor Seed Oil, 2006) using equation (7).

$$\text{P.V} = {V \times M \times 100}/{W} \dots\dots\dots\dots\dots\dots 7$$

Where V= volume of $Na_2S_2O_3$; M= molarity of $Na_2S_2O_3$ and W = weight of oil sample (g)

2.4.5 Free fatty acid (FFA)

About 2g of the oil samples were placed in a 250ml conical flask and warmed while 2.5ml of methanol were added with thorough stirring, followed by 2 drops of phenolphthalein indicator and a drop of 0.14M potassium hydroxide solution. The content was then titrated against 0.14M potassium hydroxide solution while shaking vigorously until a permanent light pink colour which persisted for 1minute was observed. The end point was recorded (Afolabi, 2008). The FFA value was calculated using equation (8).

$$\% \text{ FFA} = {V \times M \times 28.2}/{W} \dots\dots\dots\dots\dots\dots\dots 8$$

Where V= volume of KOH used; M= molarity of KOH and W= weight of the sample.

3.0 Results and Discussion

Table 1. Physical Properties of Gomo and Bura Desert date seeds oil

S/N	Analysis	Gomo Sample	Bura Sample
1.	Colour	Pale yellow	Pale yellow
2.	Odour	Mild	Mild
3.	State at room temperature	Liquid	Liquid
4.	% Yield	40.5	42
5.	Moisture content (%)	8.2	8.5
6.	Specific density (g/cm^3)	0.98	0.87
7.	Refractive index	1.33	1.34

Table 2. Chemical properties of Gomo and Bura Desert date seeds oil

S/N	Analysis	Gomo Sample	Bura Sample
1.	Saponification value (mgKOH/g)	134	136
2.	Iodine value (g/100g)	42.6	41.2
3.	Peroxide value (meq/kg)	38	36
4.	Acid value (mgKOH/g)	12.6	12.5
5.	Free fatty acid value (mgKOH/g)	12.7	12.5

Percentage yield

The % Yield of the Gomo and Bura seeds were found to be 40.5% and 42% respectively. These were found to be comparable to other various seed oil (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018).

The results of the refractive indexes are 1.33 and 1.34. These are within that obtained by (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018). This indicates that the oils are not as thick as most drying oils whose refractive index is within 1.48 – 1.49 (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018).

Saponification value

High saponification values indicate high proportion of lower fatty acid. The values of the saponification of the desert date seeds oil are 134mg KOH/g and 136mg KOH/g. This indicates that the oil could be used in the manufacture of soap (Kirschenbauer, 1995) which is comparable to 136 mg KOH/g as presented by (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018).

Iodine value

Desert date seed oil can be classified as a non – drying oil as a result its iodine value of 42.6g/100gand 41.2 g/100g indicates that the oil contains high level of unsaturated fatty acid and is responsible for the liquid state of the oil at room temperature. The iodine value obtained agrees with 43.1g/ 100g reported by (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018).

Acid value and free fatty acid value

The acid and the free fatty acid values obtained from the desert date seeds oil were 12.6mg KOH/g, 12.5 mg KOH/g and 12.7mg KOH/g, 12.5 mg KOH/g respectively which relatively agrees with that obtained by (Ogala, Elinge, Wawata, Adegoke, Muhammad, & Ige, April, 2018).

Peroxide value

Peroxide value depends on the number of factors such as state of oxidation that is quantity of oxygen consumed, method of extraction and type fatty acid present in the oil. The seeds oil has a peroxide value of 38meq/kg and 36 meq/kg.

4.0 Conclusion

The preliminary investigation on the extraction and chemical analysis of the two Desert date seeds oil revealed that the oil has similar properties and are economically viable oil source due to their oil contents were found to be high, the parameters showed that they are composed of moderately long chain fatty acids with a degree of unsaturation. This makes them good feedstock for domestic and industrial purposes.

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