

PHYTOCHEMICAL AND PHYSICOCHEMICAL PROPERTIES OF DESERT DATE (*Balanite aegyptiaca* Del.) SEED KERNEL OIL

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Abstract

The desert date (*Balanites aegyptiaca*) is an important tree found in some African countries. The study was conducted on some of the phytochemical composition of the desert date kernel and some physicochemical properties of its oil. The Oil yield was $35.0 \pm 0.6\%$ while qualitative phytochemical screening of *Balanites aegyptiaca* seed kernel oil revealed the presence of alkaloids, saponins and flavonoids. The quantitative phytochemical of the seed kernel revealed the following: Alkaloids 3.68 ± 0.008 mg/100g, saponin 2.31 ± 0.003 mg/100g, flavonoids 3.02 ± 0.04 mg/100g. The physicochemical analysis of the kernel oil revealed specific gravity, 0.94 ± 0.01 , Acid value, $(1.68 \pm 0.05 \text{ mgKOH/g})$ peroxide value, $(7.10 \pm 0.36 \text{ mEq/Kg})$ Saponification value, $(180.45 \pm 3.60 \text{ mgKOH/g})$, and iodine value, $(89.51 \pm 1.32 \text{ gI/100g})$. The results for physiochemical were compared and found to be within the FAO/WHO standards.

Keywords: Phytochemical, Physicochemical, Properties, Desert Date, Seed Kernel Oil

Introduction

Desert date (*Balanite aegyptiaca* Linn.) is an important multipurpose tree found in most African countries (Clement *et al.*, 2011). *Balanites aegyptiaca* has multiple applications with almost every part of the plant being useful. The tree is actually valued more for its fruits and seeds: The fruits and kernel are widely used in many ways in different countries including Nigeria especially during the dry season and drought periods (Lockett *et al.*, 2000). The kernel of this plant is traditionally used in the treatment of various ailments such as jaundice, intestinal worm infection, malaria,

syphilis, epilepsy, dysentery, constipation, haemorrhoid among others (Daya and Vaghasiya, 2011). The stem of the plant is used as timber, poles, charcoal, firewood, fodder, food (Elseed *et al.*, 2002), gum, shade, gum and windbreak (Guinand & Lemessa 2001).

Balanites aegyptiaca fruit is readily available in northern Nigeria and the seed which is obtained after it is being sucked is seen as a nuisance along markets and settlements in communities (Jock, 2011). This is because no suitable application for the seed kernel has been found in most developing countries. However, the seed kernel oil of *Balanites aegyptiaca* is a good

source of raw material for food, cosmetic and pharmaceutical industries (Jock, 2017).

This multipurpose tree is used for food and fodder in almost all parts of Africa and South Asia (Elseed *et al.*, 2002). Among the various useful parts of the plant are the fleshy pulp of the fruit is eaten fresh or dried; it also used as a food, and also as beverage and medicines. The kernel produces high quality edible oil (Obidah *et al.*, 2009) with large number of medicinal properties (Hanan *et al.*, 2009), and is also rich in protein and minerals contents (Elfeel & Warrag, 2011). The quality of the oil is similar to sesame and groundnuts oils. This plant has been reported to have anti-helminthic, purgative, vermifuge, febrifuge, vomiting, anti-skin boils, leukoderma and anti-malaria properties (Sibhat and Hiben, 2016). The plants have also been used in wounds, colds, liver, spleen disorders, and diarrhoea treatment (Hamid *et al.*, 2001). *Balanites aegyptiaca* has been useful in breakdown of stomach pains, epilepsy, jaundice, yellow fever and syphilis (Ojo *et al.*, 2006). All parts of the plants have ethnomedicinal uses including fruits, seeds, barks and roots. HIV/AIDS (Montasser *et al.*, 2017), *Balanites aegyptiaca* (Al Ashaal *et al.*, 2010) have been reported to contain a number of phytochemical compounds including flavonoids, alkaloid (Sarker *et al.*, 2000), glucosides (Breimer *et al.*, 2007), phenolic (Rohini and Srikumar, 2014), steroids, saponins, furanocoumarins, Diosgenin, N-trans-feruloyl tyramine, N-cis-feruloyl tyramine, trigonelline, and balanitol (Al-Thobaiti & Abu Zeid, 2018). These phytochemicals such as flavonoids, phenolic acids, tannins and lignans can

scavenge reactive oxygen species (ROS), and quench free radicals. Therefore, phytochemicals can serve as effective natural agents for preventing and treating free radical-mediated diseases. Phytochemical compounds prevent inflammatory conditions and inhibited oxidative damage of food products (Abdallah and Al-Khalifa, 2012). Previous researches reported that the curative effect of any medicinal plant is directly related to active compounds found in the plant (Abdallah, 2011)

Justification

The production of oil seeds is one of the most important agro-industries in the world today. Formulation of food, drugs and cosmetics are derived from plants and animal oil (Nimet *et al.*, 2011).

Wild plants such as *Balanites aegyptiaca* contributes greatly in improving the livelihoods of communities. Edible part of plants is nature's gift to mankind; these are not only delicious and refreshing but also provide vitamins, minerals and proteins (Kumar & Hamal, 2009).

Aim and Objectives of the Study

The aim of the study is to determine some phytochemical compounds and physicochemical properties of *Balanites aegyptiaca* seed oil.

Objectives

1. To determine the phytochemical compounds present in *Balanites aegyptiaca* oil.
2. To determine the physicochemical properties of *Balanites aegyptiaca* seed oil.

Scope of the Study

The scope of the study is limited to the qualitative and quantitative determination of alkaloids, flavonoids and saponins both qualitative and quantitative in *Balanites aegyptiaca* seed kernel oil. The physicochemical properties which include specific gravity, saponification value, Acid value, Iodine value and peroxide value.

Methodology

Sample Collection

The fruits of *Balanites aegyptiaca* (desert date) were purchased from Kaura Namoda market in Zamfara State. The plant was identified in biological laboratory unit of Science Laboratory Department Kaura Namoda Zamfara state, Nigeria by the researchers.

Sample Preparation

The fresh fruits were soaked with water for six hours. It was then washed to remove the pulps. It was then dried for two days under shade. The fruits were crushed using a steel hammer to obtain the kernels, which were then air-dried and then ground using mortar and pestle. The ground kernel was then packed in an air tight container and then stored in a desiccator ready for further analysis.

The oil was then extracted using Soxhlet extractor with petroleum for 16 hours and dried in rotary evaporator. All the chemicals and reagent used were of analytical grade.

Extraction of the Sample

The seed kernel oil of *Balanites aegyptiaca* was extracted according to the

method adopted by (Mortadha *et al.*, 2015.)

Quantitative Phytochemical Analysis

The phytochemicals were screened for the presence of alkaloids, saponin, and flavonoids in accordance with standard methods by (Harborne 1998; with slight modification by Tripathi and Mishra 2015.)

Preparation of sample for phytochemical analysis

Two grams of the extract was dissolved in 10cm³ of 1% hydrochloric acid and then filtered. The filtrate is then used for the phytochemical tests.

Test for Alkaloids

The extract (2 g) was dissolved in dilute 1% hydrochloric acid and filtered.

A portion of the filtrate (1 ml) was then treated with 4 drops of Mayer's reagent (potassium iodide). Formation of white or pale-yellow precipitate indicates the presence of alkaloids.

Test for Saponin

Froth Test: A portion of the filtrate (2 ml) was diluted with distilled water to 5 ml and then shaken in a graduated cylinder for 5 minutes. Formation of honeycomb froth that remains after 5 mins confirms the presence of saponin.

Test for Flavonoids

Alkaline Reagent Test: A fraction of the extract (2 ml) was treated with 4 drops of 1% sodium hydroxide. Formation of

yellow colour indicates the presence of flavonoids.

Determination of Qualitative Phytochemical

Determination of Alkaloids

Alkaloids were determined according to (Harborne 1973, Obadoni and Ochuko 2001).

Procedure

Five (5g) of the powdered sample were placed in 250ml conical flask and 100ml of 50% alcohol was added, the mixture was boiled under reflux for 30mins and was immediately filtered while hot through muslin cloth. The extract was cooled (some saponin may be separated) and equal volume of acetone was added to complete the project Timon of saponin. The separated saponin were collected by filtration and was washed with boiled 95% alcohol and weighed.

Calculation

$\% \text{ Saponin (g\%)} = \frac{\text{Weight of residue}}{\text{Weight of sample}} \times 100$

Determination of flavonoids

The precipitation of flavonoids was carried out according to the method described by Bohm and Kocipai (1993)

Procedure

Five (5g) of the powdered sample were placed in 250ml conical flask. 100ml of dilute HCl was added and was boiled for 35mins while hot to recover the extract. The filtrate was treated with ethyl acetate drop wise twice until in excess.

Calculation

$\% \text{ Flavonoids (g\%)} = \frac{\text{Weight of residue}}{\text{Weight of sample}} \times 100$

Determination of physicochemical properties

3.8.1 Specific gravity Determination

The specific gravity of the liquid was determined according to (AOAC, 2000). The weight of 50 mL empty density bottle was recorded and the density bottle was filled with water. Equivalent quantity of oil was replaced with the water in the same bottle and weighed. The oil was vacuum filtered to remove any suspended particles.

The specific density of the oil would be calculated

Specific gravity =

$W_2 - W_1$

$\frac{W_0 - W_1}{W_0 - W_1}$

W_0 = Weight of empty density bottle (g)

W_1 = Weight of density bottle filled with water (g)

W_2 = Weight of density bottle filled with oil (g)

Saponification value Determination

After saponification, the remaining KOH is estimated. The saponification value was determined as described by (AOAC, 1990).

Four (4g) of the oil sample was weighed into a flask and 50ml of alcoholic KOH was added from burette by allowing it to drain for a definite period of time. A blank was prepared by taking only 50ml of alcoholic KOH and allowing it to drain

at the same time the flask was connected to an air condenser and was boiled gently for 1hr. After the flask and condenser was cooled, the inside of the condenser was rinsed with a little distilled water and the condenser was removed. One (1ml) of phenolphthalein indicator was added and was titrated against 0.5N HCl until the pink colour turns colourless. The saponification value (SV) is calculated as;

$$SV = 28.05 \times (\text{Blank titre value} - \text{sample titre value}) / \text{weight of sample}$$

Two (2g) of the oil sample was weighed into a 250ml conical flask and 50ml of absolute alcohol was added. A few drops of phenolphthalein were added and was titrated against 0.1N potassium hydroxide. It was then shaken constantly until a pink colour which persists for fifteen seconds is obtained. The acid value is calculated using the expression:

$$AV = \text{titre value} \times \text{Normality} \times \text{KOH} / 56.1 / \text{weight of sample}$$

Iodine value Determination

Iodine was determined as described by (AOCS, 1998).

Procedure

0.5g of oil sample was weighed into an iodine flask and was dissolved in 10ml of chloroform. 0.25ml of Hanus iodine solution was added using a pipette. It was drained in a definite time it was mixed and was allowed to stand for 30mins in a dark room. 10ml of 15% potassium iodide was added and was shaken thoroughly. 100ml of freshly boiled and cooled water was added washing down any free iodine on the stopper. It was titrated against 0.1N sodium thiosulphate until a yellow solution turns almost colourless. At this point, a few drops of

starch indicator solution were added and was titrated until the blue colour completely disappears. Towards the end of the titration, the flask was stopped and shaken vigorously so that any iodine remaining in solution in CHCl_3 is taken up by potassium iodide solution. A blank was run without the sample. The iodine value is calculated as

$$IV =$$

$$\frac{\text{Blank titre value} - \text{Sample titre value} \times N \times 12.69}{\text{Weight of sample}}$$

Peroxide value Determination

Peroxide value was determined as described by (AOCS, 1990).

Procedure

One (1g) of the oil sample was transferred into a dry boiling tube and 1g of powdered potassium iodide was added and 20ml of the solvent mixture glacial acetic acid and chloroform in a ratio 2:1 v/v was added too. The tube was placed in a boiling water so that the liquid boils within 30 seconds. It was allowed to boil vigorously for more than 30 seconds. The content was quickly transferred into a conical flask containing 20ml of 5% potassium iodide solution. The tube was washed twice with 25ml water and was collected into the conical flask. It was titrated against 0.1N sodium thiosulphate solution until a yellow colour turns colourless, 0.5mL starch indicator was added and titration was continued until the blue colour changed to colourless. A blank titration is also carried out. The peroxide value is calculated as:

$$PV \text{ mEq/kg} = (\text{Sample titre value} - \text{Blank titre}) \times N \times 100 / \text{weight of sample}$$

Results

The result of phytochemical screening test of the seed kernel oil of *Balanite aegyptiaca* is shown in table I. The kernel oil revealed the presence of alkaloids, flavonoids and saponin.

Table I: Qualitative phytochemical screening of *Balanites aegyptiaca* seed kernel oil

Phytochemicals	Observation
Alkaloids	+ ve
Flavonoids	+ ve
Saponins	+ ve

Table II shows the results for the quantitative phytochemical determination of the desert date kernel oil with the percentage of alkaloids 3.68 ± 0.008 saponin 2.31 ± 0.003 and flavonoids 3.02 ± 0.04 .

Table II: Quantitative phytochemical of *Balanites aegyptiaca* seed kernel

Phytochemicals	Result (mg/100g)
Alkaloids	3.68 ± 0.008
Flavonoids	3.02 ± 0.04
Saponins	2.31 ± 0.003

Lower doses of alkaloids have important pharmacological activities, such as reducing blood pressure, killing tumour cells, analgesic activity, stimulating circulation and respiration (Egbuna and Ifemeje 2015).

Table III shows the qualitative phytochemical assessment of *Balanites aegyptiaca* kernel oil carried out by specific gravity, acid value, iodine value and peroxide value. The specific gravity result shows that 0.94 ± 0.01 saponification value (180.45 ± 3.60), peroxide value (7.10 ± 0.36), acid value (1.68 ± 0.05) and iodine value (89.51 ± 1.32).

Table III: Physicochemical properties of *Balanites aegyptiaca* seed kernel oilOil quality assessment of *Balanite aegyptiaca* seed kernel oil

Parameter	Desert date (mg/100g)
Oil content % w/w	35.0
Specific gravity	0.94 \pm 0.01
Saponification value (mg/kOHlg)	180.45 \pm 3.60
Peroxide value (mEq/kg)	7.10 \pm 0.36
Acid value (mg/KOH/g)	1.68 \pm 0.05
Iodine value gl/100g	89.51 \pm 1.32

The acid value was determined to quantify the fatty acid found in the oil as it measures the free fatty acids of oil. The acid value was low 1.68 ± 0.05 mgKOH/g which is just below the FAO/WHO standard of 4.0 mgKOH/g for edible oil but still shows that the oil is stable (Haftu, 2015). However, the results for the acid value obtained in this study are in agreement with similar findings by Manji *et al* (2013) and Jock (2017).

Discussion

The peroxide value, used as a measure of the extent to which rancidity reactions have occurred during storage, is used as an indication of the quality and stability of fats and oils. The peroxide value determined for the kernel oil of *Balanite aegyptiaca* was found to be 7.10 ± 0.36 mEq/g and is within the FAO/WHO standard of less than 10 mEq/g. The results of this study agree with similar reports by Mohammed *et al.* (2017). A low peroxide value in the present study increases the suitability of the oil for a long storage due to low level of oxidative

and lipolytic activities (Adegbe *et al.*, 2016).

The saponification value, which is an index of average molecular mass of fatty acid in the oil sample, was found to be 180.45 ± 3.60 mgKOH/g for *Balanites aegyptiaca* kernel oil analysed, and this value is within the FAO/WHO range of 181.4 mg KOH/g. The result agrees with similar reports by Manji *et al* (2013), and Mohammed *et al.* (2017). The saponification value of oil is an important parameter in determining the suitability of the oil for soap making.

The iodine value measures the degree of unsaturation in a fat or oil, and it determines the stability of oils to oxidation and allows the overall unsaturation of the fat to be determined qualitatively. The iodine value of the desert date kernel oil analysed in this study was found to be 89.51 ± 1.32 100/g and within the range of the FAO/WHO standard of 80-106 gl/100g. The result was in agreement to similar reports by Manji *et al.* (2013) and Mohammed *et al.* (2017). Oils with iodine values below 100

are non-drying, while those having values between 100 -130 are semi-drying and those with values above 130 are termed drying oils (Jock, 2018).

Conclusion

The present study on the phytochemical and physicochemical properties of oil from *Balanites aegyptiaca* seeds suggested that the seed of this plant has high oil content and it can be a source of raw materials for any oil base products (soap, shampoo, biodiesel, lubricants etc.). The oil could also be utilized successfully as a source of edible oil for human consumption.

Recommendations

Further research should be conducted on the physicochemical properties of the desert date oil on different locations to ascertain if the different locations have influence on the oil properties

For easy extraction of the oil, postharvest technologists should research on appropriate simple machines that can be designed to crack the fruits, grind the nuts and extract the oil.

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