

## AN EVALUATION OF THE PROXIMATE AND PHYTOCHEMICAL COMPOSITION OF *Moringa oleifera* LEAF MEAL AS POTENTIAL FEEDSTUFF FOR NON RUMINANT LIVESTOCK

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### ABSTRACT

*The increased interest in the utilization of the leaves of Moringa oleifera necessitated this study which evaluated the proximate, chemical and phytochemical composition, especially the presence of anti- physiological and toxic factors in the leaves. The results of the phytochemical analyses were: alkaloid  $1.24 \pm 0.141\%$ ; flavonoids,  $4.90 \pm 0.20\%$ ; saponins,  $0.69 \pm 0.124\%$ ; tannins  $0.03 \pm 0.118\%$  and cyanoglycosides  $0.25 \pm 0.112\%$ . The results showed crude protein to be  $18.29 \pm 2.6\%$ ; Nitrogen free extract,  $44.52 \pm 2.11\%$ ; crude fibre  $15.87 \pm 0.42\%$ ; moisture,  $9.33 \pm 0.632\%$ ; ash,  $13.67 \pm 0.01\%$  and crude fat,  $7.65 \pm 0.009\%$ . The results also showed Ca (0.49%) P (0.36%) Zn (46.70ppm) Iron (145ppm) and Cu (14.80ppm) were moderately high for a leaf meal. Quantitative chromatic analysis of MOLM hydrosylates revealed 9 essential amino acids which meet the minimum requirement (NRC) for broiler birds and in comparing its amino acid with those of hen's eggs shows an appropriate balance in all the essential amino acid but a deficiency of Methionine, Tryptophan and Histidine. The results of this study further showed that MOLM possess an appreciable quantities of all the dietary elements tested for, which, more or less could make them partial or complete substitutes for the conventional feed sources.*

Keywords: *Moringa oleifera*, phytochemicals, medicinal, nutritional and monogastrics

### INTRODUCTION

*Moringa oleifera* (also known as drumstick tree, mulangay saijhan, ewe iye, okwe oyinbo, osisi egede, zogale ), is the most widely cultivated specie of a monogeneric family, the Moringaceae, which is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan, North-eastern and South-western Africa, Madagascar and Arabia (Fahey, 2005). Fuglie (1999) indicated that one of the many uses for Moringa includes: animal forage (leaves and treated seed-cake) foliar nutrient (juice expressed from the leaves), green manure (from leaves). This tree has in recent times been advocated as an outstanding indigenous source of highly digestible protein, Ca, Fe, suitable for utilization in many of the developing regions of the world. The leaves can be

eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. Moringa is especially promising as a food source in the tropics because the tree is in full leaf at the end of the dry season when other foods/forage is typically scarce. In terms of phytochemistry, this plant family is rich in compounds containing the simple sugar, rhamnose, and it is rich in a fairly unique group of compounds called glucosinolates and isothiocyanates Foidl et al., 2001 . While these compounds are relatively unique to the Moringa family, it is also rich in a number of vitamins and minerals as well as other more commonly recognized phytochemicals with medicinal uses (Foidl et al., 2001). This plant has been well documented for its medicinal importance over a long time.

The study therefore sought to evaluate the claims made with respect to the leaves of *M. oleifera* for the proximate components, mineral constituents, phytochemical contents and amino acid composition as it relates to serving as source of food/feedstuff for man and monogastric livestock particularly in the South-South of Nigeria where the benefits of the plant is least known. It is expected that the findings from this work may add to the overall value of the medicinal and nutritional potential of the plant.

## MATERIALS AND METHODS

### Sample Collection and Preparation

The fresh plants were collected from Dr Alikwe's gardens, Ikorodu Rd, Lagos State Nigeria. Identification and authentication were carried out by Professor Ojeifo of Horticulture Unit of the Crop Science Dept of Delta State University, Asaba Campus, Delta State Nigeria. The fresh leaves of *Moringa oleifera* leafmeal (MOLM) were plucked out from the plant stalk, rinsed in clean water and dried at room temperature. The dried leaves were ground to fine powder with an electric blender, packaged in air-tight glass jar and stored in a cool dry place until use

### Phytochemical Test

Phytochemical test for the quantitative presence of alkaloids, flavonoids, tannins, saponins, and cyanogenic glycosides were measured by methods described by Harborne (1973) and Trease and Evans (1989).

### Proximate Analysis

The proximate composition of the leaves for carbohydrate, ash, and moisture were determined by methods described by AOAC (1995). Crude protein, fibre and fat content were determined by methods described by Pearson (1976). The Total ash content was determined by furnace incineration using the method of James (1995). All determinations were done in triplicates.

### Mineral Analysis

Sodium and Potassium were determined by Digital flame photometer (model 2655-00). The other

minerals; Calcium(Ca), Phosphorous(P), Magnesium(Mg), Manganese(Mn), Iron(Fe), Zinc(Zn) and Selenium(Se) were determined using the Atomic Absorption Spectrophotometer (AAS-model-Alpha 4) as described by AOAC (1995).

#### Amino Acid Analytical Procedure

Ten grams of the ground air dried sample were analyzed for amino acid using modified Ninhydrin colorimetric analysis method Rosen (1957) Spackman, *et.al* (1958) Lewis *et al.* (1995) and thin layer chromatographic quantification at SMO Laboratory Services, Ring Road Ibadan)

#### Statistical Analysis

The results obtained are presented as mean  $\pm$  standard deviation and analyzed as simple percentages.

### RESULTS and DISCUSSION

Table 1: Phytochemical /ANF Composition of *MOLM*.

Phytochemical	% composition
Alkaloids	1.24 $\pm$ 0.141
Flavonoids	4.90 $\pm$ 0.200
Saponins(soap)	0.69 $\pm$ 0.124
Cyanogenic glycosides	0.25 $\pm$ 0.112
Tannins(polyphenols)	0.03 $\pm$ 0.118

Values are means  $\pm$  standard deviation of triplicate determinations. NA= Not Available.

Table 1 showed the results of the phytochemical contents, of the dried ground leaves of *M. oleifera*. From the analyses *Moringa oleifera leaf meal (MOLM)* contains alkaloids, flavonoids, tannins, cyanogenic glycoside and saponins. The saponins' content was 0.69  $\pm$  0.124%; cyanogenic glycoside was 0.25  $\pm$  0.112%. The value of tannins was 0.03 $\pm$ 0.118% and alkaloids 1.24  $\pm$  0.141%. Phytochemicals/ANFs are a class of compounds which are generally not lethal. They diminish animal productivity but may also cause toxicity during periods of scarcity or confinement when the feed rich in these substances is consumed by animals in large quantities. The MOLM in this study had negligible amounts of tannins (0.03  $\pm$  0.118 %). A total phenol (tannins) content of 2.7% has been reported for the unextracted leaves (Gupta *et al.*, 1989). At this concentration, these simple phenols do not produce any adverse effects "when eaten by animals. The result showed that the concentration of tannins in the leaves is 0.03  $\pm$  0.118 was very

insignificant. Tannins have been reported to cause poor palatability in high Tannin diet due to the astringent property as a result of their ability to bind with protein of saliva and mucosa membranes (Melansho et al., 1987; D'mello and Devendra, 1995). Effect of high condensed tannin concentrations is to make the animal both energy and protein deficient, causing reduced growth or weight loss and poor reproduction (Sprinkle, 2006b). Tannins also have the ability to bind dietary proteins and digestive enzymes into complexes that are not readily digestible (Melansho et al., 1987; D'mello and Devendra, 1995). Saponins form a group of compounds, which on consumption in large quantities causes deleterious effects such as haemolysis and permeabilization of the intestine (Cheeke, 1996; Price et al., 1987). Saponins have also been shown to have hypocholesterolemic as well as anticarcinogenic effects (Koratkar and Rao, 1997). Saponins from some plants have an adverse effect on the growth of animals but those present in Moringa leaves did not show haemolytic activity, and humans consume them without apparent harm. The cholesterol lowering effect in animals and humans is reported to be through the formation of mixed micelles and bile acids into micellar bile acid molecules (Okenfull et al., 1984). The cyanogenic glycoside value obtained in this study (0.25%) is very negligible. Cyanogenic glycosides are toxic and on hydrolysis release Hydrogen Cyanide (HCN) which has been reported to have the ability to cause marked weight change (Aletor and Fetuga, 1988; Aletor, 1993). The Cyanide detoxification route in man and animals is through Cyanide Thiocyanate sulphur-transferase (Rhodenase pathway) which generally requires organic sulphur donors in the form of Methionine and Cysteine, thereby precipitating methionine deficiency in an otherwise balance diet (Aletor and Fasuyi, 1997). It is this methionine deficiency that results in poor growth in poultry animals (Akinmutimi and Okwu, 2006).

Flavonoids are simple phenolic compounds which have been reported to possess a wide spectrum of biochemical activities such as antioxidant, antimutagenic, anticarcinogenic, as well as ability to modify the gene expression (Beta et al., 2005; Marinova et al., 2005). The flavonoids content of  $4.90 \pm 0.200\%$  obtained from the *Moringa oleifera leafmeal (MOLM)* leaves may confer some of the biochemical advantages mentioned earlier to its users. Epidemiological studies have also correlated the consumption of plant produce with high phenolics to reduction of cardio-cerebrovascular diseases and cancer mortality (Hertog et al., 1997).

Table 2: Proximate Composition of *MOLM*.

Nutrients	% Composition
Moisture	$9.33 \pm 0.632$
Ash	$13.67 \pm 0.01$
Crude protein	$18.29 \pm 2.6$
Crude fat	$7.65 \pm 0.009$
Crude fibre	$15.87 \pm 0.42$
Total carbohydrate	$44.52 \pm 2.11$
ME (Kcal/g)*	$2.877 \pm 0.03$

Values are means ± standard deviation of triplicate determinations \*Pauzenga (1985).

Table 2 shows the proximate composition of the leaves. The results showed that the leaves are rich in carbohydrate with a value of 44.52 ± 2.11%, Crude Protein content was 18.29 ± 2.6% and moisture content was 9.33 ± 0.632%. Crude fibre was 15.87 ± 0.42 %, Ash content of 13.67 ± 0.01% and the Crude fat was 7.65 ± 0.009%.

The carbohydrate value of 44.52% reported here is similar to 39.70% reported by Indian Export (2010) and for *Carica papaya* (41.35%) Olomu (2011) but higher than 32.00% 10.89%, and *Leuceana* (37.15%) reported by Gadzirayi *et al* (2012), Okeke *et al* (2010).and Olomu (2011) but lower than *Gliricidia* (48.00%) (Kagya-Agyemang *et al* 2007). Carbohydrates of legumes are known to reduce the plasma cholesterol and gradually elevate the levels of blood glucose (Leeds 1982; Walker, 1982).

. The Crude protein value (18.29%) is lower than (22.89%, 25.10% & 29.00%) reported by Indo Export (2010), Gadzirayi *et al* (2012), Okeke *et al* (2010).and those for *Carica papaya* and *Leuceana* (38.20%, 37.40%, ) Olomu (2011) but similar to 18.20% reported for *Gliricidia sepium* (Kagya-Agyemang *et al* 2007). . The crude fibre of 15.87% is higher than those reported by Olomu(2011) for *Carica papaya* and *Leuceana* but lower than (23.40%. 22.50%) reported by Gadzirayi *et al* (2012) and Okeke *et al* (2010). High crude fibre in diet is known to enhance digestibility, decrease the blood cholesterol and reduce the risk of large bowel cancers. Dietary fiber plays an important role in decreasing the risks of many disorders such as constipation, diabetes, cardiovascular diseases (CVD), diverticulosis and obesity dietary fiber may play a major role in determining the health and disease conditions of different population groups (Slinkard,*et al* 1977) The Ash content of 13.67% reported in this work is similar to that(15.00% 15.17% reported by Gadzirayi *et al* (2012), Okeke *et al* (2010), but lower than (22.89%) reported by Indian Export (2010) and higher than (7.13%) reported by Ibok Oduro *et al* (2008). When comparing the ash content of MOLM to those of other tree leaf meals we observe that it has higher ash content than *Carica papaya* , *Leuceana* and *Microdermis puberla* (7.05%, 8.40% 12.25%, ) (Olomu, 2011) but lower than those of *Gmelina arborea*, and *Gliricidia sepium*(33.50%, 18.20%)(Olomu, 2011; Kagya-Agyemang *et al.*, 2007).

Table 3: Mineral Composition (MOLM)(mg/100g).

Mineral Composition %		(mg /Kg)	
Calcium (Ca)	0.49 ± 0.05	Manganese (Mn)	121.80 ± 2.01
Phosphorous (P)	0.36 ± 0.51	Iron (Fe)	1126 ± 4.10
Potassium (K)	1.38 ± 0.82	Zinc (Zn)	46.70 ± 0.01
Sodium (Na)	0.67 ± 0.42	Cobalt(Co)	NA
Magnesium (Mg)	0.27 ± 0.17	Copper(Cu)	14.80±1.05

Values are means ± standard deviation of triplicate determinations. NA-Not available

Values are means  $\pm$  standard deviation of triplicate determinations. NA-Not available

Table 3 shows the mineral concentration of *Moringa oleifera leafmeal (MOLM)* analyzed on dry weight basis. Mineral compositions of plants are dependent on the soil edaphic factors, including the generic origin and geographical source (Vadivel and Janardhanan, 2001). The leaf contains appreciable quantities of some of the mineral analyzed. They include: Calcium- 0.49%, Phosphorous 0.36%, Sodium 0.67%, Magnesium 4.27%, Manganese 121.80 mg Kg<sup>-1</sup>, Iron 1126mg Kg<sup>-1</sup>mg/100 g, Zinc 46.70 mg Kg<sup>-1</sup>, Copper 14.80 mg Kg<sup>-1</sup>. Considering the mineral element of MOLM (Table 3) the sample appeared fairly adequate in CaNaK ---PMgZnFe & Cu for poultry feed. The mineral profile in Table 3 showed that MOLM could be a good source of minerals in the ration of livestock. It is particularly rich in iron. Calcium is the most abundant body mineral and about 99% of it is in the bone. The balance of 1% is found inside and outside the cell (bound with proteins like albumin, myosin, modulator and transport proteins, prothrombin, troponin C, and extracellular hydrolytic enzymes and intracellular enzymes) and in the plasma. Thus, calcium, along with phosphorus and magnesium, is an important constituent of bone. Calcium is important in blood clotting and muscle contraction. Calcium is also involved in enzyme reactions, hormonal signal transmission, and glucose metabolism, release of neurotransmitter and membrane integrity and excitability. Calcium also helps to regulate the acid-base status of blood, aids hormone secretion and cell division. Phosphorus plays an important role in carbohydrate, lipid, and amino acid metabolism. Phosphorylation plays a key role in muscle contraction. Phosphorus is also required for blood coagulation (thromboplastin) Satisfactory bone calcification, optimum growth rate and optimum utilization of both calcium and phosphorus require an adequate level of each (Olomu, 2011). Cellular calcium concentrations are very important for blood coagulation (Okaka and Okaka, 2001). Lack of calcium or phosphorus causes Rickets (Fliedner and Teichman, 1965) and Osteoporosis (Hunt *et al.*, 1980; Okwu and Emenike, 2007). It is known that iron, zinc and manganese strengthen the immune system as antioxidants (Talwar *et al.*, 1989). Iron is a component of hemoglobin necessary for oxygen transport. Hemoglobin and ferredoxin play vital roles in man's and monogastric animal metabolism. Similarly, magnesium and zinc are also known to prevent cardiomyopathy, muscle degeneration, growth retardation, alopecia, dermatitis, immunologic dysfunction, gonadal atrophy, impaired spermatogenesis, congenital malformations and bleeding disorders (Chaturvedi *et al.*, 2004). The combination of magnesium, zinc, sodium, phosphorus and calcium in the presence of fluoride has been reported to have therapeutic, protective and preventive roles in teeth (Olabanji *et al.*, 1996; Okwu and Ekeke, 2003).

Table 4: Amino Acids Composition (mg/16gN) of MOLM compared to hen's egg

Amino acids	MOLM	Hen's egg (a)	%Chemical Score
Lysine	4.61±0.12	7.26	63.49
Methionine	1.95±0.11	3.52	55.39
Threonine	5.01±1.07	5.49	91.25
Leucine	7.41±1.01	9.58	77.34
Valine	5.11±1.02	18.04	28.3
Arginine	6.14±1.62	7.06	86.97
Phenylalanine	4.35±1.15	6.58	66.11
Histidine	2.95±0.14	2.96	99.66
Tryptophan	2.31±0.17	1.92	120.31

'a' Eka (1987)

**Amino Acid Composition of MOLM.** Amino acid profiles are presented in Table 4. The amino acid content (g/16g N) of MOLM is an indication of the potential food /feed value of the protein (as a source of amino acids) can be evaluated by comparison with the hen's egg ( Eka '1987). All essential amino acids are at higher than adequate concentrations when compared with the recommended amino acid pattern of the requirements for most farm animals. A comparison between the amino acid composition of MOLM and that of soybeans revealed an almost identical pattern of all essential amino acids.

### Conclusion

Proximate, mineral, phytochemical and amino acid analysis of MOLM showed that MOLM contains an appreciable level of nutrients that are usable in the nutrition of livestock. With the increasing population and emergence of large and medium scale livestock farms in Nigeria and rising cost of fish meal and soya bean meal, the need to plant *Moringa oleifera* in all parts of Nigeria including the Niger Delta is of utmost importance. To obtain high quality MOLM, processing stages must be carefully monitored. Good hygiene during collection, processing, drying, milling and transportation coupled with microbial (moulds) control measures should be strictly observed and sources of infection avoided. The result of this study therefore indicated that MOLM contained useful nutrients and essential amino acids and Phytochemicals that may offer medicinal and chemo-protective and nutritional benefits to its users and monogastric animals. Viable effects detectable through biological evaluation of all monogastric animals are necessary to enhance the acceptability and commercialization of this plant.



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