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Full Length Research Article

Analysis of the Proximate Composition, Anti-Nutrients and Mineral Content of *Maerua Crassifolia* Leaves

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ABSTRACT

This study was carried out to determine the proximate composition, anti-nutrient and the mineral content of *Maerua crassifolia* leaves. Proximate analysis was performed using standard AOAC methods, mineral contents were determined using atomic absorption spectrometry while the anti-nutrients were analysed using standard methods. The results revealed that the leaves had moisture content of 62.00 %, ash content of 12.17± 0.47 g/100 g and crude protein content of 15.17 ± 0.02 g/100 g. The value of the minerals ranged between 75.33 ± 0.05 mg/kg for potassium and 2.88 mg/kg for magnesium. For the heavy metals, zinc had the highest value of 0.22 ± 0.02 µg/mg. The sodium: potassium ratio was calculated to be 0.92 ±0.00. All the anti-nutrients studied were below the lethal doses recommended. The results obtained indicate that the leaf will be a good source of nourishment if properly utilized.

Keywords: proximate composition, mineral content, anti-nutrients, *Maerua crassifolia*

INTRODUCTION

In most developing nations like Nigeria, numerous types of edible wild plants are used as sources of food (Aberoumand, 2010). Edible wild plants are sources of medicines, food, shelters and other items used by humans every day. Their roots, stems, leaves, flowers, fruits and seeds provide food for humans (Edem and Miranda, 2011). Edible wild plants and their products have played a role in bridging the ever increasing gap between population vital statistics and provender (Bhat *et al.*, 2010; Patel and Naik, 2010). However, to reduce the effect of food scarcity, more attention has to be given to the exploitation and utilization of unusual edible wild plants especially edible leaves which can be a source of nutrient to the general populace. The *Maerua crassifolia* tree is such a plant. The *M. crassifolia* plant belongs to the family of *Caparaceae* .They are permanent green trees; their branches are twisted and often densely leaved as represented in Figure 1. The leaves are variable in shape and size, 5-15mm long and 2-8mm broad, rather fleshy, smooth and almost sessile, flowers are white, sweet-scented and without petals. Fruits are pubescent irregular cylindrical pods, 3-6 cm long, 0.6-1cm broad, distinctly constricted into 1-6 sections (Patel and Naik, 2010; Jstor, 2010).

The tree considered multipurpose is used as food for goats and wood for house furniture. The leaves which are edible to humans also serve as animal food and have many medical benefits as treatment for fever, stomach troubles and skin diseases (Saad and Asalam, 2015). The leaves of this plant have long been used for the treatment of malaria (Akuodor *et al.,* 2014) gastric ulcer, toothache and intestinal diseases (Rahman *et al.,* 2004).

In Nigeria, the plant is mainly found in Sokoto and some parts of Zamfara and Katsina states (North West Nigeria). The plant is called 'Jiga' in Sokoto in Nigeria, 'Agargar' in Republic of Niger (Rahman *et al.,* 2004). There were several claims which suggest that most edible leaves of wild plants are collected and consumed locally in different areas during the blooming season (Horo and Topno, 2015; Geng *et al.,* 2016) Unfortunately, there is a dearth of information on the nutritive value of this leaf. This study, consequently aims at determining the proximate composition and some elements as well as some anti- nutrients in *M. crassifolia* leaf to ascertain the nutritive value of the leaves.

Figure 1: Picture of the *Maerua crassifolia* plant showing the leaves and fruit

MATERIALS AND METHOD

Sample Collection

The sample of the leaves was obtained from trees in various locations in Shagari Local Government of Sokoto State and was identified at the Botany Unit of the Department of Biological Science, Faculty of Science, Usmanu Danfodiyo University Sokoto, Nigeria, with voucher identification number UDUH/ANS/0210.

Sample Treatment

The fresh leaves were separated manually, washed carefully with distilled water and dried under a shade. The leaves for determining moisture content were however separated from the lot before the drying procedure. The dried sample was ground into fine powder using an electric blender and sifted using sieve 2.0 mm mesh. The analyte was stored in air tight polythene for subsequent analysis. The dried powdered sample was used for the analysis, except determination of moisture content where a fresh sample was used. All determinations were carried out in triplicates unless otherwise stated.

Proximate Analysis

Proximate analysis was carried out according to the procedure of Association of Official Analytical Chemist (A.O.A.C., 1990) for moisture, ash, crude fibre and crude protein content. The carbohydrate was calculated by difference method (A.O.A.C., 1990) by subtracting the sum (g/100g dry matter) of crude protein, crude fat, ash and fibre from 100g. The caloric value was determined based on the Atwater factor (FAO, 2003).

Mineral Analysis

Sample Digestion

The digestion method described by Sahrawat *et al. (*2002) was adopted for the sample digestion.

Analysis of metal using AAS

Elemental analysis with the exception of sodium, potassium and phosphorous was carried out by Atomic Absorption Spectrometry (AAS). Sodium and potassium were measured using flame photometer while phosphorus was determined by vanadomolybdate colorimeteric method (Ologhobo and Fetuga, 1983).

Analysis of Anti-nutritional Factors

Determination of Total Phytate

The method of Ola and Oboh (2000) was adapted for the determination of phytate.

Determination of Total Oxalate

The method of Krishna and Ranjhan (1980) was adopted for the determination of total oxalate.

Determination of Hydrocyanic Acid

The method of AOAC (1990) was adopted for this analysis.

Statistical analysis

Except in the case of moisture content where percentage was involved and heavy metals which were not detected (ND), data collected for each parameter were analyzed for their central tendencies (mean) using descriptive statistics; values were expressed as mean ± standard deviation of the observations.

RESULTS

Table 1 represents the result of the proximate composition of *M. crassifolia* leaves. The leaves showed 62 % moisture content. Ash content was 12.17 ± 0.47 g/100 g. Crude lipids content of 3.17 ± 0.47 g/100 g, Crude fat content of 4.67 ± 0.23 g/100 g. Crude protein and carbohydrate were 15.17 ± 0.02 g/100 g and 64.83 ± 0.36 g/100 g respectively. The leaves showed a caloric value of 348.29 ± 6.11 kcal/100 g.

Table 1: Proximate composition of *Maerua crassifolia* leaves

Parameters	Composition
Moisture (%)	62.00
Ash content (g/100g)	12.17 ± 0.47
Crude lipids (g/100g)	3.17 ± 0.47
Crude fibre (g/100g)	4.67 ± 0.23
Crude protein (g/100g)	15.17 ± 0.02
Carbohydrate (g/100g)	64.83 ± 0.36
Caloric value (kcal/g)	348.29 ± 6.11

All values except for moisture are expressed in dry weight
All values represent mean ± standard deviation of triplicate determinations

Table 2 represents the mineral content of *M. crassifolia* leaves in mg/kg. Sodium was 69.17 ± 0.10 mg/kg, potassium (75.33 ± 0.05 mg/kg), calcium was 3.05 ± 0.10 mg/kg while magnesium and phosphorus were 2.88 ± 0.02 and 4.34 ± 0.02 respectively. sodium: potassium (Na/K) was 0.92 ± 0.00 while calcium: phosphorus (Ca/P) was 0.70 ± 0.00.

Table 2: The mineral content of *Maerua crassifolia* leaves

Element	Concentration (mg/kg)
Sodium (Na)	69.17 ± 0.10
Potassium (K)	75.33 ± 0.05
Calcium (Ca)	3.05 ± 0.10
Magnesium (Mg)	2.88 ± 0.02
Phosphorus (P)	4.34 ± 0.02
Na/K	0.92 ± 0.00
Ca/P	0.70 ± 0.00

Data are mean of triplicate results ± standard deviation of triplicate determinations

Table 3 represents the heavy metal contents of the *M. crassifolia*. The selenium content was 0.18 0.18 ± 0.02 µg/mg, cadmium was 0.05 ± 0.00 µg/mg. Zinc and copper had levels of 0.18 ± 0.01 µg/mg and 0.22 ± 0.02 µg/mg respectively. Manganese, nickel, chromium and lead were not detected (ND).

Table 3: Heavy metal contents of *Maerua crassifolia* leaves

Element	Concentration (µg/mg)
Selenium	0.18 ± 0.02
Cadmium	0.05 ± 0.00
Manganese	ND
Nickel	ND
Chromium	ND
Copper	0.18 ± 0.01
Lead	ND
Zinc	0.22 ± 0.02

Data are mean of triplicate results ± standard deviation of triplicate determinations

Table 4 represents the anti-nutritional composition of *M. crassifolia* leaves. The level of the oxalate was 0.01

Table 4: Anti-nutritional composition of *Maerua crassifolia* leaves

Component	Composition (mg/100g)
Oxalate	0.01 ± 0.00
Phytate	2.31± 0.01
Cyanide	0.20± 0.00

Data are mean of triplicate results ± standard deviation of triplicate determinations

DISCUSSION

The result of proximate composition of *Maerua crassifolia* leaves revealed that the sample had an average moisture content of 62.00 %. This is not too much compared to moisture content of leaves like *Corchorus oiltorius leaves*-79.98 % (Adeniyi *et al*., 2012) and *Moringa oleifera* leaves- 76.53 % (Owusu, *et al.,* 2008). As reported by Emebu and Anyika (2011), microorganisms that encourage food spoilage flourish well in foods with high moisture contents, thereby reducing the shelf life. However, lowering the moisture content could give a longer shelf life and also ease of transportation of *M. crassifolia* leaves.

The ash content of 12.17 ± 0.47 g/100 g recorded for the *M. crassifolia* leaves is high in comparison to 1.6 g/100 gand 1.5 g/100 g respectively for *Talinum triangulare* and fresh *Telferia occidentalis* (Orhuamen*, et al.,* 2012) and 2.5 g/100 g and 2.4 g/100 g *Vernonia amygdalina* and *Moringa oleifera* respectively (Saidu and Jideobi, 2009). According to Fagbohun *et al.* (2012), ash content in leafy vegetables is a reflection of the amount of mineral elements present in the vegetables. High ash content in a leafy vegetable would suggest high mineral content, therefore improved the nutritional quality (Ifon and Bassir, 1980). However, this may not always be the case according to Ukam (2008) who noted that it could be the reverse if it contained toxic metals which also contribute to the percentage ash content. Fortunately, the heavy (toxic) metal level in *M. crassifolia* as seen in Table 3 is low.

Maerua crassifolia leaf is low in crude fat with a value of 3.17 ± 0.47 g/100 g compared to reported values (8.3-27 g/100 g) in some vegetables consumed in West Africa (Akubugwo *et al*., 2007). The crude fibre content is relatively low in *Maerua crassifolia* leaves, 4.67 ± 0.23 g/100 g, compared to *Gnetum africanum*, 37.80 g/100 g, (Ndomou *et al.,* 2014). Unlike some leaves that require the softening properties of other leaves to make them palatable (Nkongho *et al.,* 2014), the *Maerua crassifolia* leaves will not require the softening properties of other leaves to make them palatable.

The average crude protein content of *M. crassifolia* leaves obtained from the analysis was 15.17 ± 0.02 g/100 g. In comparison to cowpea (*Vigna unguiculata)* 19.82 g /100 g (Famata *et al*., 2013) which is normally considered a source of plant protein this value is not too low. Plant protein still remains a main source of food nutrient for the less privileged population in developing countries, Nigeria inclusive (Emebu and Anyika, 2011). The protein content of the *M. crassifolia* leaves makes it fit to be considered as a good plant protein supplement.

The available carbohydrates content of *M. crassifolia* leaves found to be 64.83 ± 0.36 g/100 g is high when compared to dried *Moringa* leaves 45.3 g/100 g (Ogbe and Affiku, 2011) ,43.8 g/100 g (Anthonia, 2002) 63.11 g/100 g (Onu and Aneibo, 2011) and *Piper guinenses* 48.21 ± 0.00 g/100 g, *Ocimum gratissium* 40.30 ± 0.04 g/100 g (Nwankwo *et al*.,2014). Since *M. crassifolia* leaves has high carbohydrates content, its consumption could provide the body with fuel and energy that is required for daily activities and exercise (Udousoro and Ekanem, 2013). Adequate carbohydrate is also required for optimum function of the brain, heart, nervous, digestive and immune system while carbohydrate deficiency causes depletion of body tissue (Offor *et al*., 2014). The calorific value of the *M. crassifolia* leaves determined by calculation was 348.64 ± 6.11 kcal/100 g. This is in agreement with results of Antia *et al.* (2006) who recorded values between 248.8-307.1 kcal/g for some Nigerian leafy vegetables. Therefore, affirming the universal observation that vegetables have low energy value (Lintas, 1992) due to their low lipid content and relatively high moisture in comparison to their other components. Minerals are inorganic substances, present in all body tissues and fluids. Their presence is required to maintain certain physical and chemical processes which are essential to life (Anavi, 2013). The concentrations of different mineral elements in *M. crassifolia* leaves analysed are reported in Table 2 .Iron was not detected. The ratio of sodium to potassium (Na/K) and calcium to phosphorus (Ca/P) are shown on the same table. The sodium/potassium (Na/K) ratio for *M. crassifolia* leaves is 0.92±0.001. This value according to The BMJ (2015) makes for a desirable dietary sodium–potassium ratio of approximately 1.0. High sodium /potassium ratio has been implicated in cardiovascular disease (Anavi, 2013).

The Calcium: Phosphorus (C: P) ratio recorded for *M. crassifolia* is 0.70±0.001. This falls below the optimum ratio of 1:1 (McDowell, 2003) that is being advocated. According to Pravina *et al.* (2013), calcium deficiency can lead to osteoporosis in which the bone deteriorates and there is an increased risk of fractures. If there is more phosphorus than calcium in the diet, the body will start to take calcium from its own reserves (the bones) to compensate. Over a long or short period of time, this may affect the bones in a negative way. It is therefore necessary that a good source of calcium is used to complement the *M. crassifolia* leaves in diet.

The *M. crassifolia* leaves have a very minute quantity of zinc, copper, cadmium, and selenium as 0.22 ± 0.02, 0.18 ± 0.01, 0.05 ± 0.001 and 0.18 ± 0.02 all in µg/mg respectively. Meanwhile manganese, nickel, chromium and lead were not detected. Thus consumption of the leaves will not pose a threat of heavy metal ingestion.

Oxalate is an anti-nutrient responsible for kidney stone, electrolyte imbalance and irritation of digestive system in man and animal (Egbuna, and Ifemeje, 2015) dried *M. crassifolia* leaves has oxalate (0.01g ± 0.001 mg/ml) which is quite low. Oxalates affect calcium and magnesium metabolism and react with proteins to form complexes which have an inhibitory effect in peptic digestion (Akande *et al.*, 2010). Phytic acid (2.31± 0.01 mg/ml) (inositol hexaphosphate) in plants binds calcium in the intestinal lumen, preventing its absorption as well as other minerals including zinc, are also chelated by phytate (Adesuyi *et al.,* 2012). Cyanide in *M. crassifolia* (0.197 ± 0.001 mg/ml) is considered to be non-toxic when ingested due to its very small amount. Thus, the results revealed that the anti-nutrient composition of *M. crassifolia* were generally low such that none of the anti-nutrients was above the lethal dosage approved by standard bodies like National Agency for Food and Drugs Administration and Control (NAFDAC) in Nigeria (Bolanle *et al.,* 2014).

CONCLUSION

The proximate and mineral analysis of *Maerua crassifolia* leaves have shown that the leaf is worthy of being exploited outside its immediate locality. Having a protein content that is comparable with good sources of plant protein as well as low heavy metal and toxicant levels, a moisture content that makes the transportation outside the locality convenient due reduced bulkiness which consequently increased shelf life; *Maerua crassifolia* will make a good nutrient source for the ever growing population.

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