PROXIMATE AND ANTI-NUTRIENT COMPOSITION OF RAW AND BOILED MORINGA (*Moringa oleifera*) SEEDS: A POTENTIAL BENEFIT FOR INCREASING ANIMAL PROTEIN SUPPLY

[1]Rabiu, M., [2]Muhammad, U.R., [2]Idris, D.Y., [2]Alimi, H.M., [2]Madu, A. and [2]Abubakar, M.B.
[1]Department of Animal Science, Ahmad Bello University, Zaria, Kaduna State, Nigeria State, Nigeria
[2]Department of Animal Health and Production Technology, Federal College of Agricultural Produce Technology, Kano State, Nigeria
Corresponding author: mdrabiu@yahoo.com; +2348033002271

ABSTRACT
The present study was conducted to evaluate the nutritive value of raw and boiled Moringa (*Moringa oleifera*) seeds for their possible usage as livestock feed ingredients. Fresh samples of Moringa seeds were collected from Giwa market, Zaria, Kaduna State for chemical analysis. Chemical analyses were carried out on the samples to determine their nutrient and anti-nutrient compositions. Results in the proximate compositions of raw and boiled Moringa seeds showed that the dry matter content of raw Moringa seeds was found to be 93.76, crude protein 26.83, ether extract 39.25, crude fibre 9.90, ash 4.84 and Nitrogen free extract 12.94%. While the boiled sample has a dry matter content of 97.68, crude protein 32.10, ether extract 35.29, crude fibre 10.25, ash 6.45 and Nitrogen free extract 13.59%. The anti-nutritional factors analysed were flavonoid, trypsin inhibitor activity (TIA), phytate, oxalate, tannin, saponnin and alkaloid and the percentage reductions obtained were 25.58, 79.88, 69.57, 88.44, 70.81, 63.71 and 32.86% respectively. The oxalate content had the highest percentage reduction of 88.44% and flavonoid having the least the least value of 25.58%. The data obtained for proximate analysis showed that both raw and boiled Moringa seeds were rich in nutrients and could serve as potential alternative livestock feed ingredients. From the result of this study, it could be concluded that the boiling of Moringa seeds for 60 minutes improved crude protein level and as well reduced the anti-nutrients components of the seeds.
Key words: Moringa seed, nutrient, anti-nutrient, crude protein, oxalate

INTRODUCTION
The use of unconventional feedstuff in animal feeds had been recommended (Adeola and Olukosi, 2008). One such class of comparable alternative is *Moringa oleifera*, a highly valued plant, distributed in many countries of the tropics and subtropics (Mbikay, 2012). Moringa is a fast growing, aesthetically pleasing tree. It is known by several names in different countries, but popularly called drumstick tree for it pod that is used by drummers (Rajangam *et al.*, 2001). In different parts of the world, *M. oleifera* is known by divers name: among the Igbos, it is known as "Okwe Oyibo", among the Hausas, it is called "Zogale", among the Yorubas, it is called "Ewe ile", among the Fulani, it is called "Gawara", "Nuggekai" in Canada, "Murungai" in Tamil, "Mashinga Sanga" in Malayalan, "Muringa" in Konkani (Peter and Philip, 2014).
Feeding *Moringa oleifera* based diets to monogastric animals is limited by the presence of anti-nutritional factors, such as protease inhibitors, haemaglutinins, tannins and cyanogenic glycosides (Ahaota *et al.*, 2013). Heat treatment and other processing methods are able to eliminate portions of anti-nutritional factors, such as trypsin inhibitor and lectins, although these components are not completely purged (Kocher *et al.*, 2003). However, there is a scarcity of information on the nutritive value of Moringa seeds cultivated in Nigeria and for its inclusion in livestock feeds. Therefore, this study was conducted to analyse the proximate composition and anti-nutritional factor profile of raw and boiled *Moringa oleifera* seeds with an objective of addressing the shortage of conventional feed source in Nigeria.

MATERIALS AND METHODS
The study was carried out in the Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. The town is located in the Northern Guinea Savannah zone of Nigeria, latitude 11^0 9' 14'' N and longitude 7^0 38' 45'' E and at an altitude of 610mm above sea level (Ovimaps, 2015). Moringa seeds used for this research were sourced at Giwa market, Zaria, Kaduna State. The

dry Moringa seeds were sorted, remove from the pods and cleaned. The quantity of seeds used were weighed and then poured into a pot containing boiled water at 100^{o}C. The sample was allowed to boil for about 60 minutes, after which the water was drained out and the sample was spread in aluminium metal trays to sun dry for 3 days (Edegbo, 2009). The boiling was done to minimize the anti-nutritive factors that inhibit the digestion of plant proteins.

Proximate and Anti-Nutritional Factor Analysis

Samples of Moringa seeds were taken to Department of Animal Science Biochemical Laboratory for proximate and anti-nutrients analyses. Proximate analysis was carried out using the standard method described by A.O.A.C. (2005) and the analyses were done to obtain the nutrient composition (Dry matter, Crude Protein, Ether Extract, Crude Fibre, Ash and Nitrogen Free Extract). While for the anti-nutritional factors, phytic acids were determined using the procedure described by Sutardi and Buckle (1985). Trypsin inhibitor activity (TIA) was determined according to the method of Kakade *et al.* (1974) with the modification described by Liu and Markakis (1989). The tannin was determined using the method of Earp *et al.* (1981). Oxalate was determined using the titration method while Saponin was determined using the gravimetric method of A.O.A.C (2005).

RESULTS AND DICUSSION

Proximate composition of the raw and boiled Moringa seeds

The results of the proximate compositions of raw and boiled Moringa seeds are presented in Table 1. The dry matter content of raw Moringa seeds was found to be 93.76, crude protein 26.83, ether extract 39.25, crude fibre 9.90, ash 4.84 and Nitrogen free extract 12.94%. While the boiled sample has a dry matter content of 97.68, crude protein 32.10, ether extract 35.29, crude fibre 10.25, ash 6.45 and Nitrogen free extract 13.59%. Higher nutrient values were observed for dry matter, crude protein, crude fiber, ash and nitrogen free extract in the boiled Moringa sample when compared with the raw sample except ether extract that was higher in the raw sample. The dry matter values of 93.76 and 97.68% observed for raw and boiled Moringa seeds respectively in this report were lower than the findings of Edegbo (2009) who reported the dry matter of raw and boiled Moringa seed meal of 95.28 and 99.14% respectively. The variations observed might be due to the effect of the season in which the studies were conducted. The observed dry matter content was an indication that the activity of the microorganisms would be reduced and thereby increased the shelf life of the Moringa samples as reported by these authors Adeyeye and Adejuyo (1994). The crude protein content of 26.83 and 32.10% obtained were similar to the report of Edegbo (2009) who reported 27.81 and 32.28% crude protein for raw and boiled Moringa seeds respectively. However, the values in this work were lower than the range of 33.30 to 40.31% reported for Moringa seeds (Foidl *et al.* 2001; Anhwange *et al.* 2004). The variations observed in this report and those of other reports on Moringa seeds could be due to seed variety, environmental condition and laboratory methods of analyses. The ether extract values of 39.25 and 35.29% in this finding were lower than the range of 41.58 to 43.69% reported by Edegbo (2009), Foidl *et al.* (2001) and Anhwange *et al.* (2004). A decrease in fat content of the boiled Moringa seeds might have been due to various physio-chemical changes in the seeds. Edegbo, (2009) suggested that some oils were leached into the hot water used in the seeds treatment. The observed crude fiber values of 9.90% and 10.25% were higher than those of 8.05 and 3.05% reported by Edegbo (2009) and Anhwange *et al.* (2004) respectively. The ash content of 4.84 and 6.45% were obtained from raw and boiled Moringa seeds respectively. The result suggested a high deposit of mineral elements in the seeds. The Nitrogen free extract (NFE) content represents the carbohydrate portion of the tested ingredient. It was observed that the NFE of the boiled seed was higher to what was obtained for the raw seeds sample. The NFE values of 12.94 and 13.59% obtained from raw and boiled Moringa seeds respectively, were lower when compared with the report of Council for Scientific and Industrial Research (1962) and Edegbo (2009) who reported 16.63 and 16.40% respectively. The observed variations in nitrogen free extra in the present study may be attributed to differences in Agro climatic conditions or seed variety.

Anti-nutrient content of the raw and boiled Moringa seeds

The anti-nutrient factors and percentage reduction in raw and boiled Moringa seeds are presented in Table 2. The anti-nutritional factors analysed were flavonoid, trypsin inhibitor activity (TIA), phytate, oxalate, tannin, saponnin and alkaloid and the percentage reductions obtained were 25.58, 79.88, 69.57, 88.44, 70.81, 63.71 and 32.86% respectively. The oxalate content had the highest percentage

reduction of 88.44% and flavonoid having the least the least value of 25.58%. These observations showed that boiling significantly reduced the anti-nutrients components of Moringa seeds. The value of 69.57, 70.81 and 79.88% reduction in phytase, tannin and trypsin inhibitor activity, respectively obtained from the boiled Moringa seeds were comparable with the reduction of 68.33, 71.00 and 86.47% in phytase, tannin and trypsin inhibitor activity respectively as reported by Edegbo (2009) for Moringa seeds boiled for 60 minutes at 100^{o}C. The significant reduction in tannin, phytase and trypsin inhibitor activity levels could be attributed to their solubility in the boiling water.

CONCLUSION

This study showed that both raw and boiled Moringa seeds were rich in nutrients and could serve as a potential alternative livestock feed ingredient. From the result of this study, it could be concluded that the boiling of Moringa seeds for 60 minutes improved crude protein level from 26.83 to 32.10% and as well reduced the anti-nutrients components of the seeds. Thus, boiling enhanced the nutritional quality of the seed and make it to be useful in formulations and fortifications of animal feeds.

REFERENCES

Adeola, O. and Olukosi, O. A. (2008). Opportunities and challenges in the use of alternative feedstuffs in poultry production. *Nigeria Poultry Science Journal,* 5 (4), 147- 155

Adeyeye, E. I. and Ayejuyo, O. O. (1994). Chemical composition of Cola accuminata and Garcina kola seeds grown in Nigeria. *Int. J. Food Sci. Nutr.*, 45: 223-230.

Ahaotu, E.O., Omeje, S.I. and Ayo – Enwerem, C.M. (2013). Evaluation of low-and-high cyanide cassava peels on the performance, nutrient digestibility and serum metabolites of growing pigs. *International Journal of Tropical Agriculture.*

Anhwange, B. A., Ajibola, V. O. and Oniye, S. J. (2004). Chemical studies of the seeds of *Moringa oleifera* (Lam) and Detarium microcarpum (Guill and Sperr). *Journal of Biological Science,* 4: 711-715.

A.O.A.C. (2005). Official Methods of Analysis Association of Analytical Chemists. 15th Edition Arlington, Virginia, USA. Pp. 200-210.

Council of Scientific and Industrial Research. (1962). The Wealth of India – A dictionary of Indian raw materials and industrial products. New Delhi. Vol. Vi. pp 425 – 429.

Earp, C.F., Akinghala, J.O., Ring, S.H. and Rooney, L.W. (1981). Evaluation of several methods to determine tannin in sorghum with varying kernel characteristics. *Cereal Chemistry* 58: 234-238.

Edegbo, M. (2009). Evaluation of the nutritive value of differently processed Moringa *oleifera*leaves and seeds in weaner rabbit diets. Unpublished Msc. Thesis submitted to the department of Animal Science, Ahmadu Bello University, Zaria.

Foidl, N., Makkar, H. P. S., and Becker, K. (2001). The potential of Moringa oleifera for agricultural and industrial Uses. In J. Lowell and C. T. A. Fuglie (Eds.), *The miracle tree:* Pp. 45– 76). Wageningen: The Netherlands.

Kakade, M.L., Simons, N.R. and Liener, I.E. (1974). An Evaluation of Natural Vs Synthetic Substrates for measuring the Antitryptic Activity of Soybeans Samples. *Cereal Chemistry.* (46): 518.

Kocher, A., Choct, M., Ross, G., Broz, J. and Chung. T.K. (2003). Effects of enzyme combinations on apparent metabolizable energy of corn-soybean meal-based diets in broilers. *Journal of Applied Poultry Resources*, 12:275-283.

Liu, k. and Markakis, P. (1989). An improved colorimetric method for determining antitryptic activity in soyabean products. *Cereals chemistry,* 66: 500-507.

Mbikay, M. (2012). Therapeutic potential of *Moringa oleifera* leaves in chronic hyperglycemia and dyslipidemia: A Review. *Frontiers in Pharmacology,* 3, 1–12.

Ovimaps, (2015). Ovi location map; Ovi earth imagery date.

Peter, T.O. and Philip, C.N.A. (2014). Proximate analysis and chemical composition of raw and Defatted. *Moringa oleifera* kernel. *Journal of Advances in Life Science and Technology*, Vol.24, 2014.

Rajangam, J., Azahakia, M.R.S., Thangaraj, T. and Vijayakumar, A. (2001). Status of Production and Utilization of Moringa in Southern India. *Journal of Agricultural and Food Chemistry,* Pp 38 – 46.

Sutardi, I. and Buckle, K.A. (1985). Reduction in phytic acid levels in soya bean during temperature, production, storage and frying. *Journal of Food Science,* 50: 260-263.

Table 1: Proximate Composition of raw and boiled Moringa seeds

Parameters %	Composition %	
	Raw	Boiled (60 mins)
Dry matter	93.76	97.68
Crude protein	26.83	32.10
Crude fibre	9.90	10.25
Ether Extract	39.25	35.29
Ash	4.84	6.45
Nitrogen free extract	12.94	13.59

Table 2: Anti-nutritional factors of raw and boiled Moringa seeds

	Composition %		
Anti-nutritional factors	Raw	Boiled (60 mins)	% Reduction
Phytase (mg/100g)	18.67	5.69	69.57
Tannin (mg/100)	24.84	7.25	70.81
Trypsin (mg/100)	11.93	2.40	79.88
Oxalate (mg/100)	17.21	1.99	88.44
Saponin (%)	8.15	2.96	63.68
Alkaloid (%)	3.50	2.35	32.86
Flavonoid (%)	6.02	4.48	25.58