IOSR Journal Of Pharmacy And Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 17, Issue 6 Ser. IV (Nov. – Dec. 2022), PP 01-05
www.Iosrjournals.Org

Mineral Content of *Phyllantus amarus*

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This study investigated the mineral content of the plant leaf of Phyllantus amarus. The mineral content of the leaf were determined using atomic absorption spectrophotometer. The result revealed that the following minerals were present in the leaf extract: calcium, sodium, magnesium, potassium, copper, zinc, manganese, iron, chromium, molybdenum, selenium, silver, lead, mercury, nickel and cadmium while cobalt, arsenic, tin and vanadium were not detectable. The result shows that Phyllantus amarus contains some minerals which that could impart some medicinal property to it.

***Key words**: Phyllantus amarus, mineral, calcium, sodium, zinc, lead medicinal*

Date of Submission: 07-12-2022 Date of Acceptance: 21-12-2022

I. Introduction

Herbal plants are small erect medicinal plants with pale green leaves having small oblong elliptic glabrous leaves. They are widely distributed in the tropics, and grow up to 30-40 cm in height (Achi *et al*., 2017), with little girth. These plants are widely spread throughout the tropics and subtropics in sandy region as weeds or shrubs in cultivated and waste lands (Achi *et al*., 2017), and have high utility in ethnobotanical medicine.

Phyllanthus is one of the largest genuses in the family *Phyllanthaceae*, with 11 sub-genuses that comprise over 700 well known species and are cosmopolitan in distribution, mainly in the tropics and subtropics. The extracts of *Phyllanthus* amarus (*P. amarus*) show good antioxidant activity, along with antibacterial potential, particularly in conditions including diarrhoea, dysentery, dropsy, running nose, winter common colds, blennorrhagia, colic, indigestion, alternating fevers, hepatitis, and malaria (Achi *et al*., 2017).

Phyllanthus amarus is important for its commercial use in the preparation of wines. The utilization of *Phyllanthus* amarus in traditional medical treatments to cure several ailments, including fevers, toothache, dysmenorrhea, anemia, and paralysis has been reported. *Phyllanthus amarus* extract has diverse uses in confectionaries, the food industry, and as a traditional medicine. Many studies have evidenced that it contains various potential and active phytochemicals are can be used for different human diseases linked with human lifestyles when mainly taken up as neutraceuticals (Ashok and Upadhyaya, 2012).

Phyllanthus amarus leaves contained crude fibre, crude protein, crude lipids, carbohydrate and dry matter (Umoh *et al*., 2013). Minerals are inorganic elements that cannot be synthesized in the body but obtained from the diet (Sahay and Sahay, 2012). They are needed in the buildup and function of important bio-molecules in the human body. Although, minerals are not a source of energy in the body but they are necessary for the maintenance of normal biochemical processes in the body (Zhao *et al*., 2016).

Though, valuable pieces of information about *Phyllanthus amarus* abound in literatures, however, there is apparently scanty report of mineral contents of the leaf extract of *Phyllanthus amarus*. Thus, this project research work is aimed at determining the mineral composition of *Phyllanthus amarus* leaf extract harvested from Nkanu land in Enugu State with the view of recommending it as a good source of micronutrient.

II. Method

Sample Collection

Fresh leaves of *Phyllanthus amarus* were obtained from Akegbe-Ugwu in Nkanu West Local Government of Enugu State, Nigeria. It was conveyed to Department of Botany, UNIZIK Akwa in a black polyethylene bag where it was identified as *Phyllanthus amarus* (Ngwu) and named in with code NAUH-202[A].

Sample Preparation

Fresh leaves of *Phyllanthus amarus* were thoroughly were plucked and slightly rinsed in cold tap water to remove sand, dirt and dust. The leaves were thoroughly air dried at room temperature for three weeks at room temperature. The dried sample was ground into powder using mortar and pestle and subsequently into fine powder using an electric blender, sieved through muslin cloth. One hundred grams (100 g) of the powdered sample was obtained and then kept in an air-tight container prior to analysis.2.3 Sample Analysis. The mineral contents of the samples were determined using the atomic absorption spectrophotometer.

Determination of the Mineral Content

The mineral content was determined by Atomic Absorption Spectroscopy using Varian AA 240 Atomic Absorption Spectrophotometer (APHA, 1995).The extract of the sample was placed on a bench. The atomic absorption spectrophotometer was switched on and set to required wavelength which was determined by the mineral being assayed. The appropriate lamp which was determined by the mineral was in the appropriate place in the machine. A tube from the machine was inserted into the water sample on the bench and water sample was aspirated into the instrument through the tube. The machine was then set to take the absorbance as well as the concentration which was displayed on the screen at the front of the machine. Concentration of mineral in the sample was recorded.

III. Results

Table 1: Elemental mineral composition in *Phyllanthus amarus* leaf extract

Parameters	Composition µg/g
Calcium	6.738±0.000
Sodium	7.393±0.001
Magnesium	1.692±0.003
Potassium	7.389±0.001
Copper	0.021±0.000
Zinc	0.215±0.001
Manganese	0.028±0.002
Iron	0.122±0.001
Cobalt	0.00±0.000
Chromium	0.020±0.000
Molybdenum	0.020±0.000
Selenium	0.367±0.003
Silver	0.033±0.002
Lead	0.016±0.000
Arsenic	0.00±0.001
Mercury	0.662±0.001
Tin	0.00±0.000
Nickel	0.020±0.001
Vanadium	0.00±0.002
Cadmium	0.020±0.002

Data are presented as mean ± standard error of mean (SEM).

IV. Discussion

Table 1 showed the mineral composition of *Phyllanthus amarus* grown in southeastern Nigeria. Calcium content is lower than the values reported for some selected vegetable leaves in Nigeria, such as *Amaranthus hybridus*, *Hibiscus sabdariffa*, and *Telfaria occidentali* (Asolu *et al*., 2012). Calcium functions as a constituent of bones and teeth, regulation of nerve and muscle function (Brody, 2004). The value of calcium obtained in this work is lower than the recommended safe level (43.27mg/kg) by the FAO/WHO (2012). Sodium content was lower when compared with standard dietary allowance (RDA). Sodium is the principal cation in intracellular fluid and functions in acid base balance, regulation of osmotic pressure, muscle contraction and Na^+/K^+ ATPase (Mathothra, 1998; Murray *et al*., 2000). The value of sodium obtained in this work is lower than the recommended safe level (23.12 mg/kg) by the FAO/WHO (2012). The magnesium content was value is lower than the values reported for some selected vegetable leaves in Nigeria, such as *Amaranthus hybridus*, *Hibiscus sabdariffa*, and *Telfaria occidentali* (Asolu *et al*., 2012). Magnesium aids in the maintenance of bone growth and integrity and is involved in the regulation of the cardiac cycle and the functioning of muscles and nerves. Deficiency diseases are hypomagnesaemia and neuromuscular irritability. The value of magnesium obtained in this work is lower than the recommended safe level (3.55mg/kg) by the FAO/WHO (2012).

Potassium content was lower than the values reported for some selected vegetable leaves in Nigeria, such as *Amaranthus hybridus*, *Hibiscus sabdariffa*, and *Telfaria occidentali* (Asolu *et al*., 2012). Potassium is one of the principal cations in intracellular fluid and functions in acid base balance, regulation of osmotic pressure, muscle contraction and Na^+/K^+ ATPase (Mathothra, 1998; Murray *et al*., 2000). The value of potassium obtained in this work is lower than the recommended safe level (5.21mg/kg) by the FAO/WHO (2012). Copper is a constituent of enzymes like cytochrome c oxidase, amine oxidase, catalase, peroxidase, ascorbic acid oxidase, cytochrome oxidase, plasma monoamine oxidase, erythrocuprin (ceruloplasmin), lactase, uricase, tyrosinase, cytosolic superoxide dismutase etc (Chandra, 2010). Copper is required for red blood cell production. Copper-containing proteins like ceruloplasmin contribute to the absorption of iron in the gastrointestinal tract. It is involved in bone formation and hematopoiesis (Patil *et al*., 2013). The value of copper obtained in this work is lower than the recommended safe level (1.31mg/kg) by the FAO/WHO (2012). Zinc is a constituent of metalloenzymes and enables cell growth and proliferation, sexual maturity, and fertility. It improves immunity, appetite, and taste. Zinc deficiency is rare and can be seen in patients with kidney diseases and in alcoholic patients. The growth of children with zinc deficiency is reduced. Zinc toxicity symptoms include the development of gastrointestinal diseases and a decreased immune function (Prasad 2008; Bredholt and Frederiksen, 2016). The value of zinc obtained in this work is lower than the recommended safe level (0.31mg/kg) by the FAO/WHO (2012). Manganese is part of enzyme involved in urea formation, pyruvate metabolism and the galactotransferase of connective tissue biosynthesis (Chandra, 1999). The value of manganese obtained in this work is lower than the recommended safe level (0.53 mg/kg) by the FAO/WHO (2012).

Iron content was was significantly higher than the values reported for some selected leafy vegetables in Nigeria (Chinma and Igyor, 2007). Iron is a part of the heme of haemoglobin (Hb), myoglobin, and cytochromes, Fe is an important constituent of succinate dehydrogenase as well as a part of the haeme of haemoglobin (Hb), myoglobin and the cytochromes (Chandra, 2010).Iron is required for proper myelination of spinal cord and white matter of cerebellar folds in brain and is a cofactor for a number of enzymes involved in neurotransmitter synthesis (Larkin and Rao, 2010). Iron is involved in synthesis and packaging of neurotransmitters, their uptake and degradation into other iron-containing proteins which may directly or indirectly alter brain function (Beard, 2011). The value of iron obtained in this work is lower than the recommended safe level (4.51mg/kg) by the FAO/WHO (2012).

Cobalt is a trace element that the body can actually work without though it is a co-factor in the synthesis of vitamin B_{12}. Cobalt deficiencies in ruminants have been successfully alleviated by the use of cobalt oxide pellets (Hays and Swenson, 2015). The value of cobalt obtained in this work is lower than the recommended safe level (4.00mg/kg) by the FAO/WHO (2012). Chromium is an essential element for animals and humans (Fried, 2004). It has been found in nucleoproteins isolated from beef liver and also in RNA preparations (Uppala *et al*., 2005). It could play a role in maintaining the configuration of the RNA molecule, because Cr has been shown to be particularly effective as a cross-linking agent for collagen (Eastmond *et al*., 2008). Cr has also been identified as the active ingredient of the glucose tolerant factor (Brown, 2003), a dietary factor required to maintain normal glucose tolerance in the rat. Trivalent chromium is a constituent of ‘‘glucose tolerance factor’’ (GTF), which binds to and activates/potentiates insulin action (Wennberg, 2014; Murray *et al*., 2010). The value of chromium obtained in this work is lower than the recommended safe level (0.12mg/kg) by the FAO/WHO (2012).

Molybdenum is a component of several metalloenzyme including xanthine oxidase, aldehyde oxidase, nitrate reductase, and hydrogenase. Xanthine oxidase and aldehyde oxidase play a role in iron utilization as well as in cellular metabolism in electron transport. Xanthine oxidase is actively involved in the uptake and release of iron from ferritin in the intestinal mucosa and in the release of iron from ferritin in the liver, placenta, and erythropoietic tissues to the ferrous form (Hays and Swenson, 2015; Murray *et al*., 2010). The value of molybdenum obtained in this work is lower than the recommended safe level (0.45mg/kg) by the FAO/WHO (2012).

Selenium as an antioxidant helps prevent oxidative stress, inflammation and DNA repair. It is also a constituent of glutathione peroxidase which is a major scavenger of H_2O_2 (Arinola *et al*., 2008; Murray *et al*., 2000). The value of selenium obtained in this work is lower than the recommended safe level (0.92mg/kg) by the FAO/WHO (2012). Silver is used widely in wound dressings and medical devices as a broad-spectrum antibiotic. Metallic silver and most inorganic silver compounds ionise in moisture, body fluids, and secretions to release biologically active. Silver has a long and intriguing history as an antibiotic in human health care. It has been developed for use in water purification, wound care, bone prostheses, reconstructive orthopaedic surgery, cardiac devices, catheters and surgical appliances. Though toxicity of silver is low, the human body has no biological use for silver and when inhaled, ingested, injected, or applied topically, silver will accumulate irreversibly in the body, particularly in the skin, and chronic use combined with exposure to sunlight can result in a disfiguring condition known as argyria in which the skin becomes blue or blue-gray (Hays and Swenson, 2015). The value of silver obtained in this work is lower than the recommended safe level (0.32mg/kg) by the FAO/WHO (2012).

Lead causes adverse effect in several organ and organ systems including nervous, renal, cardiovascular, reproduction, haematological, and immune system (Patil *et al*., 2006). Lead is a toxic element that can be harmful to animal. Lead is a well-known neurotoxin. Impairment of neurodevelopment in children is the most critical effect. Exposure in uterus, during breastfeeding and in early childhood may all be responsible for the effects. Lead accumulates in the skeleton and its mobilization from bones during pregnancy and lactation causes exposure to fetuses and breastfed infants (ATSDR, 2007). The value of lead obtained in this work is lower than the recommended safe level (0.3mg/kg) by the FAO/WHO (2012). Arsenic has no identifiable role in human metabolism. However, arsenic poisoning occurs in multicellular life if quantities are larger than needed. The toxicity of arsenic is connected to its solubility and is affected by pH. The value of arsenic obtained in this work is lower than the recommended safe level (0.22 mg/kg) by the FAO/WHO (2012).

Mercury is a ubiquitous environmental toxin that produces a wide range of adverse health effects in humans (Guzzi and La Porta, 2018). Symptoms of mercury poisoning include permanent damage to the brain and kidneys, personality changes (irritability, shyness, and nervousness), tremors, changes in vision, deafness, muscle uncoordination, loss of sensation, and difficulties with memory. The value of mercury obtained in this work is lower than the recommended safe level (10.01mg/kg) by the FAO/WHO (2012). Tin has no identifiable role in human metabolism. Tin is required for normal growth in the rat and there is no specific clinical or pathological changes in the animal (Schwarz, 1974). It also improved the pigmentation of incisors in the rats. The value of tin obtained in this work is lower than the recommended safe level (0.22mg/kg) by the FAO/WHO (2012). Cadmium binds to the mitochondria and can inhibit both cellular respiration and oxidative phosphorylation at low concentration (Asagba, 2009). Cadmium affects cell proliferation, differentiation, and apoptosis. These activities interact with DNA repair mechanism, the generation of reaction oxygen species (ROS) and the induction of apoptosis (Yavuz *et al*., 2015). The value of tin obtained in this work is lower than the recommended safe level (0.21mg/kg) by the FAO/WHO (2012).

Conclusion

The study has shown that the *Phyllanthus amarus* leaf examined has an appreciable content of both macro and trace mineral elements. The leaf contained good minerals with abundance of them in potassium, sodium, calcium and zinc while it had least amount of vanadium, tin, arsenic and cobalt. The results suggest that the leaf if consumed in sufficient amount would contribute greatly towards meeting human nutritional requirement for normal growth and adequate protection against diseases arising from malnutrition.

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CE Achikanu, et. al. "Mineral Content of Phyllantus amarus." *IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS),* 17(6), (2022): pp. 01-05.