COMPARATIVE ANALYSIS OF PROXIMATE AND MINERAL COMPOSITION OF *Moringa oleifera* SEEDS, ROOTS AND LEAVES IN DUTSE, JIGAWA STATE, NIGERIA

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ABSTRACT
Proximate and mineral composition analyses were carried out on the leaves, seeds, and roots of Moringa oleifera obtained from the Teaching and Research Farm, Faculty of Agriculture, Federal University Dutse, Jigawa State, Nigeria. Results of proximate analysis in percentage showed moisture content in the following range: leaves (6.76%), seeds (4.85%) and roots (5.02%), crude protein; leaves (24.62%) seeds (13.13%) and roots (10.47%), fat content; leaves (2.92%) seeds (16.93%) and roots (1.78%), Ash Content; leaves (7.52%) seeds (3.23%) and roots (10.18%), Carbohydrate Content; leaves (58.19%) seeds (61.78%) and root (72.83%), Crude fibre; leaves (11.02%) seeds, (6.08%) and roots (13.66%) Dry matter; leaves (93.24%) seeds (95.15%) and roots (94.46%). Mineral content in percentage showed potassium in the roots, 0.82%, leaves 0.69%,and seeds 0.79% Magnesium; roots 1.65%, leaves, 1.17% and seeds, 1.05%, Calcium; roots, 4.10%, leaves, 3.00% and seeds, 2.60%. Phosphorus; roots, 0.21%, leaves, 0.49% and seeds, 0.73%. These results showed that for proximate composition, the leaves had higher values followed by the roots and lowest in seeds for most of the analysis. The mineral value contents mostly showed higher percentages in the roots followed by leaves and lowest in seeds. Though, all the various parts of M. oleifera are nutritionally valuable, the leaves and roots are highly recommended for their higher nutritional value.
Keywords: Leaves, Seed, Root, Proximate analysis and Mineral analysis

INTRODUCTION

Moringa oleifera is the plant of the family moringaceae because of its nutritional value. It belongs to the order Brassicalis, family moringaceae, genus moringa, and species, *M. oleifera.* It is the most widely cultivated species of the genus Moringa (Ramachandran *et al*.,1980). Its fruit is large and distinctional up to 90cm long and 12mm broad, light brown, angular dehiscent capsules containing 3-winged seeds. It splits along each angle to expose the rows of rounded blackish oily seed (Anwar and Bhanger, 2003). It originated from India. Today, it is widely cultivated in Africa including Cameroon, Ghana, Gambia, Guinea, Niger, Nigeria, Sierra Leone, Sudan, Togo, etc. It is also cultivated in other countries like Central and Southern American, Sri-Lanka, Mexico, Malaysia, Indonesia and the Philippines etc. (Posmontier, 2011). Moringa tree is grown mainly in semi-arid and tropical subtropical areas. It is considered as one of the world's most useful trees, as almost every part of it can be used for food or has some other beneficial properties. *M. oleifera* seeds and roots showed high content of crude fibre indicating it is a good source of vegetable (Donovan, 2007).

MATERIAL AND METHODS

Experimental Area

This experiment was conducted in the Nutrition Laboratory of the Biochemistry Department of the Federal University Dutse, Jigawa State, Nigeria. It's located at Dutse, Jigawa state: it is found between latitude 11.00^{o}N to 13.0^{0}N and longitudes 8.00^{o}E to 10.15^{o}E. High temperatures are normally recorded between the month of April and September, the daily minimum and maximum temperature are 15^{o}C and 35^{o}C. Rain season last from May to September with average rainfall of between 600mmto1000mm (JARDA 2012)

Collection of Plant Materials

The *M. oleifera* leaves, seeds and roots were collected from the Teaching and Research Farm, Faculty of Agriculture, Federal University Dutse, Jigawa Nigeria. Samples were dried at 650^{0}C in the oven and pulverized using Thomas Willey milling machine.

Proximate Analysis

Samples were analyzed for Moisture, Ash, Ether extract, Crude Protein, Carbohydrate and Crude fibre according to AOAC, (1990) Methods

Mineral Analysis

The ground samples of Calcium, Phosphorus and Magnesium were analyzed using Atomic absorption spectrophotometer. Sodium and potassium contents were determined using flame photometer (AOAC, 2005)

Statistical Analysis

All data collected were subjected to one-way Analysis of Variance (ANOVA) while significant differences between the means were determined using Duncan Multiple Range Test (DMRT) at 5% level with aid of SPSS 23 Window.

RESULTS AND DISCUSSION

Table 1: proximate composition of moringa leaves, roots, and seeds

Composition (%)	Leaves	Seeds	Roots
Moisture	6.67±0.10 [a]	4.85±0.08[b]	5.02±0.01 [b]
Ash	7.52±0.11 [b]	3.33±0.16 [c]	10.18±0.04[a]
Fat	2.92±0.10 [b]	16.93±0.10 [a]	1.70±0.04 [c]
Crude Protein	24.62±0.80 [a]	13.13±0.00 [b]	10.47±0.66[c]
Carbohydrate	58.19±0.48 [c]	61.78±0.02 [b]	72.83±0.37[c]
Crude fiber	11.02±0.13 [b]	6.08±0.05 [c]	13.66±0.11[a]
Dry matter	93.24±0.10 [c]	95.15±0.08 [a]	94.46±46 [b]

Mean values within the same row with different alphabets are significantly different ($P<0.05$)

Results of the proximate analysis of roots, leaves and seeds are shown in Table 1. From the result, the ash content showed 3.23% in seed, 7.52% in leaves and 10.18% in root. Ash content is a measure of the total amount of minerals, present within the food substance. Ash content in roots was highest followed by the leaves and lastly by the seeds indicating a significantly high value of the minerals in the root of *M. oliefera.* Moisture contents showed 6.76 % in leaves, 5.02% in root and 4.85% in seeds. Moisture content indicates the amount of water present in the material and is very essential as it serves as standard to evaluate the quality and stability (Shell-life) of food. A lot of biochemical reactions and physiological changes that occur in food are dependent on the moisture content. High moisture content increases the biochemical reactions. A variety of factors affect the moisture, content of food and usually the period and methods of harvesting contributes enormously to the moisture content (Pih, 1993). Results also showed the dry matter content in the order: leaves 93.24%, roots 94.46% and seeds 95.15% indicating higher values in seeds followed by roots and lastly the leaves. Dry matter is very crucial since it ensures adequate nutrients balance. The nutrients required for the maintenance of animals growth, pregnancy and lactation are part of the dry matter portion of the food (Cozzolina and Labandera,2002).

The carbohydrate values obtained were roots 72.83%, seeds 61.78% and leaves 58.19% indicating higher values in the root. Carbohydrate in food originates from photosynthesis, an endothermic reductive condensation of CO_2 requiring light energy and chlorophyll pigments (Dahot and Memon, 1987). It serves as a source and represents a substantial proportion of the bodys energy supply (Pih, 1993). *M. oleifera* has an appreciable percentage of energy though it is not an energy giving plant. Crude fibre content values ranged in the order; roots 13.66%, leaves 11.02% and seeds 6.08%. Highest value was recorded in the roots while the seeds recorded the lowest value. Crude fibres are materials that are indigestible in human and animal organisms. Fibre consumption is regarded as essential because it absorbs water and provides roughage for the bowels, assisting intestinal transit and well normalizes blood lipids thereby reducing cardiovascular disease. It also helps to prevent constipation and decreases blood cholesterol levels. Very low fibre in food is however, helpful to digestive processes though it lowers the vitamins and enzyme content of the food material. Higher fibre diet is important for gastro-intestinal health and cholesterol lowering benefits as well as its provision of better results in preventing diverticulosis inflammation. Studies showed that increased fibre content intake of 6g daily among men and women aged 50-70 years was associated with a 25% reduction in ischemic heart disease mortality, independent of calories fat and other dietary variables (Obodo, 2009). Fat values obtained were higher in seeds 16.93% followed by leaves 2.92%, with least in roots 1.78%. The percentage of fat present in the seeds was far higher than those of the leaves and roots. Lipids are the major components of food as they provide a good source of energy. Fats being made up of hydrogen carbon and oxygen provide essential fatty acids that are not made by the body. Fat makes up about 99% of the lipids fraction of food (Institute of Medicine, 2002).Crude protein values ranged from 24.62% in leaves, to 10.47% in roots. The protein content in leaves indicating a higher value in leaves than seeds and roots, Proteins are polymers of amino acids. Protein acts as enzymes, hormones, and antibodies. They maintain fluid, acid and base balance in the body. They also transport substances like oxygen vitamins and minerals to target cells throughout the body. Structural proteins such as collagen and keratin are

responsible for the formation of bones, teeth, hair and the outer layer of skin. They help to maintain the structure of blood vessels and other tissues. Moringa leaf is hence considered as a complete food as it contains all the essential amino acids required for a healthy body. All of the essential amino acids and the non-essential amino acids are seen in *M. oleifera* leave. Consumption of the leaves of this tree is therefore encouraged as these essential amino acids cannot be synthesized by the body. More so, these amino acids are very crucial for proper functioning of the brain, muscle, and nervous tissue as well as providing the body as a solid base for physical health. Leaves of Moringa contain higher percentages of fat, crude fibre and carbohydrate.

Table 2: mineral composition of moringa leaves, roots, and seeds

Composition	Roots	Leaves	Seeds
Calcium	4.10 ± 0.10^{a}	3.00 ± 0.41^{b}	2.60 ± 0.10^{c}
Magnesium	1.65 ± 0.04^{a}	1.17 ± 0.95^{b}	1.05 ± 0.13^{b}
Potassium	0.82 ± 0.04^{a}	0.69 ± 0.08^{a}	0.79 ± 0.48^{b}
Sodium	0.33 ± 0.66^{b}	0.83 ± 0.16^{a}	0.28 ± 0.80^{c}
Phosphorous	0.21 ± 0.34^{c}	0.49 ± 0.10^{b}	0.73 ± 0.10^{a}

Mean values within the same row with different alphabets are significantly different ($P<0.05$)

Table 2 shows the results of mineral composition of *M. oleifera* leaves, seeds, and roots Calcium values ranged from 4.10% in roots to 3.00% in leaves and 2.60% in seeds indicating its highest concentration in the roots. It also shows that *M. oliefera* is a good source of calcium in the body. Calcium is required in the formation of strong bones and teeth. The value of magnesium showed 1.65% in roots, 1.17% in leaves and 1.05% in seeds, also indicating higher value in roots. Magnesium is required for retention of calcium in teeth and constituents of bones. It also serves as the energy storage unit of the body's cells and as enzyme cofactors (Miessler and Tarr, 2011). The concentration of calcium and magnesium in the tree are the same with their highest values occurring in the roots followed by the leaves and lastly the seeds. Potassium values ranged from 0.82% in the roots to 0.69% in the leaves and 0.79% in the seed. Potassium is essential for the regulation of osmotic pressure and pH equilibrium and control of acid alkaline reaction of the blood. Sodium ranged from 0.88% in the leaves to 0.28% in the seeds. Sodium is also essential for osmotic equilibrium and body fluid volume as well as in the transmission of nerve impulses. The value of phosphorus ranged from 0.73% in the seeds to 0.49% in the leaves and to 0.21% in the roots. The root of *M. oleifera* has lower percentage of phosphorus content than the leaves and with the highest in seeds. The consumption of the seeds of moringa is vital as phosphorus helps to filter out waste in the kidneys and plays essential role in the storage and uses of energy in the body (Chumark *et al*., 2008).

CONCLUSION

The result of this study concluded that the leaves of moringa contain higher percentage of moisture and crude protein, while seed and the root contain high value of ash, fat, crude fiber and carbohydrate and dry matter. It also revealed more mineral nutrients in the roots and appreciable amounts in the leaves and seeds.

REFERENCES

Anwar, F. & Bhanger, M. I. (2003). Analytical characterization of moringa oleifera seed grown in temperate regions of *Pakistan, Journal of Agriculture and Food Chemistry*, 51, p. 28. http://dx.doi.org/10.1021/jf0209894

AOAC, 2005. Official methods of analysis 15th Edition, Association of Official Analytical Chemists, Washington D.C., Arlington, V.A. pp 503-515

AOAC. 1990. Official methods of analysis, Association of Official Analytical Chemists, Washington, D.C., USA. 15th Edition, pp. 807-928.

Chumark, P. (2008). The in vitro and ex vivo antioxidant properties, hypolipidaemic and antiatherosclerotic activities of water extract of Moringa oleifera Lam. Leaves. *Journal of Ethnopharmacol.* http://dx.doi.org/10.1016/j.jep.2007.12.010

Cozzolina, D. M. & Labandera, Z. (2002). Determination of dry matter and crude protein contents of in- dried forages by near infrared reflectance spectroscopy. *Journal Science and Food Agriculture,* 82, 380- 384. http://dx.doi.org/10.1002/jsfa.1050

Dahot, Mu & Memon, A. R. (1987). Properties of moringa oleifera seed lipase. Pakistan journal of scientific and industrial research, 30(111), 12

Dovovan, P. (2007). The miracle tree moringa oleifera, Unpublished Thesis 11.

Institute of Medicine (2002). Dietary reference intakes for energy, carbohydrates, fats, fiber, fatty acids, cholesterol protein and amino acids. *National academy press*, 265-334.

JARDA. (2012) Jigawa State Agriculture and Rural Development Authority Metrological Station Report: Temperature and Rainfall Record Book and Management.

Miessler Gil & Tarr, D. A. (2011). Inorganic chemistry, fourth edition. Pearson education Inc., Pearson Prentice Hall, United State of America. p. 270.

Obodo, G. A. (2009). Food water and land pollution and analysis. Supreme publishers, Owerri. p. 70.

Pih, R. E. (1993). Forage moisture determination. Publication 59, NRAES Ithaca, New York. p. 196.

Posmontier, D. (2011). The medicinal qualities of moringa oleifera, 25(2), 80-87.

Ramachandran, C., Peter, K. V. & Gopala K. P. K. (1980). Drumstick, A multi-purpose India vegetable. Economic Botany, 34(3), 276-283. http://dx.doi.org/10.1007/BF02858648