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Anti-nutritional Factors in the Roots of a Local Cultivar of *Moringa oleifera* (Lam)

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Abstract: The evergreen plant, *Moringa oleifera* (Lam) has been known to have both medicinal and nutritional properties, thus its wide use in traditional medicine in Africa and Asia. The roots, in particular, have been reported to possess antibiotic, anti-tumour and anti-oxidative activities. This study therefore seeks to determine the levels of the anti-nutritional factors and other proximate analyses in the roots of a local cultivar of *Moringa oleifera* which might be responsible for such activities. The concentrations of oxalates and phytates in the roots were determined using the methods of Munro and Bassir and Griffith and Thomas, respectively. The methods of Association of Analytical Chemists (AOAC) were used to estimate the amount of tannins, saponins and cyanogenic glycosides while the Technicon sequential Multi-sample amino acid analyzer (TSM) was used determine the amino acid concentration in the roots. Tannins (45 mg 100 g^{-1}) and oxalates (17.08 mg 100 g^{-1}) were present in the roots at higher levels while saponins (4.20 mg 100 g^{-1}), cyanogenic glycosides (2.72 mg 100 g^{-1}) and phytates (0.07 mg 100 g^{-1}) occurred at much lower levels. The roots contained (Mean±Standard Error of mean) %crude lipid (6.33±1.64), %crude proteins (5.02±1.52), %carbohydrates (76.75), %ash (4.97±0.53) and %moisture (6.93±0.58). The roots lacked the water-soluble vitamins pyridoxine, riboflavin and thiamine but contained ascorbic acid (48.13 mg 100 g^{-1}) and niacin (5.83 mg 100 g^{-1}). This study has shown that *Moringa oleifera* roots are rich in anti-nutritional factors and that is why they are widely used in traditional medicine in Africa, Asia and Americas for its medicinal importance.

Key words: *Moringa oleifera*, anti-nutritional factors, nutrient composition, amino acids

INTRODUCTION

Moringa oleifera is the best known Moringaceae, among the fourteen species in the family. Although, it is native to Sub-Himalayan parts of northern India, it is now widely distributed in the tropics and sub-tropics (Fuglie, 2001; Ozumba *et al*., 2009; Igwilo *et al*., 2011; Nsofor *et al*., 2012), with their different major Nigerian vernacular names: Okwe oyibo (Ibo), Ewe ile (Yoruba), Zogalla (Hausa), Gawara (Fulani) etc. (Igwilo *et al*., 2011; Ozumba, 2008). *Moringa oleifera* is resistant to drought because of the presence of a long taproot and is available all year round (Bhuptawat *et al*., 2007; Akhtar *et al*., 2007). It tolerates a wide range of soil and rainfall conditions and thrives within a temperature range of 25-35°C. *Moringa oleifera* trees can form pods once in a year but in some places fruiting may occur twice in a year (Fuglie, 2001; Igwilo *et al*., 2010).

Local folklore credits *Moringa* with a lot of herbal potency (Fuglie, 2001; Ozumba *et al*., 2009; Igwilo *et al*., 2010; Nsofor *et al*., 2012). The roots of *Moringa oleifera* have been reported to cure intermittent fever and cold symptoms. They are used as tonic for both cardiac and circulatory purposes. It has also been reported that in India and Senegal that the roots are used in treating rheumatism, articular pains and lower back or kidney pains. Furthermore, literature has shown that the roots can be used as a purgative and in the treatment of epilepsy, hysteria and nervous debility (Ozumba, 2008; Fuglie, 1999). The root juice mixed with milk is useful against hiccups, asthma, gout, lumbago, enlarged spleen or liver, internal and deep-seated inflammations and infections (Fuglie, 1999). Other ailments that can be treated with the *Moringa oleifera* roots include arthritis, scurvy, earache and toothache. It can also be used to cleanse sores and ulcers (Fuglie, 1999).

Despite these wide claims on herbal potency of *Moringa oleifera* roots, studies on the bioactive potentials of this plant remain scanty, especially in Nigeria. Therefore, this study is aimed at determining the levels of anti-nutritional factors in *Moringa oleifera* roots grown in Awka, Anambra state, Nigeria, in order to support the herbal potency or otherwise.

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MATERIALS AND METHODS

Sample collection and treatment: The mature *Moringa oleifera* roots were collected from family gardens in Ifite, Awka, Anambra state, Nigeria. The roots were cut into pieces first using knives and dried, before grinding into fine powder. The milled sample was kept in screw-capped containers and stored in a deep freezer and analyzed within seven days.

Determination of the anti-nutrients: The concentrations of oxalates and phytates in *Moringa oleifera* roots were determined using the methods of Munro and Bassir (1969) and Griffiths and Thomas (1981), respectively while tannins, saponins and cyanogenic glycosides were determined according to the methods of Association of Official Analytical Chemists (AOAC, 1984).

Proximate analysis and mineral composition: The methods of the Association of Official Analytical Chemists (AOAC, 1999) were used for the determination of percentage moisture, %crude protein, %crude lipids and %ash in the roots of the plant. The mineral content was estimated using Atomic Absorption Spectro-photometer (AAS).

Determination of amino acid profile: The amino acid content was determined using methods described by Sparkman *et al.* (1958). The dried and milled *Moringa oleifera* roots were defatted, hydrolysed, evaporated in a rotary evaporator and then loaded into the Technicon sequential Multi-Sample Amino Acid Analyzer (TSM). The chromatogram peaks were used to calculate the amino acid values of the root sample.

Vitamin analysis: The determination of water-soluble vitamins vis-a-vis niacin, pyridoxine, riboflavin, thiamine and ascorbic acid in *Moringa oleifera* roots were by High Performance Liquid Chromatography (HPLC), as described by AOAC (1984).

Statistical analysis: The mean values of the data obtained from proximate analysis were calculated and the standard error of means determined (Mean±std. error of mean).

RESULTS AND DISCUSSION

The concentrations of the anti-nutrients in the roots are shown in Fig. 1. Tannins (45 mg 100 g^{-1}) and oxalates (17.08 mg 100 g^{-1}) were higher in the roots of *Moringa oleifera,* while saponins, phytates and cyanogenic glycosides have lower values (4.20 mg 100 g^{-1}, 0.07 mg 100 g^{-1} and 2.72 mg 100 g^{-1}, respectively). Phytates and oxalates have complicated

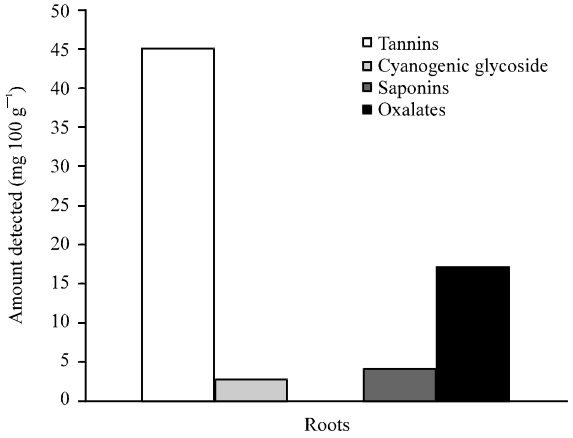

Fig. 1: The levels of anti-nutrients in *Moringa oleifera* roots

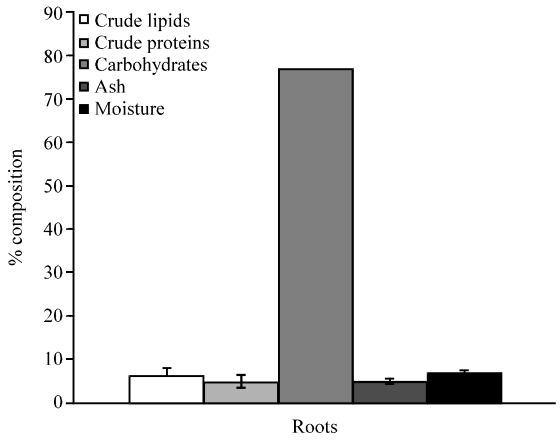

Fig. 2: The proximate composition of *M. oleifera* roots (Mean±SEM)

effects in the human system, particularly indigestion of food and flatulence (Maynard, 1997; Akubugwo *et al.*, 2007). Tannic acid is astringent and is known to be used in the treatment of bedsores and minor ulceration (Akubugwo *et al.*, 2007; Harborne, 2006). Tannins compete with proteins, thereby, lowering their bioavailability and can thus elicit protein deficiency syndrome (Igwilo *et al.*, 2010; Il Oh and Hoff, 1986).

Furthermore, (Il Oh and Hoff, 1986) suggested that non-digestibility of proteins may cause growth retardation. Tannins, phytates and oxalates also react tightly with divalent ions such as calcium and zinc ions, thereby making them unavailable to the body (Akubugwo *et al.*, 2007). However, these anti-nutrients have been reported to be removed through soaking, boiling or even frying (Ekpo and Eddy, 2005; Igwilo *et al.*, 2007).

The proximate composition of *Moringa oleifera* roots is shown in Fig. 2. It contains %crude lipids (6.33±1.64),

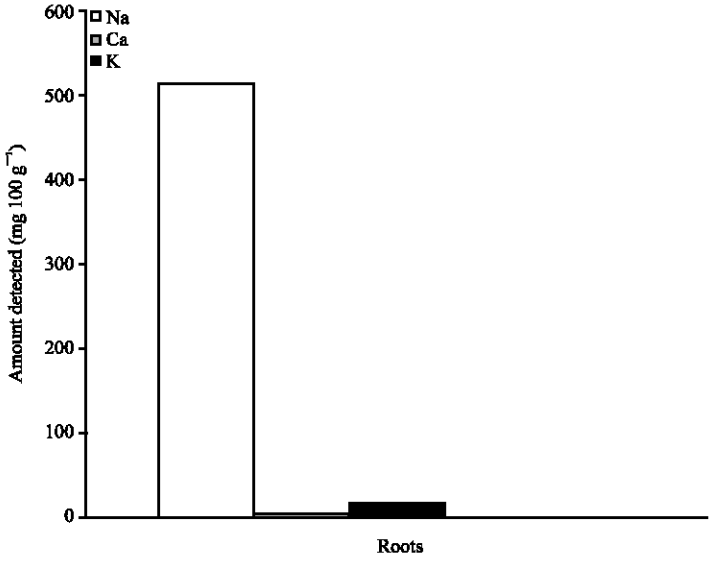

Fig. 3: Mineral composition of *Moringa oleifera* root

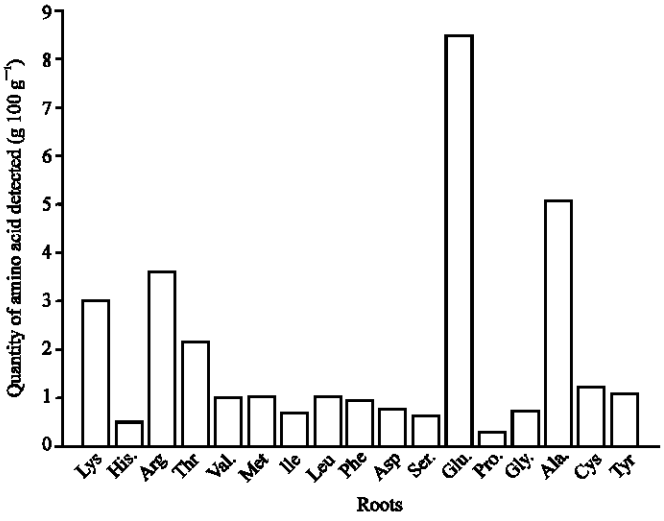

Fig. 4: Amino acid profile of *Moringa oleifera* roots

%crude proteins (5.02±1.52), %carbohydrates (76.75), %ash (4.97±0.53) and %moisture (6.93±0.58). Although, the root contains a high amount of carbohydrates (76.75%), it is not a good source of protein because according to Pearson (1976), any plant food that provides less than 12% of its calorific value from protein is not a good source of protein.

The mineral composition of the roots is shown in Fig. 3. It contains higher amount of Sodium, Na (514.80 mg 100 g^{-1}) while Calcium, Ca (3.99 mg 100 g^{-1}) and potassium (15.4 mg 100 g^{-1}) are lower in concentration.

The amino acid profile of the *M*oringa *oleifera* root is shown in Fig. 4. It contains all the essential amino acids with the highest being arginine (3.62 g 100 g^{-1} protein) and lysine (3.02 g 100 g^{-1} protein) while the lowest is histidine (0.50 g 100 g^{-1} protein). The root contains all the essential amino acids needed for normal body functioning, just as in the leaves (Fuglie, 2001; Igwilo *et al*., 2010).

The vitamin composition of the *Moringa oleifera* roots is shown in Fig. 5. The root contains higher ascorbic acid (48.13 mg 100 g^{-1}) and lower amount of niacin (5.83 mg 100 g^{-1}) but thiamine, riboflavin and pyridoxine were not detected.

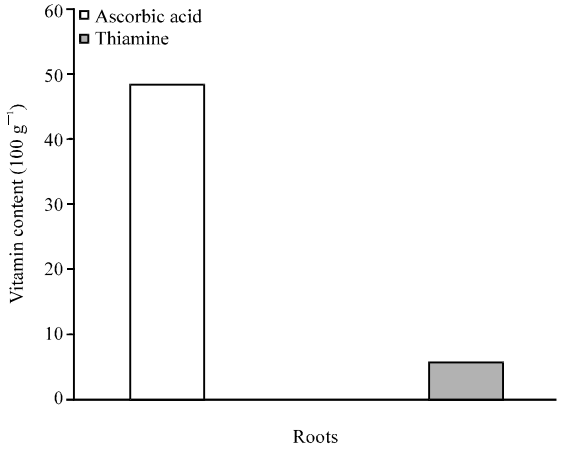

Fig. 5: Vitamin composition of *M. oleifera* root

CONCLUSION

The local cultivar of *Moringa oleifera* roots grown in Awka, Nigeria, is rich in anti-nutritional factors and that explains why it is widely used in traditional medicine in Africa, as well as in other parts of the world for its medicinal and pharmacological importance.

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