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PROXIMATE ANALYSIS, MINERALS, AND ANTI-NUTRITIONAL FACTORS OF *MORINGA OLEIFERA* LEAVES

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Abstract
Moringa oleifera is a multipurpose plant which is exploited as food and for various medicinal purposes. Despite its nutritional benefits, reports on its nutritional and anti-nutritional components needs updating due to the effects of climate, processing techniques like drying, differences in soil, age of plant, and the differences in the methods of analysis. M. oleifera leaves (FHI 109897) were analysed for proximate composition, minerals and anti-nutritional factors. The nutritional components and the anti-nutritional factors were analysed according to standard methods. The results obtained for proximate analysis were crude protein (15.04±0.18%), crude fat (3.91±0.04%), crude fibre (17.27±0.02%), ash (9.85±0.02%), moisture (7.10±0.02%) and gross energy (3.52±0.01%). Mineral analysis revealed that potassium was 0.93±0.002%, calcium (0.34±0.03%), sodium (0.19±0.003%), magnesium (0.58±0.001%) and phosphorus was 0.38±0.014%. Copper was 4.93±0.03mg/kg, zinc (52.3±0.01mg/kg), iron (191.3±.0.02mg/kg) and selenium was 0.01±.001mg/kg. The anti-nutritional factors analysed were phytate (1.58±0.02%), oxalate (0.87±0.02%), saponin (0.45±0.01%), tannin (0.05±0.01%), alkaloids (1.08±0.02%), flavonoids (0.004±0.001%), cyanogenic glycoside (0.19±0.001%), phenol (0.12±0.001%), trypsin inhibitor (2.77±0.03mg/g), haemagglutinin (15.81±0.04HU/mg) and chymotrypsin inhibitor (6.32±0.04CU/mg). The study concluded that Moringa oleifera is a plant with many nutritional potentials that could be exploited for the benefit of humans and animals. The study recommends the need for more nutritional evaluation of M. oleifera leaves (FHI 109897) using current methodologies.

Keywords: *Moringa oleifera*, minerals, nutritional, antinutritional factors, medicinal

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1. INTRODUCTION

Moringa oleifera is a highly valuable plant found in many tropical and subtropical countries. It has a high nutritional value and a wide ranges of medicinal applications (Anwar *et al*. 2007). It is an important source of food in many parts of the world and it can be grown easily and cheaply, hence it's used in many feeding programs across African countries to address malnutrition (Anwar *et al*. 2007).

Many of the indigenous medicinal plants are used as spices and food plants (Okwu, 2001). *M. oleifera* is a food plant widely reported to have many health benefits (Thilza *et al*. 2010; Nguru and Hamisu, 2012). *M. oleifera* leaves, seeds, bark, roots, sap and flowers are widely used in traditional medicine.

Stohs and Hartman, (2015) reported that the leaves and immature seed pods of *M. oleifera* are used as food products in human nutrition. Leaf extract exhibited the greatest anti-oxidant activity and shows high degree of safety in various safety studies in animals and human studies, and no adverse effects were reported (Stohs and Hartman, 2015).

The *M. oleifera* used in this evaluation is readily available in our immediate locality in Ibadan, Oyo State, South west Nigeria.

As a result of the effects of soil type, soil treatments and soil chemical composition on the nutrient content and chemical composition of plants, this study was done to evaluate the proximate, mineral and anti-nutritional factors of *M. oleifera* leaves (FHI 109897) found in our immediate environment.

2. MATERIALS AND METHODS

2.1 Source of Plant Materials

The *Moringa oleifera* leaves were obtained from Ajibode, a community in Akinyele Local Government Area in Ibadan, Oyo State, South west Nigeria. Identification of the *M. oleifera* leaves were done at the Forest Research Institute of Nigeria (FRIN) with accession number FHI 109897.

2.2 Proximate Analysis

Proximate analysis of the air-dried leaves of *M. oleifera* was carried out using established methods (AOAC, 1999). These included analysis of ash, crude fibre, crude protein, gross energy, crude fat, nitrogen free extract, dry matter and moisture content.

2.3 Evaluation of the Mineral elements

The mineral elements evaluated were calcium, copper, phosphorus, sodium, magnesium, zinc, iron, potassium and selenium. The evaluation of potassium and sodium components were performed using flame photometry (Jenway Limited, Donmow Essex, UK), while phosphorus was analysed by means of vanado-molybdate method (AOAC, 1995). Iron, selenium, magnesium, calcium, copper and zinc were analysed following wet digestion of a mixture of nitric, sulphuric and perchloric acid with atomic absorption spectrophotometer (Buck Scientific, East Norwalk, CT, USA).

2.4 Anti-nutritional Factors

Tannins were quantified using the method of Dawra *et al* (1988), while saponin levels were determined according to the method by Brunner (1984). Trypsin inhibitor activity of the samples was analysed according to the method of Liener (1979). Phytates were determined based on the method of Maga (1983). Total oxalates were analysed with method of Fasset (1996). Hemagglutinin levels were quantitated by the method of Jaffe (1979). A detailed description of the methodologies used have been reported by (Soetan, 2012).

2.5 Statistical Analysis

The data obtained (in triplicates) were calculated as mean ± standard deviation (mean±SD) and significant differences were calculated using student t-test (Bailey, 1992). For statistical comparison in all cases, values of $p \leq 0.05$ were taken as significant. The statistical package used was GraphPad Prism (Version 5.0, San Diego, CA).

3. RESULTS AND DISCUSSION

The results of the proximate analysis for the *Moringa oleifera* leaves are presented in Table 1. Table 2 revealed the percentage of the mineral elements present in the *Moringa oleifera* leaves analysed. The result for the anti-nutritional factors of *M. oleifera* leaves is presented in Table 3.

The results obtained from this study indicate that the leaves of *Moringa oleifera* (FHI 109897) had appreciable high ($p<0.05$) levels of crude protein (15.04±0.18%), crude fat (3.91±0.04%), crude fibre (17.27±.02%) and ash (9.85±.02%) as shown in Table 1. This means that the leaves of *Moringa oleifera* (FHI 109897) could be a good and ready source of protein to meet up with the low supply of quality protein affecting human and animal population in developing countries. Mohammed *et al*. (2011) studied the nutritional effect of fresh leaves of *M. oleifera*, as feed supplement on the egg production and quality of Rhode Island Red hen (RIR) and their results suggested that *M. oleifera* leaves could be successfully used as a sustainable tropical feed resource for Rhode Island Red (RIR) hens. The high level of crude fibre of *Moringa oleifera* leaves could be beneficial in the treatment of some diseases associated with low intake of diets rich in dietary fibre. Some health benefits are associated with consumption of dietary fibre-rich foods. These include reduced insulin requirements for diabetes, reduced intestinal constipation, protection against some types of chronic diseases like cancer, reduction in blood cholesterol levels, decreased diverticulosis and obesity, reduction in weight and reduced risks of cardiovascular diseases (Hung *et al*. 2003; Theuwissen and Mensink, 2008; Soetan and Olaiya, 2013).

The high content of ash in the leaves of *Moringa oleifera* (FHI 109897) is a pointer to the fact that the leaves contained good quantity of nutritionally important minerals, which are potassium, calcium, sodium, magnesium, phosphorus, copper, zinc, iron and selenium (Table 2). Minerals are utilized by the body in many ways and they play important roles in nutrition of humans and animals (Rahman *et al*. 2014).

Table 1: Proximate Analysis of *M. oleifera* leaves (FHI 109897)

Analyte	% Crude Protein	% Crude Fat	% Crude Fibre	% Ash	% Moisture	Gross Energy (Kcal/g)
Mean±SD	15.04±0.18	3.91±0.04	17.27±.02	9.85±.02	7.10±0.02	3.52±0.01

Results were shown as mean ± SD

Table 2: Mineral Elements of *M. oleifera* leaves (FHI 109897)

Analyte	Potassium %	Calcium %	Sodium %	Magnesium %	Phosphorus %	Copper (mg/kg)	Zinc (mg/kg)	Iron (mg/kg)	Selenium (mg/kg)
Mean± SD	0.93± 0.00	0.34± 0.03	0.19± 0.00	0.58± 0.00	0.38± 0.14	4.93± 0.03	52.3± 0.01	191.3± 0.02	0.01± 0.00

Results were shown as mean ± SD

Table 3: Antinutritional Factors of *M. oleifera* leaves (FHI 109897)

Analyte	Phytate %	Oxalate %	Saponin %	Tannin %	Alkaloids %	Flavonoids %	Cyanogenic Glycoside %	Phenol %	Trypsin inhibitor (mg/g)	Haemagglutinin (HU/mg)	Chymotrypsin inhibitor (CU/mg)
Mean± SD	1.58± 0.02	0.87 ± 0.02	0.45± 0.01	0.05± 0.01	1.08± 0.02	0.004 ± 0.001	0.19± 0.001	0.12± 0.001	2.77± 0.03	15.81 ± 0.04	6.32± 0.04

Results were shown as mean ± SD

They are also very important constituents of metallo-proteins of living cells and they are needed for life processes (Al-Groom *et al*. 2013).

Anti-nutritional factors (ANFs) in the leaves of *Moringa oleifera* (FHI 109897) were below toxic levels and so does note pose much adverse effects to consumers. The ANFs were phytate, oxalate, saponin, tannin, alkaloids, flavonoids, cyanogenic glycoside, phenol, trypsin inhibitor, haemagglutinin and chymotrypsin inhibitor (Table 3).

These anti-nutritional factors (ANFs) are natural plant components and are found in virtually all plants used for human foods or animal feeds (D'Mello, 2000). The detailed biochemical effects of the chemical components, including the pharmacological and other effects of the anti-nutritional factors in plants have been reported by (Soetan, 2008; Adebiyi *et al*. 2015).

4. CONCLUSION

The above results confirm the findings from other literatures that *M. oleifera* is an important food plant in the tropics and in other parts of the world, with valuable nutritional potentials, which should be maximized for the benefits of humans and animals. However, the results from this study might be variable from other published data, and this might be likely due to differences in soil, climate, age of plant, processing techniques like drying, and the differences in the methods of analysis. More information is needed on the analysis of other nutritional components of the leaves of *M. oleifera* (FHI 109897) like the amino acids, vitamins, and the fatty acids, studies on the digestibility of this plant, and nutritional evaluation of the leaves, using current methodologies.

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6. REFERENCES

[1] Anwar F, Latif S, Ashraf M, Gilani AH (2007). *Moringa oleifera*: A food plant with multiple medicinal uses. Phytotherapy Research 21: 17-25.
[2] Okwu DE (2001). Flavoring properties of spices on cassava fufu. African Journal of Root Tuber Crops, 3(2): 19-21.
[3] Thilza IB, Sanni S, Zakari AI, Sanni FS, Muhammed T, Musa BJ (2010). *In vitro* antimicrobial activity of water extract of *Moringa oleifera* leaf stalk on bacteria normally implicated in eye diseases, Academia arena 2(6):80-82.
[4] Nguru MI, Hamisu MM (2012). The potentialities of *Moringa oleifera* as an economic tree in Yobe State. International Journal of Food and Agricultural Research 9(1): 46-53.
[5] Stohs SJ, Hartman MJ (2015). Review of the safety and efficacy of *Moringa oleifera*. Phytotherapy Research 29(6): 796-804.
[6] AOAC (Association of Official Analytical Chemists) (1999). The Association of Official Analytical Chemists. Official Method of Analysis, 16th Edn, Chapter 4, pp. 17-34, Washington, DC. U.S.A.
[7] AOAC (Association of Official Analytical Chemists) (1995): The Association of Official Analytical Chemists. Official Method of Analysis, 4th Edn, (129-135) Washington, DC. U.S.A.
[8] Liener IE (1979). Determination of antitryptic activity of soybean. Journal of Science Agriciculture 16:602-609.
[9] Jaffe W (1979). In I.E. Liener (Ed.): Toxic constituents of plant foodstuffs, pg. 69. Academic Press, Inc. New York.
[10] Maga JA (1983). Phytate: Its chemistry, occurrence, food interaction, nutritional significance and methods of analysis. Journal of Agricultural and Food Chemistry 30:1-9.
[11] Dawra RK, Makkar HSP, Singh B (1988). Protein binding capacity of microquantities of Tannins. Anal. Biochem. 170:50-53.
[12] Brunner JH (1984): Direct spectrophotometric determination of saponin. Anal. Chem. 42:1752-1754.
[13] Fasset DW (1996). Oxalates: In Toxicants occurring naturally in foods. National Academy of Science Research Council, Washington D.C, U.S.A.
[14] Soetan KO (2012). Comparative Evaluation of Phytochemicals in the raw and aqueous crude extracts of three varieties of *Lablab purpureus* seeds. African Journal of Plant Science 6(15): 410-415.
[15] Bailey NT (1992). Statistical Methods in Biology, 2nd Edition, Cambridge University Press.
[16] Mohammed KAF, Sarmiento-Franco L, Santos-Ricalde R, Solorio-Sanchez JF (2011). The nutritional effect of *Moringa oleifera* fresh leaves as feed supplement on Rhode Island Red hen egg production and quality. Tropical Animal Health and Production 44(5): 1035-1040.
[17] Hung HC, Merchant A, Willett W, Ascherio A, Rosner BA, Rimm E, Joshipura KJ (2003). The association between fruit and vegetable consumptionand peripheral arterial disease, Epidemiology 14: 659-665.
[18] Theuwissen E, Mensink RP (2008). Water-soluble dietary fibers and cardiovascular Disease, Physiol. Behav. 94 (2): 285–292.
[19] Soetan KO, Olaiya CO (2013). Summarizing Evidence Based Information on the Medical Importance of Dietary Fibre. Annals Food Science and Technology 14(2): 393-399.
[20] Rahman MR, Shariff MA, Rahman MO, Uddin MS, ShafiqUllah AKM, Shameem MA, Hasan MM, Hasan SJ, Huq MA (2014). Studies of Essential and Trace Elements in Some Fruits andVegetables of Southwestern Bangladesh by PIXE Technique. Pakistan Journal of Nutrition 13 (2): 62-66.
[21] Al-Groom RM, Abdul-Wahab R, Hamad S, Al-Daline SM, (2013). Assessment of Important Trace Elements in Jordanian Adult Females and Males by Using Atomic Absorption Spectrophotometer. Pakistan Journal of Nutrition 12 (8): 761-767.
[22] D'Mello JPF (2000) Anti-nutritional factors and mycotoxins. In: Farm animal metabolismand nutrition. CAB International Wallingford, UK, pp: 383-403.
[23] Soetan KO (2008). Pharmacological and other beneficial effects of antinutritional factors in plants- A Review. African Journal of Biotechnology 7(25): 4713-4721.
[24] Adebiyi EO, Soetan, KO, Olayemi FO (2015). Comparative Studies on the proximate composition, mineral and anti-nutritional factorsin the leaves and stem of *Grewia carpinifolia*. Annals of Food Science and Technology 16(1):207-217.