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PRELIMINARY PHYTOCHEMICAL SCREENING, PROXIMATE AND ELEMENTAL COMPOSITION OF *MORINGA OLEIFERA* LAM SEED POWDER

[1*]Kawo, A.H., [1]Abdullahi, B.A., [2]Gaiya, Z.A. [3]Halilu, A., [4]Dabai, M. and [5]Dakare, M.A.
[1]Department of Biological Sciences, Bayero University, PMB 3011, Kano, NIGERIA
[2]Department of Microbiology, Ahmadu Bello University, PMB 1045, Zaria, NIGERIA
[3]Center for Biotechnology Research and Training, Ahmadu Bello University, PMB 1045, Zaria, NIGERIA
[4]Center for Energy Research and Training, Ahmadu Bello University, PMB 1045, Zaria, NIGERIA
[5]National Research Institute for Chemical Technology, Zaria, NIGERIA
*Correspondence author: ahkawo@yahoo.com)

ABSTRACT
The seed powder of Moringa oleifera was analysed for its phytochemical, proximate and elemental composition using Folin-Denis spectrophotometric method, gravimetric method and energy dispersing X-ray fluorescence (EDXRF) transmission emission technique respectively. The seed powder had the following proximate composition: nitrogen (2.98%), crude protein (18.63%), tannins (322.9 mg/100g), alkaloids (8.24 mg/100g) and saponins (9.13%). The predominant mineral elements in the seed powder were: Al (144 ± 4 ppm), Ca (602 ± 122 ppm), K (732 ± 164 ppm), P (0.619 mg/kg), Na (86.2 ± 4.9 ppm), Mn (17.5 ± 0.4 ppm), Br (0.62 ± 0.09 ppm), La (0.73 ± 0.13 ppm), Sm (0.14 ± 0.01 ppm), Rb (37.5 ± 6.7 ppm) and Sc (0.17 ± 0.03 ppm) while Mg, Fe, Cr, As, Th and Zn were all beyond detection limits. The results of the study suggest the pharmacological and nutritional potentials of M. oleifera seeds for human and other animal uses.

Keywords: Moringa oleifera, seed powder, phytochemical, nutritional composition.

INTRODUCTION

The useful products obtained from plants directly or indirectly, demonstrate their importance to man. Plants serve as a source of food (Saka and Msonthi, 1994; Katsayal *et al*., 2004; Kawo, 2007), medicinal product (Adoum *et al*., 1997; Ezeamuzie *et al*., 1996; Caceres *et al*., 1991), energy (Oladele and Yisa, 1989) and shelter to man and his livestock (Ogunkunle and Oladele, 2004). In the earlier stage man defended on wild food, which is much abundant within his immediate environment. As the population grows, however, sources of food became more difficult to him, which necessitated domestication of many plants. Although more than 250,000 plant species have been described worldwide as sources of food, man depends only on a few species mainly cereals, particularly rice, wheat and corn as the major sources of his food and collectively supply nearly 60% of the world's food supply (Parvathin and Kumar, 2002; Oliveira *et al*., 2000). *Moringa oleifera* (Syn. *M. ptrygosperma* Gaertn.) is of the family Moringaceae. It is a small graceful tree with sparse foliage, often planted in compounds or used as hedge in northern Nigeria. It is a deciduous plant and could grow up to 8 m height (Keay, 1989). The plant is commonly called horse-radish tree or the miracle tree and locally known as 'Zogale-gandi' in Hausa, 'Eweigbale' in Yoruba and 'Okweoyibo' in Igbo (Dalziel, 1956). *M. oleifera* is well known for its nutritional and medicinal values by many communities in northern Nigeria. The leaves of this plant are used as vegetables in soup preparation or cooked and mixed with grounded groundnut cake and other spices, and then eaten as food. The present work reports the phytochemical and nutritional potentials of *M. oleifera* seed powder with a view to utilising it as an alternative source of food.

MATERIALS AND METHODS

Collection and identification of the plant material

Naturally dried, high quality dry pods of *M. oleifera* were randomly collected from different areas in Gabasawa and Tofa Local Government Areas of Kano State, northern Nigeria. The plant was first identified at the field using standard keys and descriptions (Dalziel, 1956; Keay, 1989). Its botanical identity was further confirmed and authenticated at the Herbarium Section of the Botany Unit of the Department of Biological Sciences, Bayero University, Kano, Nigeria. Voucher specimens (Kawo-2-AH2006) were preserved and stored at the Herbarium for future reference.

Preparation of the treatment samples

The pods were broken using hands to expose the winged and coated seeds. This was left to stand for 24 hours after which period the seed coat was removed using local mortar and pestle. The broken seed coat and wings were blown off with the aid of gravitation while the bare seeds were obtained. The seeds were ground using a clean, electronic blending machine. The grinding was repeated continuously until a fine powder was obtained to ensure homogeneity.

The powder was sieved through 250 µm mesh sieves to remove any remaining coat. The ground and sieved powder was then stored in airtight, plastic containers until use (Folkard *et al*., 2001)

Phytochemical screening, proximate and elemental analysis of *M. oleifera* seed powder

The Folin-Denis spectrophotometric method was used for the determination of tannins while gravimetric method was used for the determination of alkaloids (Onwuka, 2005). Nitrogen, phosphorus, crude proteins and saponins were determined according to the method of the Association of the Official Analytical Chemists (AOAC, 1984). Elemental analysis was carried out according to the method of Halilu (2005) as described by Jonah *et al* (2006) using energy dispersing X-ray fluorescence (EDXRF) transmission emission technique. Here, a certified reference material (for quality control and assurance), IAEA-359 cabbage (*Brassica oleracea var. Sabauda*), was used to determine the calibration factors for all the elements, for which standards were prepared in-house.

RESULTS AND DISCUSSION

The results of the phytochemical screening, proximate and elemental analyses of *M. oleifera* seed powder are shown in Table 1. The results show that the plant contains alkaloids (8.24 mg/100g), saponins (9.13%) and tannins (322.9 mg/100g). According to Duke (1992), Evans (1996), Lawal *et al* (2005), Wasagu *et al* (2005), Ibrahim *et al* (2006) as well as Magaji and Yaro (2006), phytochemical components are responsible for both pharmacological and toxic activities in plants. These metabolites are said to be useful to a plant itself but can be toxic to animals, including man. The presence of these chemical constituents in this plant is an indication that the plant, if properly screened, could yield drugs of pharmaceutical significance. This is better supported by the fact that members of the family of this plant have been known to be involved in ethnomedicine in the management of various ailments (Caceres *et al*., 1991; Ezeamuzie *et al*., 1996; Aliyu, 2006). Tannins adversely affect protein digestibility but its minimum level required to elicit a negative growth response has not been fully established, hence it is still unclear as to what of it could be harmful (Elemo *et al*., 2001). However, the level of tannins in this plant (322.9 mg/100g) is low when compared to the tannin contents of some other plants, e.g., sorghum grains were reported to have 28-43 mg/g (Elemo *et al*., 2001), *Cajanus cajan* had 5.50 ± 0.05 mg/g while *Sterculia setigera* and *Vigna dekindtiana* had 4.24 ± 0.04 mg/g and 16.16 ± 0.05 mg/g respectively (Ayodele and Kigbu, 2005).

Table 1: Phytochemical, proximate and elemental composition of *M. oleifera* seed powder (all units in ppm except where otherwise stated)

Constituent	*M. oleifera* seed powder	[1]Cabbage IAEA-359
Nitrogen (%)	2.98	[2]-
Crude proteins (%)	18.63	-
Tannins (mg/100g)	322.9	-
Alkaloids (mg/100g)	8.24	-
Phosphorus (mg/kg)	0.619	-
Saponins (%)	9.13	-
Aluminium	[3]144 ± 4	176 ± 14
Calcium	602 ± 122	828 ±306
Magnesium	[4]BDL	BDL
Potassium	732 ± 164	30.9 ± 0.5
Iron	BDL	BDL
Sodium	86.2 ± 4.9	794 ± 18
Manganese	17.5 ± 0.4	57.2 ± 0.6
Chromium	BDL	BDL
Arsenic	BDL	BDL
Bromine	0.62 ±0.09	0.98 ± 0.17
Lanthanum	0.73 ± 0.13	0.98 ± 0.17
Samarium	0.14 ± 0.01	BDL
Rubidium	37.5 ± 6.7	BDL
Scandium	0.17 ± 0.03	BDL
Thorium	BDL	BDL
Zinc	BDL	BDL

Key:

[1] IAEA-359 Cabbage (*Brassica oleracea var. Sabauda*) was used as a quality control and assurance (reference) material.

[2] Not tested.

[3] The reported uncertainty was calculated mainly from counting statistics and is not the normal standard deviation on triplicate analyses.

[4] Beyond detection limit.

Considering the different elements analysed from the *M. oleifera* seed powder and their wide uses, this plant has the potentials for providing essential nutrients for human and other animal nutrition, since the nutritional activity of any plant is usually traced to the particular elements it contains (Sofowora, 1993). For example, calcium plays a fundamental role in the constitution of biological systems; its presence in bones provides an animal with the required rigidity and support (Ibrahim *et al*., 2001). The normal required plasma calcium concentration of 10 mg/100ml has to be maintained within narrow limit for an animal to carry out its varied functions and survival (Rubin, 1974).

The level of calcium in this plant (602 ± 122 ppm) is therefore adequate for the required needs of the body. Potassium exists primarily as an intracellular constituent in the body. The requirement of this element is estimated to be 0.2 – 0.6% of the dry weight of animals. The level of potassium in this study (732 ± 164 ppm) is therefore adequate and hence could be of advantage to the improvement of healthy conditions of an individual (Maynard *et al*., 1979). The presence of these elements in *M. oleifera* seed powder (Table 1) correlates with the work of Ramachandran *et al* (1980) and Council of Scientific and Industrial Research (CSIR, 1962) who reported the presence of calcium (30 mg/100g), magnesium (24 mg/100g), phosphorus (110 mg/100g) and potassium (259 mg/100g) in the *M. oleifera* fruits. The variability observed in the amounts of the elements reported by Ramachandran *et al* (1980) and CSIR (1962) with those obtained in the present study could be attributed to variability in geographical location of the plants as well as the part of the plant examined (Adoum *et al*., 1997). The presence of such reportedly harmful elements such as arsenic and chromium in *M. oleifera* seed powder seems to be within beyond detection limit, it could thus be concluded that consumption of this plant's parts collected from around Kano State, Nigeria as food might be safe. This could serve as pointer to the work of Katsayal *et al* (2004) who reported the presence of such harmful elements as Sr (69 ± 3.0), Rb (122 ± 0.0) and Zr (11 ± 2.0) in the leaves of *M. oleifera* collected from around Dambo village of Sabon-gari local government area of Kaduna State, Nigeria. The amount of crude protein (18.63%) obtained in this study, which is within the range of 16 – 65 mg/l recommended dietary allowances (RDAs) in children and lactating women (Table 2) reported by WHO (1999) suggests that *M .oleifera* seed powder could be utilised as a cheap source of protein supplement. The mineral profile of *M. oleifera* seed powder (Table 1) shows that potassium was the most abundant (732 ± 164 ppm), followed by calcium (602 ± 122 ppm), aluminium (144 ± 4 ppm) and sodium (86.2 ± 4.9 ppm) while samarium (0.14 ± 0.01) was the least. The high content of potassium could be due to the intake of the element by the plant from the soil. On the other hand, Mg, Fe, Cr, As, Th and Zn were all beyond detection limits. Comparing the amounts found in this study (Table 1) with reference values (Table 2), it is clear that the *M. oleifera* seeds are adequate to supply the daily nutrient requirements for children and lactating mothers. Manganese acts as activator of many enzymes (McDonald and Sapone, 1993; McDonald *et al*., 1995) while zinc is involved in normal function of immune system. The manganese content is within the range reported in some tropical plants (Ifon and Bassir, 1979; 1980; Sena *et al.,* 1998) and considered to be adequate when compared with the recommended dietary allowances (Table 2).

Table 2: Mineral composition of *M. oleifera* seed powder (all units in ppm except where otherwise stated) in comparison with FAO/WHO (1999) RDAs

Constituent	Concentration (Seed powder)	FAO/WHO recommended dietary allowances for a child aged 1-3 years and a woman during lactation (WHO, 1999)	
		Children	Lactating mothers
Proteins (%)	18.63	16	65
Calcium	[1]602 ± 122	400	1200
Iron	BDL	10	15
Potassium	732 ± 164	800	3000
Magnesium	BDL	150	340
Phosphorus (mg/kg)	0.619	800	1200
Zinc	[2]BDL	3.9	13.7

Key:
[1] The reported uncertainty was calculated mainly from counting statistics and is not the normal standard deviation on triplicate analyses.
[2] Beyond detection limit.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results obtained in this study, it could be said that *M. oleifera* seed powder contains chemical constituents of pharmacological and nutritional significance. However, it is recommended that further work be carried out to isolate and purify the bioactive constituents in *M. oleifera* seed powder using various extraction solvents with a view to characterizing their molecular structure, formula, weight and charge as well as evaluating their safety or otherwise (toxicity) for human and other animal use.

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REFERENCES

Adoum, O.A., Akinniyi, J.A. and Omar, T. (1997): The effect of geographical location on the antimicrobial activities and trace element concentration in the root of *Calotropis procera* (Ait.) R. Br. *Annals of Borno* ***13(14)***:199-207.

Aliyu, B.S. (2006): *Common ethnomedicinal plants of the semi-arid regions of West Africa – Their descriptions and phytochemicals*. Triumph publishing company limited, Gidan Sa'adu Zungur, Kano, Nigeria. ***1***:93-94.

Association of Official Analytical Chemists (AOAC, 1984): *Official methods of analysis of the Association of Official Analytical Chemists*. 14th edition. Washington DC, USA. Pp52-162.

Ayodele, J.T. and Kigbu, P.E. (2005): Some anti-nutritional factors in *Cajanus cajan*, *Sterculia setigera* and *Vigna dekindtiana*. *Biological and Environmental Sciences Journal for the Tropics* ***2(2)***:43-45.

Caceres, A., Cabrera, O., Morales, O., Mollinedo, P. and Mendia, P. (1991): Pharmacological properties of *M. oleifera* I: Preliminary screening for antimicrobial activity. *Journal of Ethnopharmacology* ***133(3)***:213-216.

Council of Scientific and Industrial Research (CSIR, 1962): The wealth of India: A dictionary of Indian raw materials and industrial products. New Delhi, India. *Raw Materials* ***6***:1-14.

Dalziel, J.M. (1956): *Useful plants of West tropical Africa*. Crown Agents for Oversea Government and Administration, London, 23pp.

Duke, J.A. (1992): *Handbook of biologically active phytochemicals and their activities*. CRC Press, Boca Raton, FL. Pp22-25.

Elemo, B.O., Elemo, G.N., Agboola, O.O. and Oyedun, A.B. (2001): Studies on some anti-nutritive factors and *in-vitro* protein digestibility of *Thaumatococcus danielli* (Benth) waste. *Nigerian Journal of Biochemistry and Molecular Biology* ***16***:43-46.

Evans, C.W. (1996): *Trease and Evans pharmacognosy*. 14th edition. WB Saunders company limited, London. pp268-270.

Ezeamuzie, T.C., Amberkedeme, A.W., Shode, F.O. and Ekwebelem, S.C. (1996): Anti-inflammatory effects of *Moringa oleifera* root. *International Journal of Pharmacognosy* ***34(93)***:207-212.

Folkard, G.K., Sutherland, J.P. and Al-Khalili, R.S. (2001): Water clarification using *Moringa oleifera* seed coagulant. *In*: Fugile, L.J. (ed): *The miracle tree – The multiple attributes of Moringa*. ACTA publishers, Dakar, Senegal. Pp77-81.

Halilu, A. (2005): *Sample preparation techniques for neutron activation analysis and determination of elements present in Carica papaya seed using Nigerian Research Reactor (NIRR-1)*. Center for Energy Research and Training, Ahmadu Bello University, Zaria, Nigeria. 9pp.

Ibrahim, N.D.G., Abdulrahman, E.M. and Ibrahim, G. (2001): Elemental analysis of the leaves of *Vernonia amydalina* and its biological evaluation in rats. *Nigerian Journal of Natural Products and Medicine* ***5***:13-17.

Ibrahim, G., Mahmud, N., Yaro, A.H. and Ahmed, A. (2006): Phytochemical and toxicity evaluation of the stem bark of *Ficus sycomprus* LINN (Moraceae). *Biological and Environmental Sciences Journal for the Tropics* ***3(3)***:37-40.

Ifon, E.T. and Bassir, O. (1979): The nutritive value of some Nigerian leafy green vegetables – Part 1: Vitamin and Mineral contents. *Food Chemistry* **4:** 263 – 267.

Ifon, E.T. and Bassir, O. (1980): The nutritive value of some Nigerian leafy green vegetables – Part 2: The distribution of protein, carbohydrates (including ethanol-soluble simple sugars), crude fat, fibre and ash. *Food Chemistry* **5(3):** 231 – 235.

Jonah, S.A., I.M. Umar, M.O.A. Oladipo, G.I. Balogun and D.J. Adeyemo (2006): Standardization of NIRR-1 irradiation and counting facilities for instrumental neutron activation analysis. *Applied Radiation and Isotopes* ***64***:818-822.

Katsayal, U.A., Ambi, A.A., Ibrahim, N.D.G. and AbdulRahman, E.M. (2004): Histopathological studies and elemental analysis of *Moringa oleifera* Lam seeds. *Biological and Environmental Sciences Journal for the Tropics* ***1(2)***:7-9.

Kawo, A.H. (2007): *Water purification potentials and in-vivo toxicity evaluation of the aqueous and petroleum-ether extracts of Calotropis procera (Ait.F.) Ait.F. latex and Moringa oleifera Lam seed powder*. PhD thesis, Microbiology Unit, Department of Biological Sciences, Bayero University, Kano, Nigeria. 184pp.

Keay, R.W. (1989): *Trees of Nigeria*. Revised edition. Calarendon Press, Oxford, USA. Pp1-450

Lawal, M., Wasagu, R.S.U. and Ladan, M.J. (2005): Hepatotoxicity risk assessment of neem (*Azadirachta indica*) seed extract using albino rats. *Biological and Environmental Sciences Journal for the Tropics* ***2(2)***:36-38.

Magaji, R.A. and Yaro, A.H. (2006): Acute toxicity evaluation of the aqueous extract of *Syzygium aromaticum* in mice. *Biological and Environmental Sciences Journal for the Tropics* ***3(1)***:1-3.

Maynard, L.A., Loosil, J.K., Hintx, H.F. and Warner, R.G. (1979): *Animal nutrition*. 7th edition. Tata McGraw-Hill publishing company limited, New Delhi. Pp240-242.

McDonald, H.J. and Sapone, F.M. (1993): *Nutrition for the prime of life: The adult's guide to healthier living*. Insight books, Plenem press, New York, USA.

McDonald, P., Edwards, R.A., Greenhill, F.D. and Morgan, C.A. (1995): *Animal nutrition*. Prentices Hall, London.

Ogunkunle, A.T.J. and Oladele, F.A. (2004): Ethnobotanical study of fuel wood and timber wood consumption and replenishment in Ogbomosho, Oyo State, Nigeria. *Environmental Monitoring and Assessment* ***19***:223-236.

Oladele, F.A. and Yisa, A.B. (1989): Frequencies of dominant tree species used as source of fuel wood in Ilorin Local Government Area of Kwara State, Nigeria. *Bioscience Research Communications* ***1***:19-24.

Oliveira, J.T.A., Vasconcelos, I.M., Bezeira, L.C.N.M., Silveira, S.B., Monteiro, A.C.O. and Moreira, R.A. (2000): Composition and nutritional properties of seeds from *Pachira aquatica* Auol, *Sterculia striata* St. Hilet naud and *Terminalia catappa* Linn. *Food Chemistry* **70:**185-191.

Onwuka, G.I. (2005): *Food analysis and instrumentation: theory and practice*. Naphthali prints, Surulere, Lagos, Nigeria. Pp1-150.

Parvathin, S. and Kumar, V.J.F. (2002): Studies on the chemical composition and utilization of the wild edible vegetable athalakkai (*Momordica tuberosa*). *Plant Foods for Human Nutrition* **57:** 215-222

Ramachandran, C., Peter, K.V. and Gopalakrishman, P.K. (1980): Drumstick (*Moringa oleifera*): A multipurpose Indian vegetable. *Economic Botany* ***34(3)***:276-283.

Rubin, R.P. (1974): *Calcium and secretory process*. Plenum press, New York and London. Pp1-3.

Saka, J.D.K. and Msonthi, J.D. (1994): Nutritional value of edible fruits of indigenous wild trees in Malawi. *Forest Ecology and Management* **64:** 245 – 248.

Sena, L.P., VanderJagt, D.J., Rivera, C., Tsin, A.T.C., Muhammadu, I., Mahamadou, O., Milson, M., Pastosyn, A. and Glew, R.H. (1998): Analysis of nutritional components of eight famine foods of the Republic of Niger. *Plant Foods for Human Nutrition* **52:** 17 – 30.

Sofowora, A. (1993): *Medicinal plants and traditional medicine in Africa*. Spectrum books limited, Ibadan, Nigeria. Pp220-224.

Wasagu, R.S.U., Hassan, S.W. and Lawal, M. (2005): Evaluation of phytochemical and anti-oxidant levels and antimicrobial screening of aqueous leaf extract of *Aloe vera* (*Aloe barbadensis* MILLER). *Biological and Environmental Sciences Journal for the Tropics* ***2(2)***:21-25.

World Health Organization (1999): *Management of severe malnutrition: A manual for physicians and other senior health workers*. Geneva, p4.