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Comparative Study on the Proximate Analysis and Nutritional Composition of *Musanga cercropioides* and *Maesobotyra barteri* leaves

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ABSTRACT: This study investigated the proximate, mineral, vitamins and amino acid compositions of *Musanga cercropioides* and *Maesobotrya barteri* leaves. Proximate analysis was done according to the AOAC methods; Atomic Absorption Spectroscopy (AAS) was used to determine the mineral content, while High Performance Liquid Chromatography and Gas Chromatography were used to determine the vitamins and amino acids contents respectively. The proximate composition of the dried leaf of *M. cercropioides* was; moisture (60.58 ± 0.43 %), crude protein (6.58 ± 0.4%), crude fibre (8.85 ± 0.05%), crude fat (7.0 ±1.0%), ash (4.75 ± 0.25%) and carbohydrate (12.26 ± 0.12%). On the other hand, that of *M. barteri* was; moisture (50.53 ± 0.08%), crude protein (9.63 ±0.88%), crude fibre (2.9 ± 0.3%), crude fat (14.0 ± 0.3%) ash (8.5 ± 0.5%) and carbohydrate (14.44 ± 1.6%). Elemental analyses showed that *M. cercropioides* had significantly higher ($p<0.05$) levels of the elements (Fe, Mn, Zn, P, Na, K, Ca, Mg, Cr) when compared to *M. barteri*. The leaf of *M. cercropioides* was significantly higher in vitamins A, E, B_1, B_2, B_3, B_6 and B_{12} ($p<0.05$) when compared to that of *M. barteri*. However, *M. barteri* leaf had higher vitamin C content than *M. cercropioides.* The amino acid analysis revealed that. *M. cercropioides* had significantly higher levels of leucine, methionine, threonine and serine ($p < 0.05$). *M. barteri,* on the other hand, was higher in histidine, lysine, alanine, phenylalanine and valine. This study suggests that these two plants can serve as a good source of nutraceutical.

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Over the years, there has been an increased demand for the consumption of leafy vegetables in developing countries. This is due to their attendant medicinal and nutritional benefits. Most herbal medicines are believed to be safe, without much adverse side effects especially when compared with synthetic drugs. Moreso, due to their affordability, proximity, reliability as well as age-long practices, many people still depend on traditional medicines for their healthcare (Motley, 1994). Green leafy vegetables are important components of the dietary regime of humans because they provide the necessary vitamins and mineral elements required for growth and maintenance of good health through all ages (Fasuyi, 2006).

Musanga cecropioides (Moraceae) is found mostly in the tropical forests of Africa stretching from Guinea to Congo (Ayinde*et al.,* 2007). It is commonly called 'Umbrella tree (English)', 'Igiaga' (Yoruba) and 'Uhophe' (Urhobo). It is a pioneer colonizer constituting the first phase of succession leading to the rebuilding of rain forest. It is a quick growing soft wooded tree with straight stem, stilt roots and an umbrella– like crown, up to about 60m high. Branchlets are very stout and pithy. Ethnomedicinal uses of the plant leaves as oxytocic (Kamanyi *et al.,* 1992), antihypertensive (Kamanyi *et al.,* 1991) and antiglycaemic agents have been scientifically validated (Kamanyi*et al.,* 1996). Hypotensive effects of the water extract of the stem bark have also been suggested to be due to its negative chronotropic and inotropic effects on the heart (Ayinde *et al.,* 2003). Uwah *et al.,* (2013) reported the antimicrobial activities of the adventitious root sap of *M. cercropioides.*

Maesobotrya barteri, a member of the Euphorbiaceae family, is the most widely distributed *Maesobortrya* species in Nigeria (Ogbuagu and Agu 2008). It is a rainforest plant occurring in Sierra Leone, Southern Nigeria and Western Cameroon (Kaey, 1989). It is thought to be an underexploited tropical fruit tree (Ogbuagu and Agu 2008). It is commonly called "Bush Cherry" or Red Maeso (English). In Nigeria, it is known by several vernacular names including "Oruru" (Benin), "Orhurhu" (Urhobo) and"Uvune" (Igbo). *M. barteri* bears fruits from April to June,

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which is up to 1 cm long, ovoid and often distinctly pointed. The fruits are succulent black-purple berries. They are edible and stain the tongue. The stems are used as chewing stick to treat toothache, the roots are cut and infused in gin for arthritis while the stems are also used for fencing and supporting yam tendrils on the farm (Uzodinma, 2013).

In developing nations, numerous types of edible wild plants are exploited as sources of food and hence provide adequate levels of nutritional, pharmacological and industrial importance to man (Savithramma, *et al.,* 2011). Besides, many edible wild plants and local vegetables are under-exploited because of inadequate scientific knowledge of their nutritional potentials. This study therefore assessed the proximate, vitamin, amino acids and mineral composition of *Musanga cercropioides* and *Maesobotrya barteri* leaves.

MATERIALS AND METHODS

Collection and identification of plant materials: Fresh leaves of *Musanga cercropioides* and *Maesobotrya barteri* where collected from the rain forest of Aladja, Delta State, Nigeria. The plant samples were identified at the Department of Plant Biology and Biotechnology, University of Benin, Benin city, Nigeria. Both plant samples where air dried at ambient temperature, pulverised and kept in air tight containers prior to use.

The proximate composition of the plant extracts were carried out in accordance with the Association of Official Analytical Chemists (AOAC, 2000) methods. The parameters assayed for included crude protein, crude fibre, ash, moisture, crude fat and crude carbohydrate (Nitrogen free extract). Mineral content of the plant samples were estimated by employing Atomic Absorption Spectroscopy for iron, magnesium, calcium, manganese, chromium, zinc, phosphorus; and Flame Emission Photometry for sodium and potassium (AOAC, 1990).

The vitamin contents of the plants samples were determined by high performance liquid chromatography (HPLC) as described by Vázquez-Ortiz *et al.* (1995) and AOAC (2006).Amino acid analysis was carried out using gas chromatography technique (AOAC, 2006;Danka *et al*, 2012).

Statistical Analysis: All analyses were carried out in triplicate and. Where applicable, results are expressed as mean ± SEM. The data were subjected to one-way analysis of variance (ANOVA). P values less than 0.05 ($p< 0.05$) were regarded as statistically significant.

RESULTS AND DISCUSSION

The results of the proximate analyses revealed that both plants samples have high moisture content. *Maesobotrya barteri* had significantly higher amount of crude protein, crude fat, ash and carbohydrate ($p < 0.05$) as compared to the *Musanga cercropioides. Musanga cercropioides* was however found to be comparatively higher in crude fibre (Table 1).

Table 1: Proximate composition of the dried leaves of *Musanga cercropioides* and *Maesobotrya barteri*

Proximate Analysis	*M. cercropioides* (%)	*M. barteri* (%)
Moisture content	60.58 ± 0.43^a	50.53 ± 0.08^b
Crude Protein	6.56 ± 0.40^a	9.63 ± 0.88^b
Ash	4.75 ± 0.25^a	8.5 ± 0.5^b
Crude fat	7.0 ± 1.0^a	14.0 ± 1.0^b
Crude fibre	8.85 ± 0.65^a	2.9 ± 0.3^b
Carbohydrate	12.26 ± 0.12^a	14.44 ± 1.6^b

Different superscripts between rows depict significant difference ($P < 0.05$)

The proximate composition of *M. barteri* and *M. cercropioides* leaves revealed relatively high levels of carbohydrate in both plants (*M. cercropioides* and *M. barteri*) suggesting that they may serve as good sources of energy. The high moisture content of both plants samples indicates that they may be easily susceptible to spoilage if not well preserved (Omoregie and Osagie, 2011). The high ash content of *M. cercropioides* and *M. barteri* show they may have appreciable amounts of mineral elements. Their values however, are lower than those reported for *Vernonia calvaona* (Ogile *et al.*, 2013) and *Talinum triangulare* (Ladan *et al.*, 1996; Abu *et al.*, 2014). The ash content of *M. barteri* was comparatively higher than those reported for *Brillanta isiapatula* and *Alchorneal axiflora* (Omoregie and Osagie, 2011). In this study, there was an appreciable amount of protein in both plant samples. Protein is an essential component of human diet needed for the replacement of dead tissues and for the supply of energy and adequate amount of required amino acids (Igile *et al.*, 2013). The higher crude fibre content of *M. cercropioides* as compared to its *M. barteri* counterpart indicates that it may aid digestion, absorption of water from the body and bulk stool. Fibre soften stool and therefore, prevents constipation (Ayoola and Adeyeye, 2009). Consequently, *M. cercropioides* may be useful in the control of body weight, blood cholesterol and protection against colon cancer. The lower crude fat content observed in *M. cercropioides* leaf as against that of *M. barteri* suggests that it can be easily incorporated in weight reducing diet. The significantly higher ($p < 0.05$) iron content in *M. cercropioides* leaf, as compared to that of *M. barteri,* suggest that it may be an important element in the diet of pregnant women, nursing mothers, infants, convalescing patients and the elderly in preventing anaemia and other related diseases (Oluyemi *et al.,* 2006).

Table 2: Elemental composition of dried leaves of *M. cercropioides* and *M. barteri*

Elements	*M.cercropioides* (mg/100g dry Weight)	*M.barteri* (mg/100g dry Weight)
Iron	58.02 ± 0.67[a]	34.17 ± 0.32[b]
Manganese	0.11 ± 0.01[a]	0.11 ± 0.01[a]
Zinc	4.12 ± 0.23[a]	3.59 ± 0.03[a]
Phosphorus	89.50 ± 0.06[a]	51.10 ± 0.12[b]
Sodium	61.72 ± 0.17[a]	46.32 ± 0.12[b]
Potassium	337.42 ± 0.22[a]	171.26 ± 0.48[b]
Calcium	1023.6 ± 0.07[a]	198.51 ± 0.08[b]
Magnesium	114.55 ± 0.52[a]	98.06 ± 0.57[b]
Chromium	0.004 ± 0.0002[a]	0.002 ± 0.0004[b]

The mineral content of *M. barteri* and *M. cercropioides* is depicted in Table 2. The results showed that *Musanga cercropioides* had significantly higher levels ($p < 0.05$) of iron, phosphorus, potassium, calcium, magnesium and chromium (0.004 ± 0.0002) when compared to that of *Maesobotrya barteri* (0.002 ± 0.0004). However, both plants samples had similar amount of zinc and manganese ($p < 0.05$).

There was no significant difference ($p > 0.05$) between the manganese content of both plants. Consumption of manganese-containing foods is believed to support the immune system, regulate blood sugar levels, production of energy and cell reproduction (Igile *et al.,* 2013). Both plants showed similar amount of zinc. Zinc is regarded as an essential trace element for protein and nucleic acid synthesis and normal body development (Melaku, 2005). It also stimulates the activity of vitamins, and the formation of red and white blood cells (Claude and Paule, 1979). The phosphorus content was significantly higher ($p < 0.05$) in *M. cercropioides*. Phosphorus has been shown to play a vital role in normal kidney functioning and transfer of nerve impulses (Igile *et al.,* 2013).

Calcium was found to be most abundant in *M. cercropioides*. Normal extracellular calcium concentrations are necessary for blood coagulation, maintenance of cell integrity and intracellular cement substances (Okaka and Okaka, 2001). Calcium also helps in the regulation of muscle contraction. It is required by infants and fetuses for development of healthy bones and teeth (Margaret and Vickery, 1997).

Potassium was found to be most abundant mineral element in *M. cercropioides* when compared to *M. barteri*. Potassium helps to maintain body weight and regulate water and electrolyte balance in the blood and tissues (National Research Council, 1989). The concentrations of sodium in the both plants were low which may explain previous reports on the usefulness of *M. cercropioides* in the treatment of heart related diseases (Ayinde *et al.,* 2003).

The higher magnesium level in *M. cercropioides* leaf may play fundamental roles in most reactions involving phosphate transfer, essential in the structural stability of nucleic acids and intestinal absorption of electrolyte in the body (Igile *et al.,* 2013). Chromium was found to be the lowest in quantity in both plants. Chromium assists in glucose metabolism and helps to regulate blood sugar level by potentiating insulin and serving as a component of glucose tolerance factor (Igile *et al.,* 2013).

Results of the vitamin contents of *M. barteri* and *M. cercropioides* showed that *M. cercropioides* was significantly higher ($p < 0.05$) in all the vitamins analyzed when compared to *M. barteri* (Table 3).

Table 3: Vitamin content of dried leaves of *M. cercropioides* and *M. barteri*

Vitamins	*M.cercropioides* (mg/100g dry Weight)	*M.barteri* (mg/100g dry Weight)
Vitamin A	0.032 ± 0.0006[a]	0.011 ± 0.001[b]
Vitamin C	0.166 ± 0.003[a]	0.58 ± 0.001[a]
Vitamin E	0.086 ± 0.015[a]	0.03 ± 0.006[a]
Vitamin B_1	0.077 ± 0.0012[a]	0.027 ± 0.006[b]
Vitamin B_2	0.110 ± 0.0018[a]	0.039 ± 0..001[b]
Vitamin B_3	0.045 ± 0.009[a]	0.016 ± 0.01[b]
Vitamin B_6	0.008 ± 0.0001[a]	0.005 ± 0.001[b]
Vitamin B_{12}	0.036 ± 0.0015[a]	0.015 ± 0.003[b]

Different superscripts between rows depict significant difference (P < 0.05)

Table 4: Essential amino acid content of dried leaves of *M. cercropioides* and *M. barteri*

Amino Acid	*M. cercropioides* (mg/100g DW)	*M. barteri* (mg/100g DW)
Histidine	1.84 ± 0.03[a]	2.15 ± 0.04[b]
Leucine	18.91 ± 0.33[a]	16.45 ± 0.28[b]
Lysine	10.57 ± 0.18[a]	13.65 ± 0.23[b]
Alanine	15.85 ± 0.27[a]	20.35 ± 0.18[b]
Methionine	13.57 ± 0.23[a]	10.35 ± 0.18[b]
Phenylalanine	11.73 ± 0.19[a]	15.51 ± 0.27[b]
Threonine	8.29 ± 0.14[a]	5.62 ± 0.09[b]
Serine	20.39 ± 0.39[a]	17.82 ± 0.31[b]
Valine	10.15 ± 0.17[a]	13.54 ± 0.23[b]

Different superscripts between rows indicate significant difference (P < 0.05)

Vitamin B_1, B_2 B_3 B_6 and B_{12} principally function as coenzymes in macronutrient metabolism. The amount present in *M. cercropioides* and *M. barteri* were relatively low when compared to their Recommended

Daily Allowance (RDA). Vitamin A, C and E have been known to possess great antioxidant activities. They also aid in the normal functioning of the visual system; growth and development, maintenance of epithelial cellular integrity, immune function, and reproduction (Sharma *et al.,* 2008). The amino acid content of *M. barteri* and *M. cercropioides* leaves is presented in Table 4. The results showed that *M. cercropioides* had significantly higher contents of leucine, methionine, threonine and serine ($p < 0.05$). *M. barteri,* on the other hand, had higher histidine, lysine, alanine, phenylalanine and valine.

The *M. cercropioides* leaf was found to possess some essential amino acids with serine being the most abundant while histidine was the least. On the other hand, *M. barteri* leaf sample was considerably high in alanine but low in histidine. Histidine is significant in growth and repair of worn out tissues. It is important in the maintenance of the myelin sheaths that protect nerve cells, and is needed for the production of both red and white blood cells (Vázquez-Ortiz *et al.,* 1995).

Conclusion: This study revealed that *M. cercropioides* and *M. barteri* are important sources of macro and micronutrients. In line with the global demands for food, these plants can therefore be incorporated as potential sources of supplements in the formulation of functional foods. Nevertheless, extensive toxicity study on both plants needs to be done to ascertain their safety levels.

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