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Elemental Analysis and Proximate Composition of *Guiera senegalensis* Leaves from West Kordofan, Sudan

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study investigates the proximate composition and elemental contents of *Guiera senegalensis* leaves collected from West Kordofan, Sudan, and the leaf powder was prepared and analyzed using inductivity-coupled plasma \ Optical Emission Spectrometry to determine the concentration of elements and proximate composition were assessed according to the AOAC method. The Proximate analysis revealed moisture (4.142%), protein (12.250%), fat (4.248%), carbohydrate (51.496%), crude fiber (23.440%), and ash (4.424%). Five types of carbohydrate were evaluated such as Fructose, Glucose, Sucrose, Maltose and Lactose values obtained were 2.2687%, 2.49%, 2.5942%,0.0% and 1.3624% respectively. Elemental analysis using ICP-OES identified significant concentrations of Fe (860 ppm), K (840 ppm), Ca (810 ppm), and Mn (700 ppm), as well as traces

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of other elements. These findings underscore the nutritional and pharmacological potential of *G. senegalensis*, supporting its use in traditional medicine and as a natural ingredient in food and pharmaceutical applications.

Keywords: Guiera senegalensis; anti-inflammatory; phytochemical; combretaceae; Gabeish.

1. INTRODUCTION

Guiera senegalensis is one of the most widely used medicinal plants in Africa. *G. senegalensis*, also known as Moshi medicine, belongs to the family of *Combretaceae*. Other common names include Sabara, Barb\arta (in the local Hausa language, Nigeria), and Gabeish (in Sudan) (Elmalik et al., 2022). *G. senegalensis* is widely distributed in central and Western Africa (Anka et al., 2020). Traditionally, *G. senegalensis* was reported to be used alone or in combination for the treatment of dysentery, diarrhea, leprosy, depression, snake bite, epilepsy, and malaria (Mamman & Isa, 2013; Ogbeba et al., 2017). Pharmacological investigations revealed that the plant possesses antioxidant, anti-inflammatory, acaricidal, and antimicrobial activities against potential bacterial pathogens such as Shigella dysenteriae, Salmonella typhi, Staphylococcus aureus, and Pseudomonas aeruginosa (Abubakar et al., 2021; Hamadnalla, 2020; Momoh et al., 2021; Abdullahi & Abubakar, 2021). General phytochemical investigations indicated that *Guiera Senegalensis* contains tannins, flavonoids, terpenoids, saponins and alkaloids. Potential phytochemicals have been identified in the leaves of *G. senegalensis*, such as kaempferol, quercetin, ethyl gallate, miricitrin, gallic acid, myricetin, 5-methyl-dihydroflavasperon, isorhamnetin, guieranone A, β-sitosterol, rhamnetin and hyperoside (Silva et al., 2008). Besides its antimicrobial ethnomedicine activity, interesting traditional uses were reported. G senegalensis decoction is used to increase milk production during postnatal periods (Momoh et al., 2021) such ethnopharmacological uses require further investigations.

This work aim to investigate nutritional value of the leaves of *Guiera Senegalensis* collected from south kordofan state in Sudan by proximate analysis and determining the elements concentration.

2. MATERIALS AND METHODS

2.1 Plant material

The leaves of *Guiera Senegalensis* were collected in 2020 from West Kordofan State, Sudan. A plant taxonomist from the Institute of Aromatic and Medicinal Plants in Khartoum, Sudan identified and authenticated the plant. The preserved leaves of plant were dried under laboratory conditions and homogenized into a fine powder.

2.2 Proximate Composition

Proximate of Moisture content, protein content, fat, carbohydrate, crude fiber, and ash content were determined according to the Association of Official Analytical chemist (AOAC, 2000).

2.3 Mineral Composition

0.25 gram of G. senegalensis leaves powder was weighed and then 2 ml of concentrated HCl and 6 ml of concentrated HNO_3 were added. The mixture was placed in hot plate for 15 minutes and hence the sample is fully digested. After that, the digest was diluted with the addition of 50 ml of ultrapure water. Finally, the sample was analyzed using inductivity-coupled plasma \ Optical Emission Spectrometry (Shimadzu 2009) to determine the concentration of minerals in ppm.

Inductively coupled plasma is an elemental technique used for identifying and measuring the concentration of individual elements.

3. RESULTS AND DISCUSSION

Generally *Guiera Senegalensis* leaves are considered to be cheap sources of many nutritive contents and elemental compounds, in Table 1 shows the approximate analysis of the nutritive contents from *Guiera Senegalensis* leaves which containing moisture content (4.142%). Moisture content is among the most vital and mostly used measurement in the processing, preservation and storage of food (Sanni et al., 2008). The value g indicates that leaves can not be stored for a long time without spoilage. The value of the ash (4.424%) which is higher than that reported by Nabaa (2.15%), the crude protein of these seeds (12.250 %) less than that reported by Nabaa **(**13.93%) for *Guiera Senegalensis* leaves. The considerable amount of crude fiber (23.440 %) in these leaves show that they will enhance

easy movement of bolus in the large intestine, the crude fat value of the leaves (4.248%) that refer this plant leave is a good source of fat.

In Table 2 There are five types of carbohydrates were determined: Fructose, Glucose, Sucrose, Maltose and Lactose were gotten values 2,2687%, 2,49%, 2,5942%, 0,0%, and 1,3624% respectively. Shows that the *Guiera Senegalensis* leaves are serving animal nutrition because they have a relatively high content of carbohydrates, fats, ash, and proteins are a good source of energy.

The Guiera *Senegalensis* leaves contained significant amounts of important minerals shown in Table 3.

Medicinal plant contains the indispensable nutrients such as minerals, carbohydrates, proteins, vitamins, fibers, and fats required by the human body and is considered a source of energy. The elements are categorized in three classes a macro elements (primary), micro elements (trace elements) elements and ultra-trace elements. Macro elements include Calcium, Phosphorus, Potassium, Sodium, Sulphur and Chloride, whereas the micro elements include Iron, lithium, Magnesium, Zinc, Copper, Iodine, Beryllium, Cobalt, Selenium, Chromium, Manganese, Fluoride, and Molybdenum but ultra-trace elements such as Radium. (Murray et al., 2000; Baloch, 2021; Aletor & Omodara, 1994). The macro elements are required in amounts greater than 100 mg/dl, and the micro-minerals are required in amounts less than 100 mg/dl (Baloch, 2021). Macro, Micro elements, are considered as a potential health risk (Murray et al., 2000; Basgel & Erdemogˇlu, 2006). The results of nutritionally valuable mineral and trace elements are presented in table (3). The elements with the highest concentration is Fe (860ppm), followed by K (840 ppm), Ca (810 ppm), Mn (700ppm), I (440 ppm), Mg (170ppm), Na (110ppm). The Elemental analysis shows that the leaves are excellent sources of macro elements such as Calcium (Ca), Potassium (K), Sodium (Na), Phosphorus(P), Potassium(K), Sulphur(S) and Magnesium (Mg) and also are very rich with trace elements, Chromium, Manganese, iron, and subjected in Table 3 the concentration of elements (Ca, Cu ,K, Na, Fe, Mg, B, Zn, , Al, Cr, Li) reported in this study is the highest among previous study (Basgel & Erdemogˇlu, 2006; Alshafei et al., 2016) which recorded concentrations as (102, 0.0045, 14.7, 375, 3.2, 11.2, 0.013, 0.0173, 0.0126, 0.0045, 0.0124) respectively. Iron is well confirmed as an essential element and it is very important for the formation of haemoglobin, various human enzymes and normal functioning of the central nervous system and is present in the iron deficiency leads to anaemia and High doses of iron can cause hepatotoxicity that effect appeared in levels of red blood cells and muscle tissue. ((Daram & Hayashi, 2002; Fu et al., 2004; Adubiaro et al., 2011)

Sodium and Potassium are both essential elements that occur at high concentrations in the body (112g and 160g) respectively (Prinessa & Sadler, 2015). Potassium is involved in electrolytes balance and signal transduction by the famous Na\K ATP pump and has very important function for activation of enzymes in plant photosynthesis, protein synthesis and starch formation (Mohammed, 2013). A deficiency of sodium lead to Loss of body weight (Alshafei et al., 2016). The copper contain reported in this study (33 ppm) which more than that reported in (Mohammed, 2013). The Copper an important essential trace element, is found in various human transcription factors and enzymes. Excessive copper intake can lead to liver damage and Wilson's disease (NIH, 2017) Deficiency of copper effective of human health including blood vessel damage, aneurysms, nosebleeds, hernias, and can also affect the movement of nutrients through cell walls (Araya et al., 2006). The value obtained for Mn was (700ppm) it is an important element and is a constituent of metalloenzymes that oxidize fatty acids and cholesterol (Rehnberg et al., 1982). Excessive amounts of Manganese can cause, leg cramps, encephalitis and speech disorder, while deficiency in manganese can cause bleeding disorders (EFSA, 2013). Calcium is an essential elements with high level in the body (1.1 kg), it is necessary to formation and resorption of bones and teeth (Prinessa & Sadler, 2015).

Table 1. Proximate nutritive composition of Guiera *Senegalensis* leaves

Sample	Moisture	Ash	Protein	Fat	Fiber	Carbohydrate
Composition (%)	4.142	4.424	12.250	4.248	23.440	51.496

Table 2. Proximate some types of carbohydrate from Guiera *Senegalensis* leaves

Sample	Fructose	Glucose	Sucrose	Maltose	Lactose
Composition (%)	2.2687	2.6649	2.5942	-	1.3624

Chromium (Cr) is found to be (3.5ppm) in *Guiera Senegalensis* leaves (Table 3) which is believed to be important in the production and utilization of insulin (Basgel & Erdemogˇlu, 2006). Also plays an important role in the metabolism of carbohydrate, cholesterol and protein synthesis (Ano & Ubochi, 2008). In this study the level of Indium *(*In) was (42 ppm) it is used in clinical diagnostic imaging. Iodine appeared (440ppm) in this study it is essential for the thyroid gland in the form of thyroid hormones (Prinessa & Sadler, 2015).

Table 3. Elemental analysis of *Guiera Senegalensis* leaves

Element	Concentration (ppm)
Na	110
Fe	860
K	840
Ca	810
P	1.5
B	20
Cu	33
Mg	170
Mn	700
S	2.1
I	440
Zn	6,5
Cr	3,5
Al	1,5
Li	0.19
In	42

The concentration of Magnesium (170ppm) in plants it is very necessary for the synthesis of chlorophyll and photosynthesis. (Alshafei et al., 2016). The Boron recorded content (20 ppm) may play a role in the development of healthy bones and joints, and as a dietary supplement (Newnham, 1994; Price et al., 2012). Zinc is an essential element together with a copper are considered important for metabolizing glucose and lowering cholesterol, a deficiency of zinc has been linked to a suppressed immune response (Plum et al., 2010). This result suggest that the studied plant are a potential source of micronutrient elements such as Fe, Cu, Zn, Mn and Se, which are considered as anti-oxidant elements. Other elements present in trace amounts include P, S, Al and Li at 1.5, 2.1, 1.5 and 0.19 ppm respectively. Our study reported a high elements concentration in *Guiera Senegalensis* plant than reported in previse studies. That variation depends on several factors, such as climate, analytical instrument, soil components, and harvest season.

4. CONCLUSION

The results obtained shows that the leaves of *Guiera Senegalensis* contains Proximate Composition, which might be beneficial for the nutritional industry as natural food additives and supplements. Also the leaves of Guiera *Senegalensis* it is an excellent source of essential and non-essential elements that can be formulated into nutritive herbal drugs. Our study supports the fact that some medicinal plants commonly consumed in Sudan are promising sources of complementary foods.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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