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## Phytochemistry and proximate composition of root, stem bark, leaf and fruit of desert date, *Balanites aegyptiaca*

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### ABSTRACT

*Balanites aegyptiaca* or Desert date is a common plant in all dry lands of Africa and South Asia. Some parts of the plant are used as fish poisons but not poisonous to man. It is also used as medicine or food in humans as well as insect repellent. Four parts of the plant were phytochemically and proximately screened to determine whether the bioactive compounds can be utilized in sedation or anaesthetization of fish as well as supplementation of fish nutrition. The root, stem bark, leaf and fruit of the plant were screened using petroleum ether, methanol, chloroform ethanol and water as solvents. Proximate analysis to determine proximate composition of the parts of the plant was also conducted. Phytochemical analysis revealed the presence of alkanoids, flavonoids, tannins, saponins, terpenes & steroids, cardiac glycosides, balsam, carbohydrates, phenols in the root and fruit. There was absence of alkanoids, flavonoids, balsam, and carbohydrates in the stem bark. The leaf confirmed the aforementioned phytochemicals except cardiac glycoside. The proximate analysis showed low percentage crude protein composition in all the plant parts [Leaf (22.94%), fruit (15.63%), root (12.81%) and stem (6.94%)]. Moisture content of the plant was also low with fruit having the highest (4.56%) and the leaf with the lowest (2.69%). The results of this work provide evidence that the bioactive compounds of the root, leaf and fruit could be utilized in sedation and anaesthetization of fish while the proximate composition was not suitable for supplementation in fish nutrition.

**Keywords:** Phytochemical, Proximate, *Balanites aegyptiaca*, Extract.

### INTRODUCTION

*Balanites aegyptiaca* is a desert plant commonly called Desert date, Soapberry tree, Egyptian balsam or Thorn tree. It is a member of the family Zygophyllaceae. It is known by different vernacular names in Nigeria and other parts of the world. In Nigeria the Hausa name is 'Aduwa' while Fulani call it 'Tanni'. In Swahili, it is called 'mchunju', the Arabs refer to it as 'Heglig' [1]. Indians and Amharic in Ethiopia call it 'Hingot' and 'Bedena' respectively [1]. *B. aegyptiaca* is widely distributed but neglected tree of the arid zones of Africa and South Asia [2]. It is highly resistant to sandstorms and heat waves and grows with minimal available moisture and are available in different habitats. *B. aegyptiaca* can grow on different soil types i.e. from sand to heavy clay [3]. The plant is a deep-rooted, evergreen or semi-deciduous, multi-branched, spiny tree which grows up to 12m in height [4]. The colour of the stem bark of the old plant ranges from brownish to greyish and abysmally fissured. The shoots bear long and thick green thorns when young but later become yellow. The thorn can grow up to 8 cm long which are soft at first and later become woody [4]. The leaves are dark green or grey-green, fleshy and succulent with two firm coriaceous leaflets spirally arranged on the shoots [5]. The leaflets are long, up to 2.5-6.0cm; grainy surface, with fine hairs when young while the fruit is a long, slender drupe, ranges from 2.5 to 7cm long and 1.5 to 4cm in diameter. Fresh fruits are always green and tormentose but later becomes yellow and glabrous as it becomes older [5]. These workers further reported that the soft mesocarp has a mixed bitter-sweet taste. The hard endocarp is the pyrene which forms more than half of the fruit.

The stem bark of *Balanites aegyptiaca* is used as a fish poison but it is not poisonous to man [8]. The stem bark and the fruits are used in Morocco, Nigeria and Senegal as a laxative or purgative for colic and stomach aches [9]. The edible bitter-sweet pulp is used as food or confectionary, and laxative as well as for the treatment of constipation. The leaves are used to make soup by some tribes in Nigeria while in Chad the fresh twigs are burned to produce smoke to keep insect away [9].

The plant is indigenous to all arid zones, south of the Sahara, which extends southward to Malawi in the Rift Valley, and to the Middle East [6]. The plant was later cultivated in Latin America and India

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particularly in drier parts of Rajasthan, Gujarat, Madhya and Deccan [5, 7]. It is widely distributed, especially on level alluvial sites loamy soil and free access to water.

Methanolic and acetone phyto-chemical screening of stem bark of *B. aegyptiaca* by [6] reported the presence of alkanoids, tannins and saponins while flavonoids, glycosides and steroids were absent. Similarly [3], screened the stem bark of *B. aegyptiaca* using methanol and acetone and reported the presence of saponins, tannins, volatile oils and terpenes; flavonoids, alkanoids and glycosides were, however absent. [10] reported the presence of amino acids, carbohydrates, steroids, saponins coumarins and triterpenoids while alkanoids, tannins flavonoids and phenols were absent in fruit of *B. aegyptiaca*. Workers on the fruit mesocarp reported the presence of alkaloids, tannins, saponins, anthraquinones, steroids, flavonoids and cardiac glycosides as active ingredients [11]. The screened leaves of the plant showed the presence of carbohydrates, amino acids, glycosides, saponins, flavonoids, phenols and tannins but there were no alkanoids, as reported by [7]. In a separate study, [12] reported the presence of saponins, flavonoids, phenols, cardiac glycosides, alkanoids, terpenoids, and tannins in leaf extracts of *B. aegyptiaca* (L.). These workers could not establish the presence of Steroids and anthraquinones in the leaves. [13] conducted phytochemical screening of the root, stem and leaf of *B. aegyptiaca* and reported presence of very high concentration of saponins and moderately high concentration of tannin in all the parts of the plant while Cardiac glycosides and anthraquinones were only present in the leaf.

Researches aimed at determining the nutritive value of plant parts have been conducted by many workers [14, 15, 16]. The determinations of the nutritive values by the researchers were carried out by analysing the proximate composition of the various parts of the plants. [14] investigated the nutritive profile of *B. aegyptiaca* flower and reported 43.3±2.89% moisture, 10.8±0.49% crude protein, 4.5±0.50% crude lipid and 3.80±0.29 crude fibre. Similarly, [15] earlier screened the nutritional composition of leaves and stems of *Ocimum gratissimum* (Tea bush) and reported that the parts contain 82.60±0.01% moisture and ash (13.67±0.13%). [16] screened the proximate composition of leaves, stem and seeds of *Cannabis sativa* and reported that the leaves have a crude protein of 23.78%, crude fibre of 18.95%, ash content of 11.18% and moisture content of 6.87% respectively while the stem showed less (17.20%) crude protein compared to the leaves (23.78%).

Due to the paucity of information on phytochemistry and proximate composition of the four main parts (stem bark, root, leaf and fruit) of *B. aegyptiaca* plant, this study was necessitated to investigate the bioactive compounds in the root, stem bark, leaf and fruit extracts of *B. aegyptiaca* which may provide baseline information for their subsequent utilization in supplementing nutritional requirements and sedation and anesthetization of fish.

## MATERIALS AND METHODS

### Obtaining and Preparation of the Parts of *B. aegyptiaca*

The root, stem bark, leaf and fruit of *B. aegyptiaca* were obtained from Gashua, Bade Local Government Area of Yobe state, north eastern Nigeria. An axe was used to shear the stem bark; the root was dug out with hoe and sheared with axe while the leaves and fruits were hand plucked from the tree. The collected plant parts were washed in clean water several times to remove soil, dust or dirt and 1kg each of the sample was air dried. Exposure to sunlight was avoided to prevent the loss of active components. The dried samples were pulverized with pestle and mortar and sieved with 0.5mm sieve into fine powder before storing in airtight plastic containers.

### Phytochemical Screening of the Root, Stem Bark, Leaf and Fruit of *B. Aegyptiaca*

Solvents including chloroform, petroleum ether, ethanol, methanol and water were used to macerate the crude extracts of the root, stem

bark, leaf and fruit of *B. aegyptiaca*. 10g each of the pulverized root, stem bark, leaf and fruit were poured into 200ml conical flask containing 50ml each of the solvents (chloroform, petroleum ether, ethanol, methanol and water). The mixtures were gently stirred then tightly covered with a cork stopper and left for 24 hours to macerate after which each mixture was filtered into another conical flask through a funnel choked with non-absorbent cotton. Standard phytochemical test was carried out on each of the macerated extracts using the methods of [17, 18] to determine the presence of bioactive components.

### Test for Alkanoids (Dragendoff's Test)

To test for alkanoids, 2ml each of the root, stem bark, leaf, and fruit extracts was measured in a 5ml measuring cylinder and poured into a test tube. Few drops of Dragendoff's reagent were added using a dropper. Formation of orange colour indicates the presence of alkanoids.

### Test for Flavonoids (Lead Acetate Test)

Exactly 2ml each of the root, stem bark, leaf, and fruit extracts was poured into a test tube and few drops of 5% lead acetate was added using a dropper, cream light yellow colour formation indicates the presence of flavonoids.

### Test for Tanins (Ferric Chloride Test)

Few drops of 10% Ferric chloride (FeCl<sub>3</sub>) were added to 2ml each of the root, stem bark, leaf, and fruit extracts using a dropper. A deep bluish or greenish Colour indicates the presence of tanins.

### Test for Saponins (Foam Test)

From each of the root, stem bark, leaf, and fruit extracts, 1ml was measured using a 5ml measuring cylinder and poured into a tube using a dropper. 4ml of distilled water was added and shaken vigorously. Formation of honey comb froth indicates the presence of saponins.

### Test for Terpens and Steroids (Burchard's Test)

To 1ml each of the root, stem bark, leaf, and fruit extracts was added 1ml of concentrated Tetraoxosulphate (VI) acid (H<sub>2</sub>SO<sub>4</sub>) along the side of the test tube. Formation of reddish-brown ring colour at the interphase indicates the presence of terpens and steroids.

### Test for Cardiac Glycosides (Salkowski's Test)

To 2ml each of the root, stem bark, leaf, and fruit extracts was dissolved in 2ml chloroform in a test tube. H<sub>2</sub>SO<sub>4</sub> was carefully added to form a lower layer. A reddish-brown colour formation at the interphase indicates the presence of cardiac glycosides.

### Test for Balsam (General Test)

To 2ml each of the crude root, stem bark, leaf, and fruit extracts was added 3 drops of Alcoholic Ferric Chloride. Formation of dark green colouration indicates the presence of balsam.

### Test for Carbohydrates (Benedict's Test)

A measured 2ml each of the root, stem bark, leaf, and fruit extracts were poured into a test tube and 5 drops of Benedict's reagent was added. The mixture was placed on a hot plate for 5 minutes. Formation of brick red precipitate indicates the presence of carbohydrates.

### Test for Phenols

To the measured 2ml each of the root, stem bark, leaf, and fruit extracts was added 2ml of Ferric Chloride (FeCl<sub>3</sub>). A change in the

resultant mixture to deep bluish green colouration indicates the presence of phenols.

#### Test for Resins

A measured 2ml of Acetic Anhydride and drops of H<sub>2</sub>SO<sub>4</sub> were added to each of the root, stem bark, leaf, and fruit extracts. A formation of violet colouration indicates the presence of resins.

#### Determination of Proximate Composition of Crude Root, Stem Bark, Leaf and Fruit Extracts of *B. aegyptiaca*

The proximate composition of each of the root, stem bark, leaf, and fruit extracts of *B. aegyptiaca* was determined using the standard methods of [19]. The following parameters were examined: moisture content, crude protein, crude fat, fibre, ash as well as Nitrogen Free Extracts.

#### Determination of Moisture Content of Root, Stem Bark, Leaf, and Fruit of *B. aegyptiaca*

Each of the powdered root, stem bark, leaf, and fruit samples of *B. aegyptiaca* was weighed and oven dried to constant weight at a temperature of 105 °C for 24 hours. The dried root, stem bark, leaf, and fruit were then cooled in a desiccator and the weight retaken. The change in weight of the samples was considered as the moisture content of the sample and expressed as a percentage of the original weight. The percentage moisture content was determined using the formula:

$$\text{Percentage moisture} = \frac{W1 - W2}{\text{Weight of sample before drying}} \times 100$$

Where:

W1 = initial weight of crucible + sample

W2 = final weight of crucible + sample [19]

#### Determination of Crude Lipid of Root, Stem Bark, Leaf, and Fruit of *B. aegyptiaca*

Exactly 2g each of the dried root, stem bark, leaf, and fruit powder of *B. aegyptiaca* was weighed and wrapped in a Whatman's filter paper and firmly tied with a string and placed into a Soxhlet apparatus. The lipid content was then extracted using 250ml of a mixture of chloroform and methanol (2.1) placed in a round bottomed flask for 8 hours. The decrease in weight of the filter paper plus the string and the increase in weight of the extraction round bottomed flask were noted as the lipid content of the sample. This was then expressed as the original weight. The lipid content was calculation as follows:

$$\text{Percentage crude lipid} = \frac{\text{Weight of oil}}{\text{Weight of sample}} \times 100 \quad [19]$$

#### Determination of Crude Protein of Root, Stem Bark, Leaf, and Fruit of *B. aegyptiaca*

Determination of the crude protein of the parts of *B. aegyptiaca* was based on the standard methods of [19]. A quantity of 0.1g each of the root, stem bark, leaf, and fruit powdered samples were enclosed in a Whatman's filter paper number 1, before introduction into a Kjeldahl's apparatus. 10ml of concentrated Tetraoxosulphate (VI) Acid (H<sub>2</sub>SO<sub>4</sub>) and 0.5g of a catalyst mixture, Disodium Sulphate (Na<sub>2</sub>SO<sub>4</sub>), Copper II Sulphate (CuSO<sub>4</sub>) and Selenium Dioxide (SeO<sub>2</sub>) in a proportion of 10:5:1 was added. Five pieces of anti-bumping granules were added and the digestion flasks were introduced into the digestion chamber for 2 hours and observed for a change of colour to light green mixture. The digested sample was allowed to cool and 60ml distilled water, was added to dilute it which was later made up to 100ml by adding distilled water in a volumetric flask. To 10ml portion of the diluted solution was added 10ml 5% NaOH and the solution was introduced into Markham distillation apparatus and allowed to distil into 10ml 2% Boric acid (H<sub>3</sub>BO<sub>3</sub>) containing 5 drops

of bromocresol green/methyl red indicator to collect exactly 73ml of the distillate. The collected distillate was then titrated with standard 0.01N HCl. The formula of [19] was used to compute the percentage crude protein of each of the plant parts

$$\text{Percentage crude protein} = \frac{(a-b) \times 0.01 \times 0.014 \times c}{d \times e} \times 100 \quad [19]$$

Where:

a = Titre value of the digested sample

b = Titre value of the blank sample

c = Volume to which the digested sample was made

d = Volume of NaOH used for distillation

e = weight of the sample

#### Determination of Crude Fibre of Root, Stem Bark, Leaf and Fruit of *B. aegyptiaca*

A weight of 2g each of the defatted root, stem bark, leaf and fruit of *B. aegyptiaca* was transferred into a 250ml quick fit flask. Exactly 2ml of 1.25% H<sub>2</sub>SO<sub>4</sub>, 5 drops of octanol and anti-bumping granules (5 pieces) were added to each defatted sample and refluxed for 30 minutes before filtering using a Whatman's filter paper (No. 1). The residue obtained for each sample was refluxed in 1.25% NaOH base for 30 minutes, filtered and oven dried at 100 °C for 12 hours. This was then weighed, poured into a crucible and then burned to ashes in a furnace at 600 °C over 24 hours. Weighing balance (Mettler Toledo PB602 model) was used to weigh the ash. The difference between the weights of the crucible and each sample of the root, stem bark, leaf and fruit of the plant plus the crucible and ash was noted as the crude fibre content as follows.

$$\text{Fibre content} = \text{weight of crucible} + \text{sample minus weight of crucible} + \text{ash} \quad [19]$$

#### Determination of Ash Content of Root, Stem Bark, Leaf, and Fruit of *B. aegyptiaca*

The pulverized root, stem bark, leaf and fruit of *B. aegyptiaca* were weighed and placed into a pre-dried and weighed crucible. Each sample in the crucible was then introduced into a Muffle furnace and heated at 600 °C for two days, then cooled in a moisture remover (desiccator) before re-weighing. Percentage ash content was calculated thus:

$$\text{Percentage ash content} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100 \quad [19]$$

#### Determination of Nitrogen Free Extracts (NFE) of *B. aegyptiaca*

NFE is determined by subtracting the sum of the percentage of all the nutrients already determined from 100 as follows:

$$\text{Percentage NFE} = 100 - (\% \text{moisture} + \% \text{Ash} + \% \text{Crude Protein} + \% \text{crude Fat} + \% \text{Crude Fibre}) \quad [19]$$

## RESULTS

The results of the screened parts (root, stem bark, leaf, and fruit) of the experimental plant using petroleum ether, methanol, chloroform, ethanol, and water as solvents confirmed the presence of alkanoids, flavonoids, tanins, saponins, terpens & steroids, cardiac glycosides, balsam, carbohydrates, phenols, and resins in the plant. This, however, did not mean that all the phytochemicals were present in each of the plant parts.

#### Phytochemicals of Root, Stem Bark, Leaf, and Fruit of *B. Aegyptiaca* after Screening with Petroleum Ether as Solvent

The results of the phytochemical screening of parts of *B. aegyptiaca* using petroleum ether as solvent (Table 1) showed that only the root extract indicated the presence of cardiac glycosides through Salkowki's test. Resins were also confirmed in the root extract.

**Table 1:** Phytochemical Screening of Parts of *B. aegyptiaca* with Petroleum Ether as Solvent

Phytochemical	Parts of <i>B. Aegyptiaca</i> Plant				Colour	Test
	Root	Stem	Leaf	Fruit		
Alkanoids	-	-	-	-	-	Dragendoff's
Flavonoids	-	-	-	-	-	Lead acetate
Tannins	-	-	-	-	-	Ferric chloride
Saponins	-	-	-	-	-	Foam test
Terpens & Steroids	-	-	-	-	-	Burchard's
Cardiac glycosides	+	-	-	-	Reddish brown	Salkowki's
Balsam	-	-	-	-	-	General test
Carbohydrates	-	-	-	-	-	Benedict's
Phenols	-	-	-	-	-	-
Resins	+	-	-	-	Violet	-

+ Moderate presence – Absence

**Phytochemicals of Root, Stem Bark, Leaf, and Fruit of *B. aegyptiaca* after Screening with Methanol as solvent**

The results of methanolic screening of parts of *B. Aegyptiaca* (Table 2) revealed the presence of alkanoids in the fruit only following the formation of orange colour using the Dragendoff's test. The lead acetate test of the Root, leaf and fruit of *B. aegyptiaca* showed cream light-yellow colouration indicating the presence of flavonoids but no colour change was observed in the stem bark indicating its absence. Ferric chloride test showed deep blue colouration revealing the presence of tannins in all the parts of the plant. Foam test showed honey comb froth after vigorous shaking of the fruit extract with the

solvent confirming high presence of saponins in the fruit only. The reddish-brown ring colouration observed in all the plant parts using Burchard's test indicated the presence of terpens and steroids. Salkowski's test showed reddish brown colour in the root only indicative of the presence of cardiac glycosides. Dark green colouration was formed in the root, leaf and fruit indicating the presence of balsam but not in the stem bark. Benedict's test confirmed the presence of carbohydrates in the fruit only by the formation of blue-black colouration. Deep bluish green and violet colourations were indicated in all the plant parts confirming the presence of phenols and resins respectively.

**Table 2:** Phytochemical Screening of Parts of *B. Aegyptiaca* with Methanol as Solvent

Phytochemical	Parts of <i>B. aegyptiaca</i> Plant				Colour	test
	Root	Stem	Leaf	Fruit		
Alkanoids	-	-	-	+	Orange	Dragendoff's
Flavonoids	+	-	+	+	Cream light yellow	Lead acetate
Tannins	+	+	+	+	Deep blue	Ferric chloride
Saponins	-	-	-	++	Honey comb froth	Foam test
Terpens & Steroids	+	+	+	+	Reddish brown ring	Burchard's
Cardiac glycosides	+	-	-	-	Reddish brown	Salkowki's
Balsam	+	-	+	+	Dark green	Gener*al test
Carbohydrates	-	-	-	+	Blue-black	Benedict's
Phenols	+	+	+	+	Deep bluish green	-
Resins	+	+	+	+	Violet	-

++ High presence + Moderate presence – Absence

**Screened Phytochemicals of Root, Stem Bark, Leaf, and Fruit of *B. aegyptiaca* using Chloroform as Solvent**

The screening of root, stem, leaf, and fruit extracts of *B. aegyptiaca* using chloroform as solvent (Table 3) revealed the presence of alkanoids in the leaf and fruit only This was confirmed after the formation of orange colouration using the Dragendoff's test. Flavonoid was not confirmed in any of the part of the plant extracts using lead acetate test. Ferric chloride test confirmed the presence of tannins in the crude leaf and fruit extracts only following the formation of deep blue colouration. Foam test of the crude extracts did not confirm the presence of saponins in all the extracts since no froth was formed after separately agitating the solvent with each extract. In the test for terpens and steroids using Burchard's test, a red brownish ring was formed in the crude fruit extracts only indicating the

presence of terpens and steroids. In Salkowski's test for cardiac glycosides, there was reddish brown colouration in the crude stem bark and fruit extracts confirming the presence of cardiac glycosides. The test for the presence of balsam using the general test showed dark green colouration in the crude leaf extract only indicating its presence. Carbohydrates were confirmed in the crude fruit extract only following the formation of blue-black colouration using the Benedict's test. Phenols were confirmed in the leaf and root extracts while resins were confirmed in the fruit only.

**Screened Phytochemicals of Root, Stem Bark, Leaf and Fruit of *B. aegyptiaca* using Ethanol as Solvent**

In the screening of the parts of *B. aegyptiaca* using Ethanol as Solvent (Table 4) Dragendoff's test confirmed the presence of alkanoids in the crude leaf extract only following the formation of orange colouration.

**Table 3:** Phytochemical Screening of Parts of *B. aegyptiaca* with Chloroform as Solvent

Phytochemical	Parts of <i>B. aegyptiaca</i> Plant				Colour	Test
	Root	Stem	Leaf	Fruit		
Alkanoids	-	-	+	+	Orange	Dragendoff's
Flavonoids	-	-	-	-	-	Lead acetate
Tannins	-	-	+	+	Deep blue	Ferric chloride
Saponins	-	-	-	-	-	Foam test
Terpens & Steroids	-	-	-	+	Reddish brown ring	Burchard's
Cardiac glycosides	-	+	-	+	Reddish brown	Salkowski's
Balsam	-	-	+	-	Dark green	General test
Carbohydrates	-	-	-	+	Blue-black	Benedict's
Phenols	-	-	+	+	Deep bluish green	
Resins	-	-	-	+	Violet	

++ High presence + Moderate presence - Absence

The lead acetate test using ethanol confirmed the presence of flavonoids after showing cream light-yellow colouration in the root and fruit extracts but not in the stem bark and leaf extracts. Tannins were confirmed to be present in all the plant parts using the ferric chloride test after all the parts indicated deep blue colouration. Honey comb froth was formed in the crude fruit extract only following the foam test. The Burchard's test confirmed the presence of terpens and steroids in the crude stem bark and fruit extracts by formation of reddish-brown ring colouration. The Salkowski's test confirmed the presence of cardiac glycosides in the crude root and stem bark extracts

following the formation of reddish-brown colouration. Balsam was confirmed to be present in all the parts of the plant except the stem bark following the formation of dark green colouration. Benedict's test using this solvent confirmed the presence of carbohydrates in the fruit only following the formation of blue-black colour. The formation of deep bluish green colouration confirmed the presence of phenols in the of root, stem, and leaf only. Resins were confirmed in the stem bark and fruit extracts only following the formation of violet colouration.

**Table 4:** Phytochemical Screening of Parts of *B. aegyptiaca* with Ethanol as Solvent

Phytochemical	Parts of <i>B. aegyptiaca</i> Plant				Colour	Test
	Root	Stem	Leaf	Fruit		
Alkanoids	-	-	+	-	Orange	Dragendoff's
Flavonoids	+	-	-	+	Cream light yellow	Lead acetate
Tannins	+	+	+	+	Deep blue	Ferric chloride
Saponins	-	-	-	++	Honey comb froth	Foam test
Terpens & Steroids	-	+	-	+	Reddish brown ring	Burchard's
Cardiac glycosides	+	+	-	-	Reddish brown	Salkowski's
Balsam	+	-	+	+	Dark green	General test
Carbohydrates	-	-	-	+	Blue-black	Benedict's
Phenols	+	+	+	-	Deep bluish green	-
Resins	-	+	-	+	Violet*	-

++ High presence + Moderate presence - Absence

**Screened Phytochemicals of Root, Stem Bark, Leaf and Fruit of *B. aegyptiaca* using Water as Solvent**

After screening the root, stem bark, leaf, and fruit of *B. Aegyptiaca* with water as Solvent (Table 5), the Dragendoff's test showed orange colouration in the leaf extract only confirming the presence of alkanoids. In the lead acetate test, flavonoids were confirmed in the root, leaf and fruit extracts following the formation of cream light yellow colouration in each extract. Tannins were confirmed in crude root, leaf, and fruit extracts of the plant using ferric chloride test. The confirmation was made after deep blue colouration was observed in these parts. The foam test confirmed high presence of saponins in the root, stem bark and fruit extracts, and moderate presence in the leaf extract. This result was indicated by the formation of honey comb

froth in all the parts after agitating the solution. The crude fruit extract was the only part of the plant that formed reddish brown ring during the Burchard's test indicating the presence of terpens and steroids. Salkowski's test in water did not confirm the presence of cardiac glycosides in any of the plant parts i.e. no reddish-brown colouration was formed in any of the parts. Using the General test, balsam was confirmed in the leaf and fruit extracts only. This was confirmed following the formation of dark green colouration in the two parts. Carbohydrates were indicated in the fruit extract only following the formation of blue-black colouration during the Benedict's test. Phenols were confirmed in the leaf and fruit extracts only after forming deep bluish green colour. Violet colouration was formed in the crude fruit extracts only confirming the presence of resins.



**Table 5:** Phytochemical Screening of Parts of *B. aegyptiaca* with Water as Solvent

Phytochemical	Parts of <i>B. aegyptiaca</i> Plant				Colour	Test
	Root	Stem	Leaf	Fruit		
Alkanoids	-	-	+	-	Orange	Dragendoff's
Flavonoids	+	-	+	+	Cream light yellow	Lead acetate
Tannins	+	-	+	+	Deep blue	Ferric chloride
Saponins	++	++	+	++	Honey comb froth	Foam test
Terpens & Steroids	-	-	-	+	Reddish brown ring	Burchard's
Cardiac glycosides	-	-	-	-	Reddish brown	Salkowski's
Balsam	-	-	+	+	Dark green	General test
Carbohydrates	-	-	-	+	Blue-black	Benedict's
Phenols	-	-	+	+	Deep bluish green	
Resins	-	-	-	+	Violet	

++ High presence + Moderate presence - Absence

Summarily, the phytochemical screening of *B. aegyptiaca* revealed the presence of alkanoids, flavonoids, tanins, saponins, terpens & steroids, cardiac glycosides, phenols, and renins in the root and fruit of the plant. The solvents, however, did not confirm the presence of alkanoids, flavonoids, balsam and carbohydrates in the stem bark. Similarly, cardiac glycosides were not confirmed in the leaf extract. The results also showed that there was high presence of saponins in the root, stem and fruit with moderate presence in the leaf.

#### Determined proximate compositions of root, stem bark, leaf and fruit of *B. aegyptiaca*

The determined proximate composition of root, stem, leaf and fruit of *B. aegyptiaca* is shown in Table 6 which showed that the fruit had the highest percentage moisture (4.56%) while the lowest (2.69%) percentage moisture was recorded in the leaf. The percentage crude protein composition was highest (22.94%) in the Leaf, followed by the fruit (15.63%). The lowest (6.94%) percentage Crude Protein composition was recorded in the stem. In the analysis of the crude lipid, the fruit showed the highest (10.90%) while root recorded the lowest (3.00%). The stem recorded the highest (34.80%) percentage of Crude Fibre content while the lowest (11.00%) percentage was recorded in the fruit. The Root had moderate (16.80%) percentage crude fibre content (16.80%). The Root and the Leaf recorded the highest (13.00%) percentage Ash content while the Leaf had the lowest (6.00%) percentage.

**Table 6:** Proximate Composition of Stem, Leaf, Root and Fruit Extracts of *B. aegyptiaca* Obtained from Gashua, Yobe State, Nigeria

Proximate Composition (%)	Parts of <i>Balanites aegyptiaca</i>			
	Stem	Leaf	Root	Fruit
Crude protein	6.94	22.94	12.81	15.63
Crude fibre	34.80	12.00	16.80	11.00
Crude lipid	3.70	4.60	3.00	10.90
Ash content	7.50	13.00	13.00	6.00
Moisture content	4.21	2.96	4.36	4.56
NFE	42.85	44.50	50.03	51.91

NFE – Nitrogen Free Extract

## DISCUSSION

The phytochemical screenings of parts of *B. aegyptiaca* obtained from Gashua, Yobe State, Nigeria using different solvents (petroleum ether, methanol, chloroform, ethanol, and water) revealed the presence of Alkanoids, flavonoids, tanins, saponins, terpens & steroids, cardiac glycosides, phenols, balsam and renins except the stem where there was complete absence of Alkanoids, flavonoids, Balsam and

carbohydrate but with very high level of saponins. Saponins have been known to have a lytic action on erythrocyte [28] while the other phytochemicals have been reported to poison or sedate animals [29]. This result agrees with [20] who reported the presence of saponins, flavonoids, tannins and alkaloids in *B. aegyptiaca*, and [6] who also reported the presence of alkanoids, tannins and saponins in the same plant while flavonoids, glycosides and steroids were absent. The result is also in conformity with [3] whose work on the stem of the same plant reported the presence of saponins, tannins, volatile oils and terpens with absence of flavonoids, alkanoids and glycosides. There was high presence of saponins in the root, stem, and fruit with moderate presence in the leaf extracts in this work. This is partially similar to the work of [13] who reported very high concentration of saponins in the root, stem and leaf of the plant. The screening of the leaf extract revealed the presence of alkanoids, flavonoids, tannins, saponins, balsam, phenols and renins which is in agreement with the results of [12] in the same plant. The result of the phytochemical screening of the fruit extract agreed with the report of [11] who reported the presence of alkaloids, tannins, saponins, anthraquinones, steroids, flavonoids and cardiac glycosides in the fruit mesocarp but disagreed with the report of [10] whose results indicated the presence of amino acids, carbohydrates, steroids, saponins coumarins and triterpenoids while alkanoids, tannins flavonoids and phenols were absent in the fruits of *B. aegyptiaca*. The variation in the phytochemistry of the fruit of *B. aegyptiaca* may be due to variation in the types of test, macerating solvent and the environment of the plant.

The results of the proximate composition of *B. aegyptiaca* obtained from Gashua, Yobe State, Nigeria showed that the root, stem bark, leaf and fruit contained low percentage crude protein of 12.81, 6.94, 22.94 and 15.63% respectively. These crude protein contents are higher than 10.8% crude protein reported for the flower of the same plant [14] and 6.77% reported for *Parkia biglobosa* flower [21]. The report of [22] showed much higher crude protein content of ripe fruit (85.7%), unripe fruit (92.2%), and leaves (75.4%) of *Carica papaya*. The crude protein compositions of all the parts of *B. aegyptiaca* are lower than the 25-35% crude protein requirement of teleost such as tilapia [23]. This suggests that these parts of *B. aegyptiaca* cannot be incorporated into the diets of *Oreochromis niloticus*. The moisture contents of the root (4.36%), stem bark (4.21%), leaf (2.96%) and fruit (4.566%) extracts of *B. aegyptiaca* of this work are much lower than that of *Carica papaya* leaves (75.4%) as reported by [14]; and 82.60% of stem and leaves of *Ocimum gratissimum* (Tea bush) reported by [15]. Moisture in food, according to [24] determines the shelf life, rate of digestion, and absorption/assimilation of food within the body system. The low moisture contents of the parts of *B. aegyptiaca* are, therefore, indicative of long shelf life, implying that the parts could be dried under ordinary conditions and kept for longer period of time [25]. The low moisture could also cause slow digestion and assimilation/absorption in the digestive system indicating that the

parts of the plant are not ideal for inclusion into fish feed [25]. Ash content estimated in the leaf and the root were 13.00% each while those of the stem bark and the fruit were 7.50 and 6.00% respectively which are similar to the report of [26] who indicated that the ash content of leaf extract of *B. aegyptiaca* was 10.4%. This report was also similar to that of [22] who reported that the ash content of leaves, seeds, unripe and ripe papaya fruits were 11.4, 8.2, 6.6 and 5.8% respectively. The moderate value of the ash content suggests that the different parts of *B. aegyptiaca* would provide essential minerals for fish. The crude fibre content of the leaf, root and fruit extracts of the experimental plant was 12.00, 16.80, and 11.00% respectively. This result is similar to the 12.10% crude fibre of *B. aegyptiaca* stem reported by [15], and 14.10% crude fibre of *Carica papaya* reported by [22] but not in conformity with the report of [26] which showed *B. aegyptiaca* to have 20.0% crude fibre. Low crude lipid content (3.70, 4.60, 3.00, and 10.00%) were recorded in the stem bark, leaf, root and fruit respectively of the experimental plant. The recorded values are comparable with the crude lipid content of *Aloe vera* (4.2%) and *Euphorbia radians* (4.9%) as reported by [27], as well as flower of *B. aegyptiaca* (4.5%) as reported by [14]. The low lipid content of the parts of the experimental plant also confirmed the report of [25] who reported low percentage of lipid in the fresh leaves (2.02%), flower (2.74%) and fruit pulp (0.43%) of *B. aegyptiaca*. The Nitrogen Free Extract (NFE) of the stem bark, leaf, root and fruit of *B. aegyptiaca* in this study was 42.85, 44.50, 50.03 and 51.91% respectively. This result agrees with the work of [26] who reported 46.9% as NFE of *B. aegyptiaca*.

## CONCLUSION

Conclusively, the results of the phytochemical screening of *Balanites aegyptiaca* parts obtained from Gashua, Yobe State, Nigeria using petroleum ether, methanol, chloroform, ethanol, and water revealed the presence of bioactive compounds in the root, leaf and fruit extracts that can reduce stress as well as anaesthetise fish. The stem bark extract, however, is rather a fish poison than a sedative compound owing to the very high presence of saponins and absence of alkanoids, flavonoids, balsam and carbohydrates. The proximate composition of the parts of this plant has no potential for supplementing the protein requirement of *Oreochromis niloticus*.

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