Journal of Forestry Research and Management. Vol. 20(2).107-116; 2023, ISSN 0189-8418

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Proximate, Phytochemical Screening and Mineral Analysis of African Olive (*Canarium schweinfurthii* Engl) Bark Extracts.

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ABSTRACT

Canarium schweinfurthii (Engl), *C. schweinfurthii*also known as "African elemi," is a huge evergreen forest tree with a native spread over tropical Africa. The plant is valued for its various uses, including the production of essential oils, resin, gum, and timber. While thephytochemistry, pharmacological activities and medicinal uses of different parts of the plant have been studied, there is limited information on the phytochemical screening, proximate analysis, and mineral content of the plant's bark. The bark of *C. schweinfurthii*was collected from a parent tree inUbiaja, Edo State,Nigeria and prepared samples for analysis. Proximate composition analysis was conducted to determine the moisture content, crude protein, crude fat, crude fibre, and ash content of the bark. Phytochemical screening was performed to identify the presence of various secondary metabolites in the bark, such as alkaloids, flavonoids, tannins, saponins, and terpenoids. Additionally, the mineral composition of the bark, including sodium, calcium, magnesium, potassium, iron, copper, and zinc, was determined. The results showed that the bark of *C. schweinfurthii*.had a moisture content of 11.82%, protein content of 4.97%, fat content of 2.73%, fibre content of 15.39%, and ash content of 2.17%. Phytochemical analysis revealed the presence of tannins, anthraquinones, steroids, terpenoids, and flavonoids, whilealkaloids andcardiac glycosides were absent. The mineral composition analysis indicated the presence of sodium (0.029± 0.04), calcium (0.175± 0.13), magnesium(0.315±0.04), potassium (0.0108±0.01), iron(0.027±0.05), copper (0.0013±0.01), and zinc (0.0013±0.01) in varying amounts.*C. schweinfurthii*can be incorporated into animal diets highlights its remarkable potential as a significant source of dietary magnesium for animalsThe findings highlight the potential nutritional and medicinal value of this plant and lay the foundation for further exploration of its applications in various industries.

Keywords: *Canarium schweinfurthii;* Mineral Analysis; Health; Phytochemical Screening.

Introduction

Green Plants offer a substantialpart of human foodand medicine varying from species to species. Ariel components of plants encompassing the fruit, leaves, seed, and stem depending on the plant species are known to have secondary metabolites and organic compounds. (Magashi and Abayeh., 2021; Adams and Moss., 1999).C. *schweinfurthii*usually known as 'Bush candle', 'African olive' or 'African elemi' is a massive evergreen forest tree with a pinnacle getting to the upper canopy of the forest (PROTA., 2008). It is a tree species native to Tropical African countries such as Nigeria, Angola and Uganda (ICRAF., 2013) and originatesmainly from hot tropical rainforests, growing at elevations from sea level to 1,000 meters. It fosters best in areas where the mean annual rainfall is in the range of 900 - 1,400mm (Ken Fern Tropical Plants Database, 2022).The edible seeds are harvested from the wild for local use - they are often sold in some local markets around where the trees are found. The C. *schweinfurthii* tree is a large source of elemi, an oleoresin used in food, medicine, and a range of industrial purposes; the tree is normally maintained by communities even though it is not typically grown.

In Nigeria the Edo's call it 'Odonorumu-kyakya' or'Uda' , Igbo's call it 'Ube ntoku', Yoruba either call it 'Eleme', 'OrigboEkugbi', 'Agbabubu' and Hausa call it 'Atili'. It belongs to the family Burseraceae. The aerial parts of the plants are widely used in the production of essential oils and exudates(PROTA., 2008). Other Indigenous uses of the plants include the production of gum, fuel wood, and timber for construction and the pulp on the bark of the nutsis consumed as edible fruits. The rigid stone kernel of its fruitsistraditionally used for divinationamong some tribes in Plateau State, Middlebelt,Nigeria.The medicinal uses as well as the phytochemistry and pharmacological activities of this plant have been discussed. Orwa*et al*., (2009) stated that bark decoction is used fortreating dysentery, cough, chest pain, and food poisoning and also serves as an emollient for skin infections(Cleminson*et al.,* 2021). Phytochemical studies discovered that the keycomponent of the oil from the plant varied with the geographical area. The pharmacological properties of *C. schweinfurthii* include antidiabetic, antioxidant, antibacterial, antifungal, analgesic and anti-inflammatory as well as antiparasitic activities.(Kuete, 2017).The resin from tree barkis used to mendcrackedvessels made from the art of pottery, for sealing boats and as adhesive for fastening arrowheads to shafts. The resin is also used in the productionof tattoo inks and henna in some parts of Africa (Bernard,2022).

The resin contains 8–20% essential oil, with limonene serving as its primary constituent. The resin is used as a mosquito fumigant. (Orwa *et al*., 2009). The elemi has been planted to promote reforestation purposes in Uganda, and it is frequently left standing on land that has been cleared for its ability to give shade and act as a wind buffer. (Orwa*et al*., 2009). A study carried out by Bernard (2022), showed that *C. schweinfurthii* resin is a suitable binder for the production of carbonized briquettes. According to Magashiand Abayeh.(2021), Tannin and Saponin were present in the oil extracted from the seed of *C. schweinfurthii*while Saponin, Tannin, Cardiac glycosides, Steroids, and flavonoids were present in the leaves of *C. schweinfurthii*screened from Lamingo area in Plateau State (Ngbede*et al*., 2008) as Alkaloid and Anthraquinone were not detected in the leaves extract.There is a dearth of information on thephytochemical screening, proximate analysis and mineral content of the bark of this promising plant and thus there is a need to carry out these tests to determine the proximate components, and mineral content and know the presence of secondary metabolites (phytochemical screening) in the plant bark.

Materials and Methods

Plant collection, identification, and Preparation of samples

The *C. schweinfurthii*bark was obtained from a parent tree located in **Latitude** 6° 39' 20.92" N
Longitude: 6° 23' 5.78" EUbiaja community,

Journal of Forestry Research and Management. Vol. 20(2).107-116; 2023, ISSN 0189-8418

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Esan South-East Local Government Area of Edo State, Nigeria in July 2022. It is at an altitude of 221 m. Ubiaja is in the rainforest region with 1800- 2000 mm of rainfall each year with 76% humidity at a maximum annual temperature of 27°C. The plant parts were authenticated and Identified at the Herbarium of Forestry Research Institute of Nigeria, Ibadan, Oyo State with a voucher number No.FHI 112897. The plant part was air-dried for a month and pulverized using the Victoria milling machine in the Soil Laboratory in FRIN, Ibadan before analyses. All analyses were performed in triplicates, and descriptive analysis was utilised to interpret the mean and standard deviation values..

Proximate Composition Analyses

Following theAssociation of Official Analytical Chemists(2005) procedure adopted by Irabor*et al.*, 2023. The following parameters were considered for Proximate composition analysis:

Moisture Content Determination

Two grams (2 g) of the powdered samplewere placed in the crucible and heated at 105°C until a constant weight was attained. The moisture content of each variety was calculated as a loss in weight of the original sample and expressed as a percentage of moisture content.

Determination of Crude Protein

The crude protein was determined by the Kjeldahl method with slight modification. 0.5 g of the powdery form of the sample was digested with 5 ml of concentrated sulphuric acid in the presence of a Kjeldahl catalyst. The nitrogen from the protein in the sample was converted to ammonium sulphate that reacted with 2.5 ml of 2.5 % Brucine reagent, and 5 ml of 98 % $H_2SO_4$to give a coloured derivative and the absorbance read at 470 nm. The percentage of nitrogen was calculated and multiplied by the 6.25 constant to obtain the value of the crude protein.

Determination of Crude Fat

This estimation was performed using the Soxhlet extraction method. 10 g of the powdery form C. *schweinfurthii* bark were weighed wrapped with filter paper and placed in a thimble. The thimble was covered with cotton wool and placed in the extraction column that was connected to a condenser. 200ml of n–Hexane was used as an organic solvent to extract the lipid for 14 hours. The extract was then oven-dried at 1100C for 30 minutes and weighed to get the fat content.

Determination of Crude Fiber

Five grams (5 g) of the powdery form of each sample and 200 ml of 1.25% H_2SO_4were digested for 30 minutes and filtered with a Buchner funnel. The acid-free insoluble residue was rinsed with distilled water. After boiling the rubble for 30 minutes in 200 ml of 1.25% NaOH, it was filtered and washed numerous times with distilled water until it was alkaline-free. It was then rinsed twice with ethanol and once with 10% HCl. It was finally cleaned three times with petroleum ether. The residue was put in a crucible and incinerated at 105°C in an oven overnight. After cooling in a desiccator, it was ignited in a muffle furnace at 550°C for 90 minutes to obtain the fibre content.

Determination of Ash Content

A substance's total ash content is the percentage of inorganic residue that remains after the organic stuff has been burnt. 2 g of the pulverised materials were placed in a crucible and fired for 6 hours in a muffle furnace at 750°C. The ash was then weighed at room temperature after being cooled in a desiccator.

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Phytochemical Screeningof *Canarium schweinfurthii* Bark

Chemical tests are conducted on the powdered extract of the plant samples using standard recommended methods of A.O.A.C., (2000) and adopted by Ogboru *et al*., (2019).

Sugar: A 200 mg powdered sample was extracted in 10 ml distilled water and was filtered using Whatman filter paper. To the 2ml filtrate, 2ml of Fehling solution (A and B) and heated in a water bath, brick red precipitate indicated the presence of carbohydrates.

Alkaloids: 200 mg powdered sample was extracted with 10 ml methanol and filtered. To 2ml filtrate, 1%HCL was then added at passed through steam. 6 drops of Mayor's reagent/Wagner's reagent/Dragendroff's reagent,were then added to 1ml of the substance obtained and a creamy precipitate/brownish-red precipitate/orange precipitate indicated the presence ofalkaloids.

Flavonoids: A 200 mg powdered sample was extracted with 10 ml ethanol and filtered: ConcHCL was then added to 2 ml filtrate. A tomato red colour indicated the presence of flavonoids.

Tannins: 200 mg powdered sample was extracted using 10 ml distilled water. Then 2 ml $FeCL_3$ wasadded to 2ml filtrate. A blue-black precipitate indicated the presence of tannins.

Glycosides (Keller-Killani test): 2 ml filtrate of extracted *C. schweinfurthii* bark with 10ml distilled water was put in a testtube. 1 ml each of glacial acetic acid + $FeCl_3$ + conc.H_2SO_4 was added to the filterate. A green–blue colour indicated the presence of glycosides.

Saponins (frothing test): 0.5 ml filtrate with 5 ml distilled water intensively mixed in a test tube. A frothing persistence indicated the presence of saponins.

Anthraquinones- 2 ml of plant extracts weretreated with 1 ml of dilute ammonia and shaken vigorously. The pink-red colour in the ammonical layer indicates the presence of anthraquinones.

Cardiac glycosides (Keller-Killani test): 1ml of glacial acetic acid containing traces of $FeCl_3$and 1 ml of concentrated H_2SO_4 were added to 2ml of plant extract carefully. Intense colouration indicates the presence of cardiac glycosides in the root extracts.

Terpenoids (Liebermann-Burchard reaction): 200 mg of powdered sample was extracted using 10 ml chloroform. It was then filtered then 2ml filtrate was measured in a test tube and 2 ml acetic anhydride and 2 ml concH_2SO_4 was also added to the mixture. A visible Blue ring at the tip of the mixture indicated the presence of terpenoids,

Determination of the Mineral composition of *C. schweinfurthii*

Minerals (Sodium, Calcium, Magnesium, Potassium, Potassium, Copper and Zinc) were determined by using standard methods described by USEPA., 1994 Mass spectroscopy method.

Results and Discussions

Table 1: Percentage Proximate Composition of *Canariumschweinfurthii.*

S/N	Components	% Composition
1	Moisture content	11.82±0.14
2	Protein	4.97±0.25
3	Fat	2,73±0.34

4	Fibre	15.39±1.21
5	Ash	2.17±2.05
6	Carbohydrate	25.02±1.43
7	Dry matter	91.70± 0.17

±; Standard Error of Mean

The essence of evaluating the moisture content in any plant sample is to measure its stability and susceptibility to microbial degradation.(Ogboru *et al*., 2021; Nwofia*et al*., 2012). Table 1 showed an appreciable amount of moisture (11.82±0.14 %) low moisture in the bark of *C. Schweifurthii*indicating that the plant may not easily be susceptible to spoilage or change of colour over time if preserved (Ngaha*et al.*, 2016). This value was similar to the work done by Alagbe*et al*. (2020). The protein content value obtained from the powdered bark of *C. schweinfurthii* was 4.97±0.25 %. The fat value of *C. schweinfurthii* was 2.73±0.34 %. In addition to providing energy for labour and body heat, fat is stored in the body as a backup for carbohydrates. Additionally, the plant's bark provides more carbohydrates. (Owusu*et al*., 2021) Ash and fibre with values of 2.17±2.05% and 15.39±1.21% respectively.

The ash content of 2.17±2.05% was very low compared to the values reported by *Solemostemonmonostachyus* leaves (Aimebenomon*et al*., 2018) and in the bark of *A. viridus* and *Picralimanitida* (Aghedo and Ogbiede, 2022). This means that there is low volatile matter in the bark of *C. schweinfurthii* and it is safe for consumption. (Ismail, 2017).The dry matter content value was high in the bark at 91.70± 0.17 %. High Dry matter content was also reported in *Desmodiumvelutinum*(Igboabuchi, 2017) and *Macrotylomageocarpum* (Fassinou*et al*., 2023). High dry matter means higher yields even under temperature stress in feed production. This provides more nutrients to rumen microbes formation in feeds (Guo*et al*., 2022).

Table2: Phytochemical Analyses of *Canariumschweinfurthii*

Phytochemical	***Scoring***
Tannins	++
Anthraquinones	+
Steroids	+
Cardiac glycosides	-
Terpenoids	+
Saponins	++
Sugar	ND*
Flavonoids	+
Alkaloids	-

+= Present, - = Absent, ++ = abundant*ND-Not detected

Table 2 presents the results of phytochemical screening showing that Tannins, Anthraquinones, steroids, cardiac glycosides, terpenoids, saponins and flavonoids were present in the bark with saponin and tannins more abundantly present.

Their presence ascertains its folkloric uses against various ailments. Cardiac glycosides and Alkaloids were absent while sugar was not detected. Saponins and tannins are responsible for their bark being extracted as a traditional medicine that is used to cure various ailments. Orwa*et al*., (2009) stated that bark decoction is used for dysentery, cough, chest pain, and food poisoning and also serves as an emollient for skin infections. The presence of flavonoids makes it useful in the treatment of cough. (Ullah*et al.*, 2022). It has also been reported that the occurrence of flavonoids in plants specified their significance in pharmaceutical industries for the production of antimicrobial, antioxidant, anticancer and other deteriorating diseases drugs (Havsteen, 2002).

Table 3: Mineral Composition *Canariumschweinfurthii*

S/N	Mineral element	Values in %
1	**Sodium (Na)**	0.029± 0.04
2	**Calcium (Ca)**	0.175± 0.13
3	**Magnesium (Mg)**	0.315±0.04
4	**Potassium (K)**	0.0108±0.01
5	**Iron (Fe)**	0.027±0.05
6	**Copper (Cu)**	0.0013±0.01
7	**Zinc (Zn)**	0.0013±0.01

±; Standard Error of Mean **%: Percentage**

Table 3 revealed the macro and micro minerals contained in the Bark of *C. schweinfurthii*play an important role in human health and nutrition. Despite the adverse health effects of sodium, the human body needs some sodium (Na) for the effective functioning of nerves and muscles as well as keeping the actual balance of fluids in the body (MedlinePlus, 2015). Na has a very strong connection with K to serve as the chief controller of extracellular fluid volume, including blood plasma volume. The Na content of *C. schweinfurthii* was 0.029± 0.040 %, this makes it harmless for ingesting since the body requires only a small amount of Na (less than 500 mg per day) to function properly or when incorporated into animal feed.

The calcium value obtained in this study was 39.4± 0.02 % which was relatively lower in the bark sample compared to Alagbe *et al*.,(2020)*in Delonix regia* bark sample and *G. Lasiocarpa* stem bark (Akwu *et al*., 2019). Uzoekwe *et al*., (2021) stated that Calcium is needed for the development of bones and teeth in animals and humans and several metabolic functions in the body. An overdose of calcium may result in respiratory failure while a deficiency may result in osteoporosis (Soetan*et al*., 2010; Valdez-Solana *et al*., 2015).The magnesium (Mg) value in the bark of *C. schweinfurthii*was 0.175 ±0.13 %. Magnesium is a non-toxic mineral to the human body and also mammals. It is an essential mineral that is required for the proper functioning of various physiological processes in animals. It plays a vital role in muscle and nerve function, bone development and the synthesis of DNA and protein.Introducing powdered *C. schweinfurthii* as part of the animal diet indicates that they would obtain important dietary magnesium from the tree. It also maintains healthy rumen function (Uzoekwe*et al*., 2021).

Potassium is the major cation in animal cells. It is an essential macronutrient required for the suitablerunning of cells, tissues and organsin the body. Potassium (K) is essential for life, as it helps the kidneys to work properly and is important for energy productionas well as fluid balance (HavardHealth letter, 2009). K content of this bark was 0.315 ± 0.04 mg/g and the daily body requirement of K for both males and females is 400mg/kg body weight (Institute of Medicine, 2005). Insufficient intake of potassium can increase blood pressure, kidney stone risk, bone turnover, urinary calcium excretion and in severe cases results in hypokalemia. Suitable ingestion of Potassium (K) can help lessen the risk of high blood pressure, lower cholesterol, regulate heartbeat, stroke control and regulation of blood glucose (Stone *etal*., 2016). Because of this, *C. schweinfurthii*can be a good remedy for the aforementioned ailments. Potassium (K), Iron (Fe), Copper(Cu) and Zinc (Zn) had values of 0.0108±0.01 %, 0.0271±0.05%, 0.0021±0.034 % and 0.0013±0.01 % respectively.

They are essential nutrients found in the ariel part of the plants including its stem bark. The benefits of adding phosphorus, iron, copper, and zinc from the bark of plants to animal feed depend on the specific needs of the animals being fed. Phosphorus is essential for the growth and maintenance of bones and teeth in animals (Akhideno *et al*., 2019). It also plays a role in energy metabolism and is required for the proper functioning of the nervous system. Iron is necessary for the formation of haemoglobin, which is the protein that carries oxygen in the blood. It is also involved in energy metabolism and is important for immune function (Ifijen *et al*., 2020) Copper plays a critical role in the formation of connective tissue, which includes bones, cartilage, and tendons.

It is also important for the formation of red blood cells and the functioning of the immune system. (Cheng *et al.*, 2022). Zinc is required for the proper functioning of many enzymes in animals, which are involved in a wide range of physiological processes. It is also important for immune function and the maintenance of healthy skin and coat. (Mocchegiani *et al.*, 2013) Adding these essential nutrients to animal feed can help ensure that the animals receive adequate nutrition for proper growth, development, and overall health. However, the appropriate amounts and ratios of these nutrients will depend on the species, age, and other specific needs of the animals being fed. (Dah-Nouvlessounon *et al*., 2015).

Conclusion

Based on the findings,*Canariumschweinfurthii* bark revealed a rich composition of phytochemicals, mineral elements, and proximate components. It was foundthat this plant bark is abundant in secondary metabolites and minerals, making it a valuable resource. The results showed that the bark contains significant amounts of moisture, protein, fat, fibre, and ash, making it a potentially valuable dietary resource. Phytochemical screening indicated the presence of various secondary metabolites like tannins, terpenoids, flavonoids, and saponins, which contribute to the plant's traditional medicinal uses. Additionally, the mineral composition revealed the presence of essential macro and micro minerals like calcium, magnesium, potassium, iron, copper, and zinc, which are important for animal and human health. This study sheds light on the nutritional and medicinal potential of *Canariumschweinfurthii*, warranting further exploration and utilization of its various components.These findings underscore the importance of *Canariumschweinfurthii*bark as a promising natural supplement with various nutritional benefits.

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