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Assessment of the Chemical and Phytochemical Constituents of the Leaves of a Wild Vegetable-*Ochthocharis dicellandroides* (Gilg)

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Abstract: Phytochemical constituents, proximate and mineral composition of *Ochthocharis dicellandroides* leaves were investigated in order to assess their nutritional value. The result of proximate composition showed that the leaves contained moisture (77.25%), crude protein (15.50%), carbohydrate (11.73%), crude fat (3.52%), energy (593.15 kj/mol) and ash (4.19%). Elemental analysis revealed that the minerals detected in the leaves were calcium, phosphorus, potassium, magnesium and iron in decreasing order of concentrations. Aluminium and sodium were found as trace elements and manganese was not detected. The phytochemicals detected in the leaves were alkaloids, flavonoids, Steroids, triterpenoids and glycosides, while anthraquinones tannins and saponins were not detected. The results showed high concentrations of flavonoids and steroids and a moderate amount of glycosides. However alkaloids and triterpenoids were detected in trace amounts. The results obtained in the present study indicate that the leaves of O. *dicellandroides* contain nutrients and mineral elements that determine their nutritional value. The presence of bioactive compounds such as flavonoids and steroids with pharmaco-therapeutical properties may justify the medicinal potential of the plant and confirm its nutritive importance for body health.

Key words: Leaves, assessment, composition, nutritional value

INTRODUCTION

Most vegetables plants consumed in tropical Africa are cultivated by farmers or consumers. Wild tropical plants used as leafy vegetables are increasingly being abandoned by rural people. Recently in Congo-Brazzaville an increasing interest in wild vegetables has been noticeable. The plants are found in the markets of Brazzaville and other localities of the country where they are commercialized. Among them, *Ochthocharis dicellandroides (gilg.*), from the melastomataceae family is an herb or shrub that grows to 1-5 m in height in damp places in the forest zone from Guinea to S. Nigeria and across Africa to Sudan, Congo and Angola. A root decoction is taken in Congo (Brazzaville) for costal pains and cough (Bouquet, 1969; Burkill, 1985). In Congo the leaves are mainly used in nutrition as leafy vegetables consumed in dishes as a component of soups or sauces. They are especially used by riverine populations as an aquatic vegetable and in others areas in the dry season when most of cultivated vegetables disappeared at the hard conditions. In ethno-medicine the mixture decoction of the leaves with the bark of *Bridelia ferruginea* or *Hymenocardia ulmoides* leaves taken orally is indicated by healers to treat stomach pain or diabetes. The mark of the leaves piled with mature Elaeis guineensis nuts is indicated in the treatment of womb ailments. Many researchers have reported various studies on vegetable seeds and plants from Congo-Brazzaville (Kimpouni, 2001; Matos *et al*., 2009; Kimbonguila *et al*., 2010a,b; Ndangui *et al*., 2010) but no reports have been found on the nutritional and the pharmaceutical potential of *O. dicellandroides*. It has been reported that vegetables contain vitamins, essential amino acids, minerals, antioxidants and protein (Fasuyi, 2006; Okator, 1983) needed for body metabolism and health care. The aim of the present study was to investigate the chemical composition and the phytochemical constituents of the leaves of *O. dicellandroides* in order to assess their nutritional and medicinal potential.

MATERIALS AND METHODS

Collection and processing of plant materials: The experimental leaves of O. *dicellandroides* were collected around the village of Enkouele, in the Gamboma district, north area of Congo on 23th August 2010. The plant materials were identified and authenticated by Nkouka Saminou from the national herbarium of the vegetal research centre of Brazzaville (ex-OROSTOM-Congo) where voucher specimens have been deposited. The leaves were air-dried for 21 days and milled in powder with a mechanical blender. The powder was stored at room temperature under dry conditions before analysis. Chemical analysis was carried out on the powdered leaves.

Proximate analysis: The sample was analyzed for moisture, crude protein, crude fat and ash content.

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Crude protein was determined by using the Kjeldahl method. The moisture and crude fat were determined according to the procedure of AOAC (1990) and the percentage calculated on dry weigh basis. Ash was determined by incineration in a muffle furnace and the weight of ash was calculated from difference with the sample taken and calculated on a dry weight basis. Carbohydrates were determined by difference of the sum of all the proximate composition from 100%. Energy values were obtained by multiplying carbohydrate, protein and fat by Atwater conversion factors of 17, 17 and 37 respectively (Kilgour, 1987).

Mineral analysis: Mineral analyses were carried out according to Martin-Prevel *et al*. (1984). The sample was drying ashed at 450°C and 550°C for incineration. Elemental analyses was carried out using an atomic absorption spectrophotometer and flame emission photometer. Aluminium and phosphorus were determined calorimetrically. The concentration of each element in the sample was calculated on a dry matter basis.

Extraction procedure: The powdered leaves (100 g) of *O. dicellandroides* were soaked in 350 ml of 98% ethanol solution for 72 h. The extract was then filtered and the filtrate was concentrated by evaporation at the room temperature for five days and submitted to phytochemical screening.

Preliminary phytochemical screening: Phytochemical constituents of the leaves were determined according to the methods described by Trease and Evans (1989), Harborne (1998) and Kokate (2001). The concentration of phytochemicals was determined analogically as described by Mariita *et al*. (2010). The phytochemicals tested were alkaloids, anthraquinones, flavonoids, saponins, steroids, tannins, triterpenoids and glycosides.

RESULTS AND DISCUSSION

Proximate composition: The results of proximate analysis of the leaves of *O. dicellandroides* are presented in Table 1. The results showed a high moisture content (77.25%) of *O. dicellandroides* leaves which was in line with the 76.00% reported for some vegetables like *Piper guineense* and *Gongronema latifolium* (Mensah *et al*., 2008) but lower than the 81.36% recorded in *Brassica oleracea* (Emebu and Anyika, 2011), 83.75% in *Pterocarpus soyeubixii* and *Gnetum africanum* (Ekumankama, 2008), 89.00% and 93.40% in *Talinum triangular* and *Baseila rubra* respectively (Mensah *et al*., 2008) and also the range of 88.00-92.50% reported for other selected vegetables grown in Peshawar (Bangash *et al*., 2011). This value was much higher than those recorded by Ujowundu *et al*. (2010) for *C. zenkeri* (11.32%), Omoyeni and Aluko (2010) for *Cissus petiolata* (6.82%), Bangash *et al*. (2011) for *Allium sativum* (66.80%) and the values ranged from 7.60-8.55% for some vegetables from Nigeria (Iheanacho and Udebuani, 2009).

Table 1: Proximate composition of *O. dicellandroides* leaves

Parameters	Percentage composition (%)
Moisture	77.25
Total fat	3.52
Crude proteins	15.50
Carbohydrate	11.73
Total ash	4.19
Energy (Kj/100 g)	593.15

According to Emebu and Anyika (2011) products that have low fat values normally have high moisture content. Moisture content is a widely used parameter in the processing and testing of food. It is an index of the water activity of many foods. Iheanacho and Udebuani (2009) reported that high moisture content provides for greater activity of water soluble enzymes and coenzymes needed for the metabolic activities of these leaves. The high moisture content of the leaves recorded in the present study indicates that they would be susceptible to microbial attack during storage and would have a short shelf life. It is also indicative of low total solids (Ogungbenle, 2006; Adepoju *et al*., 2006).

The crude protein content value of the leaves of *O. dicellandroides* (15.50%) was relatively high and compared favourably with 15.2 g/100 g (DM) recorded in *G. Africanum* (Mensah *et al*., 2008), 16.52% in *Afzelia Africana* (Ogunlade *et al*., 2011). This value was high when compared to 11.67% reported for *B. oleracea* (Emebu and Anyika, 2011) and 8.80% in *Annona senegalensis* (Yisa *et al*., 2010) and considerably higher than the range of 0.7-5.0 g/100 g reported for selected vegetables grown in Peshawar (Bangash *et al*., 2011). However, it was lower than 32.95, 20.80 and 19.67% recorded in undefatted leaves of *A. hybridus*, *C. pepo* and *G. africana* respectively (Iheanacho and Udebuani, 2009).

As observed for kale (Emebu and Anyika, 2011) the protein content of the leaves makes it suitable for consumption and it is a rich source of vegetable protein. The leaves have numerous benefits such as provision of vital body constituents, maintenance of fluid balance, formation of hormones and enzymes and contribution to the immune function. The relatively high protein content in *O. dicellandroides* leaves suggests the high amount of essential amino acids which serve as an alternative source of energy when the carbohydrate metabolism is impaired via gluconeogenesis (Iheanacho and Udebuani, 2009).

The carbohydrate content of the sample (11.73%) was found to be low, but was high when compared to the 2.36% recorded in *Brassica oleracea* (Emebu and Anyika, 2011), 3.6 g/100 g in *Celosia argentea* and 3.8 g/100 g in *Piper umbellatum* (Mensah *et al*., 2008).

However, this value was lower than the 52.32% reported for *Pachira glabra* and 45.92% for *A. africana* seed flowers (Ogunlade *et al.*, 2011), 52.18% for *Amaranthus hybridus* (Akubugwo *et al.*, 2007) and 75.74% for *I.astragalina* (Gafar *et al.*, 2011) and also the range of 15.40-30.40% reported for some leafy vegetables (Iheanacho and Udebuani, 2009).

According to Emebu and Anyika (2011) most vegetables are generally not good sources of carbohydrate. As far as vegetables are concerned, some of them are rich sources while others contain traces of the nutrients. They provide the body with a source of fuel and energy that is required to carry out daily activities (Yisa *et al.*, 2010).

The crude fat content of 3.52% in the dried leaves of *O. dicellandroides* was very low compared to that of the leaves of *A.senegalensis* (24.0%) (Yisa *et al.*, 2010), *P. gabra* (15.29%), *A. africana* (16.35%) seed flowers (Ogunlade *et al.*, 2011), *Moringa oleifera* (17.1%), seeds of *Persea Americana* (37.03%) and *Dacryodis eludes (*38.40%) (Dike, 2010). However, this fat value was higher than the 0.26% in *B. oleracea* (Emebu and Anyika, 2011), 0.40% in *Talinum triangular* (Dike, 2010), 1.29% in *Carica papaya* (Oloyode, 2005) and the levels of some selected vegetables ranged from 0.08-0.40 g/100 g (Bangash *et al.*, 2011).

The low fat content indicated that the leaves contain low quantities of lipid biomolecules (Iheanacho and Udebuani, 2009) and cannot serve in Congolese nutrition as a source of these biomolecules that are important for body metabolism.

The energy value of the leaves (593.15 kj/mol) was significantly higher than the (58.46 kcal/100 g) reported for *B. oleracea* (Emebu and Anyika, 2011) and 360.55 cal/100 g for *C. citratus* (Asaolu *et al.*, 2009) but lower than the 1086 Kj/100 g reported for *Pterocarpus mildbraedi (*Akinyeye *et al.*, 2010).

The energy value of the sample suggested that consumption of this edible vegetable could assure energy security for the Congolese population (FAO, 2008).

The low ash content of 4.19% in the leaves was in line with the values reported by Ogunlade *et al.* (2011) for *R. glabra* (4.34%) and *A. africana* (4.03%) but lower when compared to those of certain vegetables such as *P. mildbraedi* (20.6%) (Akinyeye *et al.*, 2010), *Talinum triangulare* (20.05%) (Akindahunsi and Salawu, 2005), *A. hybridus* (17.70%) and *C. pepo* (15.20%) (Iheanacho and Udebuani, 2009). The total ash content recorded in this study was higher than the 1.33% in kale (*B. oleracea*) leaf (Emebu and Anyika, 2011) and the range of 0.38-1.9 g/100 g for selected vegetables grown in Peshawar (Bangash *et al.*, 2011).

The ash content is an indication of the mineral contents of the leaves. The low ash content of the sample suggests a low mineral composition and rather good or high organic components (Egharevba and Kunle, 2010).

Table 2: Mineral contents of *O. dicellandroides* leaves

Element	Content (%)
Calcium	0.66
Magnesium	0.13
Potassium	0.50
Sodium	0.01
Manganese	0.00
Iron	0.10
Aluminium	0.04
Phosphorus	0.56

Mineral composition: The results of the mineral analysis of *O. dicellandroides* leaves is given in Table 2. The low levels of minerals observed in this study indicated that *O. Dicellandroides* is a poor mineral species. The major elements present in the leaves were calcium, phosphorus and potassium followed by magnesium, iron, sodium and aluminium. It showed that the plant sample contained an extremely low amount of all the detected elements (0.01 to 0.66%). Sodium and Aluminium were found in extremely low amounts as trace element (0.01 and 0.04%). Manganese was not detected.

Though the result showed the low levels of these elements, they acted as inorganic cofactors in metabolic processes. In their absence, there could be impaired metabolism (Iheanacho and Udebuani, 2009). Table 2 also shows that The Ca/P ratio of the sample was 1.18 and the Na/K was 0.02. The recommended Na/K ratio is 0.6 and the 0.02 of *O. dicellandroides* leaves is good for their effective health utilization and makes them useful for treating blood pressure problems according to Akinyeye *et al.* (2010). A diet high in potassium and low in sodium (low urinary Na and K ratio) favours lower blood pressure. Increase in dietary potassium as the chloride salt has been shown to decrease blood pressure in some hypertensive individuals (Fenn, 1949) and could decrease the development of cardio vascular disease (Luft, 1990).

However the Ca/P ratio of 1.18 found in this study is relatively high. Food is considered good if the ratio Ca/P is>1 and as poor if <0.5 (Adeyeye and Aye, 2005). Thus the leaves can be considered as good since the Ca/P was found to be 1.18>1.

For instance calcium helps in bone formation and blood coagulation. Phosphorus and calcium deficiency may contribute to bone loss and bone symptoms associated with rickets, such as bow legs, knock knees, curvature of the spine and pelvic and thoracic deformities (Miller and Norman, 1984; Wardlaw and Smith, 2006). Calcium and phosphorus are important in teeth formation. Potassium functions principally as the cation of the cell and also in nerve and muscle excitability. Potassium is an intracellular cation and with sodium it controls the electric potential of the nerves and the osmotic pressure of the body (Adeyeye and Aye, 2005). Lower sodium content could be beneficial in the treatment of hypertension and renal diseases (Emebu and Anyika, 2011). Distorted enzymatic activity and poor electrolyte balance of the blood fluid are related to inadequate Na, k, Mg as they are the most required elements of living cells (Alli, 2009).

The adult human body contains about 25 grams of magnesium. Over 60% of all the magnesium in the body is found in the skeleton, about 27% is found in muscle, while 6 to 7% is found in other cells and less than 1% is found outside of cells (Shils, 1998). Most vegetables are rich in magnesium (more than 500 mg/kg fresh weight) (FAO/WHO, 2001). Contrary to the result of the present study magnesium was detected in low amount. Shils *et al.* (2006) reported that magnesium is widely distributed in plants and animal sources but in differing concentrations. Although magnesium was found in little concentration in this study it is also known to prevent cardiomyopathy, muscle degeneration, growth retardation, alopecia, dermatitis, immunologic dysfunction, gonadal atrophy, impaired spermatogenesis, congenital malformations and bleeding disorders (Chaturvedi *et al.*, 2004).

Iron is a key element in the metabolism of almost all living organisms. In humans, iron is an essential component of hundreds of proteins and enzymes (Beard and Dawson, 1997; Fairbanks, 1999). The iron content of the leaves was lower than the FAO/WHO (1988) recommended dietary allowance for males (1.37 mg/day) and females (2.94 mg/day). According to Geissler and Powers (2005) iron as an essential trace metal plays numerous biochemical roles in the body, including oxygen blinding in haemoglobin and acting as an important catalytic center in many enzymes, for example the cythochrome. Thus the leaves can be recommended for diets with iron deficiency (anaemia).

Phytochemical analysis: The qualitative analysis of the phytochemical constituents of the plant leaves (Table 3) showed the presence of alkaloids, flavonoids, steroids, triterpenoids and glycosides. However anthraquinones, saponins and tannins were not detected in the present study. Table 3 also showed high concentrations of flavonoids and steroids. Glycosides were present in moderate amounts while alkaloids and triterpenoids were detected in trace amounts.

Each of these phytochemicals is known for various protective and therapeutic effects (Asaolu *et al.*, 2009). For instance, flavonoids are known to possess antibacterial, anti-inflammatory, anti-allergic, antiviral and anti neoplastic activity (Alli, 2009). They have anti-oxidation effects in animals (Enwere, 1998). Stereoidal compounds are of importance due to their relationship with some compounds such as sex hormones (Okwu, 2001). Steroids, Glycosides, terpenoids and alkaloids have been reported to exert inhibiting activity against most bacteria (Camacho-Corona *et al.*, 2008; Al-Bayati and Sulaiman, 2008).

Table 3: Results of phytochemical analysis of *O. dicellandroides* leaves

Phytochemical	Result (C_2H_5OH extract)
Alkaloids	+
Anthraquinones	-
Flavonoids	+ + +
Glycosides	+ +
Saponins	-
Steroids	+++
Tannins	-
Triterpenoids	+

+ = Present, - = Absent

Terpenoids and steroids possess antibacterial and antineoplastic properties (Oduro *et al.*, 2009). The presence of these secondary metabolites in the leaves is important as these compounds confer biological activities to the plants (Corthout and Kotra, 1995). This determine the medicinal value of these edible vegetable leaves.

Conclusion: The aim of this study was to determine the nutrient and non-nutrient composition of the leaves of *O. dicellandroides*. It provides some knowledge on the nutritional value of the leaves when eaten as vegetables. From the results, the leaves of *O. dicellandroides* could serve as a supplementary diet for the Congolese population, supplying the body with nutrients such as minerals, protein and energy. The presence of secondary metabolites *e.g.* flavonoids, steroids and glycosides in appreciable amounts in the plant leaves contributes to its medicinal value, thus the plant may be significantly important for the health management and can be recommended for inclusion in the diet of the Congolese population.

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