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Nutritive values, Mineral and Antioxidant properties of *Pistia stratiotes* (Water lettuce)

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ABSTRACT: Proximate, mineral and antioxidant composition of the leaf and root samples of *Pistia stratiotes* were estimated using standard methods. The samples show appreciable levels of moisture (4.50±0.50%and 4.50±0.10%), crude fibre (17.50±0.87% and 20.50±1.80%), crude lipid (2.17±0.29% and 1.83±0.29%), crude protein (6.96±0.13% and 3.18±0.14%), ash (35.20±1.56% and 44.50±0.50%) and carbohydrate (38.20±2.08% and 30.00±1.46%) respectively. The minerals determined were sodium (373.00±0.50mg/100g and 113.00±0.06mg100/g), potassium (3283.00±0.76mg100/g and 1750.00±0.50mg100/g), phosphorus (336.00±0.10mg/100g and 313.00±0.03mg/100g), calcium (230.00±0.01mg/100g and 230.00±0.03mg/100g) and magnesium (370.00±0.03mg/100g and 230.00±0.03mg/100g) respectively. The antioxidant estimated are vitamin A (480.0±1.50mg/100g and 1050.00±1.50mg/100g), vitamin C (560.00±0.20mg/100g and 3130.00±0.31mg/100g) and vitamin E (8260.00±3.00mg/100g and 3060±1.83mg100/g) respectively. The results show that the leaf and root portions of P.stratiotes have potential nutritional uses and the leaf parts have significant (P<0.05) high values of mineral element and antioxidant than that of the root samples.
Keywords: *Pistia stratiotes*, mineral elements, proximate analysis, antioxidants

INRODUCTION

The use of plants as medicines predates written human history and some of the earliest written records from China, Egypt and Sumeria deal with this topic (Houghton, 1995). In Northern Nigeria, wild plants are consumed as normal herbs to provide fairly good amounts of several nutrients (Musa, 2005.) It is widely accepted that herbs are significant nutritional sources of minerals. Throughout the world, there is increasing interest in the importance of dietary minerals in the diet, even though they make up only 4-6% of the human body (Hassan *et al.*, 2007).

Traditional medicine is the sum total of knowledge skills and practices based on the theories, beliefs and experiences indigenous to different cultures that are used to maintain health, as well as to prevent, diagnose, improve or treat physical and mental illness (Cragg and Newman, 2001). Herbal medicines include herbs, herbal materials, herbal preparations and finished herbal products that contain parts of plants or other plant materials as active ingredients (WHO, 2008).

Pistia stratiotes with common names: Laiteu d`eau, Pistie (French); Lechuguilla de agua, Lechuguita de agua, repollo de agua (Spanish); Water lettuce, tropical duckweed, shellflower (English) and Kainuwa (Hausa). It is an edible and attractive floating ornamental with wide distribution in the tropical and sub-tropical world. It is presently use by local practitioners (herbalist) for the treatment of liver cirrhosis in the Northern part of Nigeria. The plant was reported to have antifungal properties and antidermatophytic activity (Premkumar and Shyamsundar, 2005). The oil extract is used in the treatment of worm infestations, tuberculosis, asthma and dysentery and is applied externally to treat skin diseases, inflammation, piles, ulcers, syphilitic infections and burns (Kirtikar and Basu, 2002). The present use of *P. stratiotes* for the treatment of liver cirrhosis in the Northern part of Nigeria make this study important. The nutrient information and antioxidant properties reported in this study would enhance efforts to promote wide use of the plant because of its nutritional benefits and medicinal properties.

MATERIALS AND METHODS

Plant Material

The leaves and roots of *P.stratiotes* were collected in March 2009, in Goronyo Local Government Area of Sokoto, Nigeria. The plant was identified by a taxonomist at Botany unit where Voucher specimen was kept for reference. The study was undertaken in April to May 2009. The portions collected were air-dried and pulverized to powdered form and stored in air tight container at room temperature until required for use.

Proximate analysis and nutrients composition

The powered samples were analysed for moisture, ash, crude fibre, and crude lipid using the method of Bakare (1986) and carbohydrate by difference. Crude protein content was determined by Kjeldhal method. Sodium and Potassium were determined by Flame photometer. EDTA titration method was employed in the estimation of Calcium and Magnesium and Phosphorus was determined spectrophotometrically using the method of Black *et al.,* (1965). Vitamin A was determined by Moon and Shibamoto method (2009). Vitamin C and E were estimated by the method of Lowry *et al.,* (1983).

Statistical Analysis

The result is presented as mean ± SD of 3 replicates. The results were analysed by student,s t test using Graph pad Instat software (San Diego, USA). A $p<0.05$ was considered statistically significant.

RESULT AND DISCUSSION

The result of proximate analysis presented in Table 1 indicate a moisture and ash content of 4.50% and 35.20 – 44.50% respectively. The moisture content of both leaf and root extracts of *P. stratiotes* is low, this indicates that their shelf life will be long and also implies a great economic importance since moisture content is associated with increase in microbial activities during storage (Abdullahi, 2002) and the ash content of root sample is higher than that of leaf sample. High extent of ash is an index of mineral contents (Oyeleke, 1984). The range of crude fibre content of the leaf and root sample was 17.50 – 20.50%. Root sample has the highest fibre content. The fibre content of both leaf and root portions studied was higher than the reported values for wild yam tubers species (Ladan *et al.*, 2005) and milk weed (Hassan *et al.,* 2007). High fibre foods support bowel regularity, help maintain normal cholesterol levels and blood sugar levels, reduce constipation and also use for prevention of heart disease and certain types of cancer (WHO 2008). Carbohydrate content estimated as nitrogen free extract (NFE) was in the range of 30.0 – 38.21%. Maturing plants store very little carbohydrate (Osagie, 1992). The value recorded is by far lower than those reported for some domesticated roots from Nigeria and South Africa (Osagie, 1992; Ladan *et al.*, 2005).

The crude protein content is in the range of 3.18-6.96%, with leaf parts having the highest value. These values were slightly lower than those reported by Ladan *et al.,* (2005) for varieties of wild yam tubers from Zuru Area of Kebbi State, Nigeria. The comparatively high crude protein of the leaf sample may be a probable indicator of their nutritional superiority over the root sample. Nontheless, it is worthy to mention that the crude protein content of plants may vary considerably between both species and cultivars of species, and that such variations depend on various factors such as climate, soil type, and adoptive factors under which the plant was grown, maturity at harvest and length of time for which the sample has been stored (Heiman, 1980).The crude lipid (fat) is in the range of 1.33 – 2.17%. The leaf sample has the highest fat content than the roots. The crude lipid of both samples is low compared to the reported values (8.3 – 27%) in some vegetables consumed in Nigeria and Republic of Niger (Senna *et al.*, 1998). Values of similar range have been reported for other plant species, proving that *P. stratiotes* is a poor source of lipid. Thus, it is health wise to avoid the consumption of excess fat to avoid obesity, heart diseases and other related problems.

Table 1: Proximate composition of *Pistia stratiotes*

Parameters	Leaves (%)	Roots (%)
Moisture	4.50 ± 0.50^a	4.50 ± 0.10^a
Ash	35.20 ± 1.56^a	44.50 ± 0.50^b
Crude protein	6.96 ± 0.13^a	3.18 ± 0.14^a
Crude lipid	2.17 ± 0.29^a	1.83 ± 0.29^a
Crude fibre	17.50 ± 0.87^a	20.50 ± 1.80^a
Available carbohydrate	38.21 ± 2.08^a	30.00 ± 1.46^a

Values are mean ± standard deviation (n = 3), a indicates no significant (P>0.05) difference from the leaves and roots, b indicates significant (P<0.05) difference from leaves and roots

Table 2 represents the mineral composition of *P. stratiotes*. The sodium content is lower in root sample than in leaf sample. The low level of sodium in roots is a characteristic of plant product (Olaofe *et al*., 1994) The low sodium content coupled with high potassium content make them a good food source for hypertensive patients (Hassan *et al.*, 2005). High amount of potassium in the body increases iron utilization (Adeyeye, 2002). Increasing dietary potassium lowers blood pressure in humans and reduces the risk of stroke (Hagarty, 1985). Thus, *P. stratiotes* could be of interest in complementary food formulation and pharmaceutical industries. The calcium content was found to be the same in both the leaf and root sample. Calcium in conjunction with magnesium, chlorine and proteins are involved in the formation of bones (Abullude, 2007). It also plays important role in blood

clotting and co-ordination of inorganic elements present in the body (Brain *et al.,*1992). The availability of calcium in the body depends on calcium to phosphorus ratio and presence of antinutritional factors such as oxalate and phytate (Bentliff and Kosler, 2006). Both the leaf and root samples of *P. Stratiotes* are rich in phosphorus. The reference nutrient intake (RNI) of phosphorus varies from 270 – 400mg per day, with additional amounts for lactating women (Moynhann and Petersen, 2004) Phosphorus is required for normal function of the body since it is a major structural component of bone and teeth and helps to maintain normal pH (Knochel *et al.*, 2006). It is crucial for production of ATP and also plays important role in the growth, maintenance and repair of cells and tissues (Omoninhetile *et al.,* 2004). However, the values are lower than the range reported in some fruits vegetables (Hoe and Siong, 1999).

Magnesium is an antioxidant micronutrient and its presence may boost the immune system and aid in removing magnesium deficiencies which could lead to severe metabolic disorders and compromise the health of the organism (Hassan *et al.*, 2007). Magnesium is essential for the formation and development of bone especially in young people (Olaofe *et a.l*, 1994).

Table 2: Mineral elements and vitamins content (mg/100g) of *Pistia stratiotes*

Parameters	Leaves	Roots
Sodium	373.00 ± 0.50[a]	113.00 ± 0.60[b]
Potassium	3283.00 ± 7.60[a]	1750.00±0.50[b]
Phosphorus	336.00 ± 0.10[a]	313.00 ± 0.03[b]
Calcium	230.00 ± 0.01[a]	230.00 ± 0.03[a]
Magnesium	370.00 ± 0.03[a]	230.00 ± 0.03[a]
Vitamin A	480.00 ± 1.50[a]	1050.00±1.50[b]
Vitamin C	5600.00 ± 0.20[a]	3130.00±0.31[b]
Vitamin E	8260.00 ± 3.00[a]	3060.00±1.83[b]

Values are mean ± standard deviation (n = 3), a indicates no significant (P>0.05) difference from the leaves and roots, b indicates significant (P<0.05) difference from leaves and roots

The antioxidant composition of leaf and root sample of *P. stratiotes* is also presented in Table 2. The vitamin C content of leaf is higher than that of root sample. Presence of ascorbic acid in the diet enhances iron absorption, and iron to ascorbic acid ratio provides an index of iron availability in food sample in such a way that the lower ratio, the greater the relative bioavailability of iron (Omoninhenle *et al.*, 2004). Vitamin C prevents many debilitating diseases, increases the body's immunity and is powerful antioxidant (Bjelakoni *et al.,* 2007*)* It also helps in recycling other antioxidants and it also aids in the formation of collagen. Collagen, tendons and ligaments depend upon Vitamin C to stay strong and healthy (John, 2009).

The leaves contain high amount of vitamin E compared to the root. Vitamin E provides protection which might include its function as an antioxidant and its roles in anti-inflammatory processes, inhibition of platelet aggregation, and immune enhancement (George, 2009). Vitamin E is also involved in immune function and, as shown primarily by *in vitro* studies of cells, cell signalling, regulation of gene expression, and other metabolic processes (Fact Sheet, 2009). Vitamin E also may block the formation of nitrosamines, which are carcinogens formed in the stomach from nitrites consumed in the diet (Hassan, et al., 2005). It also may protect against the development of cancers by enhancing immune functions. Some evidence links higher intake of vitamin E to a decreased incidence of prostate and breast cancers (George, 2009). The vitamin A content of the leaf sample is higher compared to the root. Vitamin A serves as an antioxidant and is essential for normal growth and for the formation of strong bones and teeth in children, for normal vision and cell structure, for protecting the lining of the respiratory, digestive, and urinary tracts against infection, and for healthy skin (Damon, 2009). It also functions as a hormone, visual pigment of the vertebrate eye and regulates gene expression in the development of epithelial tissue, including skin (Nelson and Cox, 1999).

CONCLUSION

The present study shows that, the leaf and root of *Pistia stratiotes* could be utilized as a cheap source of nutrients with high content of antioxidants. Studies on antimicrobial activities and toxicology of the plant are recommended as it has the potential to improve the lives of both urban and rural dwellers.

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