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Review Article

Potential Use of *Moringa Olifera* in Poultry Diets

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ABSTRACT

This paper reviewed researches on the use of *Moringa oleifera*in poultry diets. As the price of compound feed continues to escalate due to the high expense of conventional protein sources such as fishmeal and soybean meal there is an urgent need to look for alternative sources of protein and Moringa is one of such protein sources. Moringa has excellent nutritive value and therapeutic properties. The crude protein (CP) content of Moringa ranges from 71.2 to 391.7 g/kg and varies across the plant parts with the seeds having the highest CP content followed by flowers, leaves, whole plant, stems and pods. However, Moringa contains anti-nutritional factors such as tannins, phytates, trypsin inhibitors, saponins, oxalates and cyanide, which affect protein and mineral metabolism and availability to the animal.The availability of phosphorus to the birds can be enhanced through addition of phytase to break down phytate that binds phosphorus. It is apparent from the previous studies that inclusion of Moringa in poultry diets improves performance of chickens in terms of growth rate and egg production. As the cost of Moringa can be prohibitively high in some countries, economically inclusion levels should be determined.

Keywords: Anti-nutritional factors, broilers, layers, *Moringa oleifera*, protein source.

INTRODUCTION

Livestock feed costs in developing countries are a continuing challenge. The high and increasing prices for animal feeds have compelled researchers in developing countries to direct their attention to non-conventional feeds, with particular emphasis on protein substitutes (Gaia, 2005). *Moringa oleifera* Lam is one of the 13 species of Moringaceae, which is native to India, Red Sea and parts of Africa including Madagascar. Of these, *M. oleifera* is the most widely known (Price, 2007). *Moringa oleifera* is among plants that can be integrated with livestock production to increase feed quality and availability as it can be used as a cheap protein supplement to improve digestibility of other diets. All plant parts can be used to feed livestock.

Moringa grows best in the hot, semi-arid tropics; hence it is drought-tolerant and grows at a rainfall of 250-1500 mm per year (Martin, 2007). In its natural habitat Moringa grows up to 1 400 m of altitude, along the biggest rivers on alluvial, sandy or gravel soils (Pérez, 2005). Moringa tree prefers well-drained sandy or loam soil. It also grows on a soil pH ranging between 4.5 and 8, except on heavy clays, and it prefers neutral or slightly acidic soils. A good temperature range for the tree is 25-35 ºC though it can tolerate up to 48 ºC for limited amount of time (Pérez, 2005). The tree has an average height of 5 to 12 m (Paguia *et al*., 2012). The trees cultivated for forage are pruned to restrict the development of the crown and promote the growth of new branches (Pérez, 2005).In Botswana, Moringa tree is found in Gaborone, Mahalapye, Palapye, Francistown, Maun and other parts of the country but only a few people know the benefits and uses of this miracle tree (Nduwayezu, 2006).

The poultry industry in the developing countries is facing some challenges, one of which is an increase in the cost of feed because of high prices of protein and energy sources (Abbas, 2013). Although rich in nutrients such as protein and minerals, *Moringa oleifera* is one of those plants that have not been studied for many years but now is being investigated for its fast growth, higher nutritional value, and utilization as a livestock fodder crop (Nouman *et al*., 2013). Therefore, this manuscript endeavours to present a detailed discussion on the use of *M. oleifera* in poultry diets.

Nutrient composition of *Moringa oleifera*

Moringa oleifera tree contains high crude protein (CP) in the leaves (251 g/kg DM) and negligible content of tannins and other anti-nutritive compounds and offers an alternative source of protein to ruminants (Nouala *et al*., 2006) and non-ruminants. The nutrient composition and digestibility of morphological parts of *M. oleifera* is shown in Table 1. According to Table 1, the seeds contain high amount of CP, followed by flowers and leaves, suggesting that *M. oleifera* can be used as a protein source for both livestock and humans. The fact that the seeds contain higher CP content than other parts suggests that suggesting that they can be used as a valuable source of protein.Ojukwu (2012) stated that Moringa leaves are periodically harvested to make a sauce, locally known as "*mboum*" or can be used to feed poultry, pigs and cattle. In a recent study, Aye and Adegun (2013) in Nigeria found lower percentages of DM of MOLM to be 93.63±0.01, ash (7.96±0.03), CP (22.23±0.25), CF (6.77±0.01), EE (6.41±0.01), NFE (40.28+0.25) while gross energy was (14.790) (MJ/kg). These results indicate that nutrient composition of MOLM differs according to location and possibly stage of harvesting of Moringa leaves.

Table 1: Nutrient composition and digestibility of morphological parts of *Moringa oleifera*

Plant parts	DM	Ash	CP	EE	CF	Digestibility
Seeds, g/kg	950.0	34.8	391.7	388.0	48.0	-
Flowers, g/kg	892.5	112.1	314.8	68.0	170.0	-
Pods, g/kg	940.0	97.1	71.2	20.0	490	430.7
Leaves, g/kg	930.0	138.9	267.9	64.0	210.0	790.5
Stems, g/kg	940.0	101.1	112.3	32.0	430.0	521.7
Whole plant, g/kg	914.0	123.7	200.0	24.0	270.0	760.9

Source: Mabruk *et al.* (2010)

Morphological parts of *M. oleifera* such as leaves, stems, whole plants and pods according to their moderate to high CP content (71.2-267.9 g/kg DM) and high crude fibre content (CF) of 210.0 - 490.0 g/kg DM are considered good sources of roughage for feeding domestic ruminants for maintenance and production (Mabruk *et al*., 2010).

Multiple uses of *Moringa oleifera*

The multiple uses of *M. oleifera* are illustrated in Figure 1. It is clear from Figure 1 that there is a lot of potential for Moringa to be used as an ingredient in livestock diets. Despite the high CP content of MOLM, there are few reports in literature on feeding trials with livestock. Sarwatt *et al*. (2002) stated that both large and small-scale farmers in Tanzania grow *M. oleifera* for extraction of seed oil and thus there is potential to use the foliage for feeding livestock and the cake as a protein source. Nouala *et al*. (2006) investigated the influence of *M. oleifera* leaves as a substitute to conventional concentrate on the *in vitro* gas production and digestibility of groundnut hay and reported that *M. oleifera* leaves appeared to be an alternative source of protein for ruminant production in West African settings and can be used as supplement to diets based on crop residues/poor roughage. In combination with concentrate, *M. oleifera* leaves further improved the efficiency of concentrate utilization. Ogbe and John (2012) harvested the leaves of *M. oleifera* from Lafia in Nasarawa State of Nigeria during the rainy season in June 2011 and determined their proximate, mineral and phytochemical analysis. The proximate analysis revealed the presence of high CP (17.01% ±0.1) and carbohydrate (63.11% ±0.09), CF (7.09% ±0.11), ash (7.93% ± 0.12), ether extract (EE) (2.11% ±0.11) and fatty acid (1.69% ±0.09). The phytochemical analysis and anti-nutrients showed the presence of tannins (21.19% ±0.25), phytates (2.57% ±0.13), trypsin inhibitors (3.0% ±0.04), saponins (1.60% ±0.05), oxalates (0.45% ±0.01) and cyanide (0.1% ±0.01). The presence of these essential nutrients and minerals implies that *M. oleifera* leaves could be utilized as a source of feed supplement to improve growth performance and health status of poultry. However, the high protein content of Moringa leaves must be balanced with other energy feeds. Martin (2007) suggested that cattle feed consisting of 40-50% Moringa leaves should be mixed with molasses, sugar cane, young elephant grass, young sweet sorghum plants, or whatever else is locally available. Several researches have demonstrated that inclusion of *M. oleifera* in livestock diets has beneficial effects.

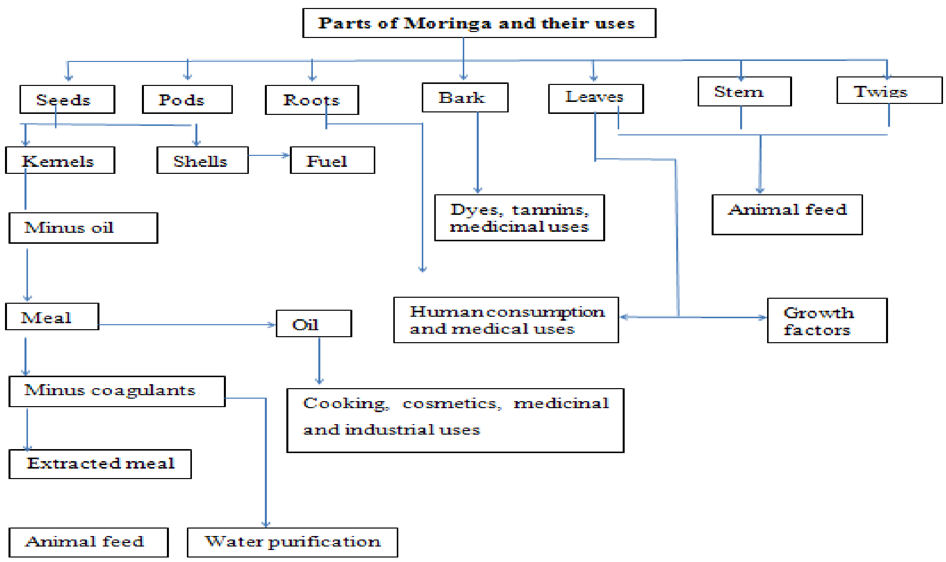

Figure 1: Multiple uses of Moringa
Source: Foidl *et al*. (2001)

Moringa oleifera trees are useful for alley cropping as they have a loose canopy, which prevents excessive crop shading. Foliage can be regularly pruned and left in the field to improve soil fertility or fed to livestock in a cut-and-carry system. The leaves are highly nutritious and contain significant quantities of vitamins (A, B and C), calcium, iron, phosphorus and protein (Murro *et al*., 2003). Furthermore, heavy metals such as mercury, arsenic and cadmium which are potentially toxic are absent from the leaves of *M. oleifera*, thus making their incorporation into poultry diet safe (Donkor *et al*., 2013).

Other uses of *M. oleifera* to include construction (growth factors, pole and fibre), fuel wood, ornamental (hedge and shade) and medicinal (Maroyi, 2006). Chollom *et al*. (2012) investigated the effect of aqueous seed extract of *M. oleifera* against Newcastle disease virus (NDV) using an *in ovo*assay and found that an increase in extract concentration was directly proportional to virus death and inversely proportional to production of antibody against NDV. These findings have clearly demonstrated that *M. oleifera* seed extract has nutritional value, as well as, strong antiviral activity against NDV *in ovo*.

Inclusion of Moringa in chicken diets

Chickens will not voluntarily consume Moringa leaves or Moringa leaf powder. However, about half the protein content can be extracted from the leaves in the form of a concentrate that can be added to chicken feed (Price, 2007). According to Fuglie (2009), the nutrient value of Moringa leaves can be increased for chickens through the addition of phytase to break down phytate leading to increased absorption of phosphorus. Phytase should be simply mixed with the leaves without heating. If uncontrolled, raw Moringa in poultry diets can be dangerous because of high bio-availability of protein; therefore particular care must be taken to avoid excessive protein intake (Gaia, 2005). Moringa is not only concentrated in nutrients, but in the raw form, it seems to reduce the activity of pathogenic bacteria and moulds and improves the digestibility of other foods, thus helping chickens to express their natural genetic potential (Gaia, 2005). Ayssiwede *et al*. (2011) assessed the effects of MOLM inclusion in poultry diets on growth performances, carcass and organs' characteristics and economics results of growing indigenous Senegal chickens and found that MOLM inclusion in the diets up to 24% did not cause any adverse impact on live body weight, average daily weight gain, feed conversion ratio (FCR), mortality, carcass and organs characteristics in birds compared to their controls.

According to Limcangco-Lopez *et al*. (1989), Moringa fed in high quantities (7.5 and 10%) to one-week old chicks results in reduced growth, indicating that higher levels of Moringa in chick diets has a detrimental effect on chick growth. Onu (2011) in Nigeria investigated the effects of MOLM on the performance and blood chemistry of starter broilers and found that MOLM could be included at 7.5% in broiler diets without any deleterious effect on performance and blood characteristics of broilers. The Golden Valley Agricultural Research Trust (2010) in Zambia incorporated 1 kg MOLM into broiler diets and reported reduced feed intake in the first two weeks. Thereafter, improvement in feed intake was observed which resulted in increased body weight and cock activities. Paguia *et al.* (2012) fed *M. oleifera* leaf and twig powder (MLTP) to force molted hens and assessed their performance. The authors found no effect of MLTP on feed intake, feed efficiency, egg sensory evaluation (egg flavour and egg acceptability score) but reported significant effect on egg weight and feed cost per kilogramme of eggs produced. In another study, the influence of MOLM on growth performance of broilers was assessed and treatment was found to have no effect on average cumulative feed consumption, final live weight, FCR, feed cost per kilogramme of broiler produced, and income over feed and chick cost.

A study by Zanu *et al*. (2011) found that *M. oleifera* when partially used to replace fish meal may hamper growth rate of broiler chickens. In Botswana, Kwedibana (2008) evaluated the effects of MOLM at 10% inclusion level on the growth rate of broilers and found that commercial broiler diet significantly ($P<0.05$) promoted higher weight gain (1.04 kg) than MOLM. Feed intake was also higher for birds fed commercial diets than those on MOLM. On the other hand, FCR was higher for birds on MOLM than those fed commercial diets.

In Zimbabwe, Gadzirayi *et al*. (2012) investigated the effects of supplementing soya bean meals with MOLM as a protein source in poultry and found no significant differences in feed intake of broilers, however, significant differences in FCR were noted. It was concluded that inclusion of MOLM as protein supplement in broiler diets at 25% promoted more growth than commercial diets. Portugaliza and Fernandez (2012) supplemented Cobb broiler diets with varying concentrations of *M. oleifera* aqueous leaf extract (MoALE) through drinking water and found that at 90 ml MoALE, feed intake of broilers was consistently lower than that of control group (commercial diet). The live weight of broilers given 30 ml, 60 ml and 90 ml MoALE were significantly higher than the control group. The MoALE treated broilers were more efficient converters of feeds into meat than the control group. Kakengi *et al*. (2007) in Tanzania investigated the effect of MOLM as a substitute for sunflower seed meal on performance of laying hens and found that MOLM could be used as a source of plant protein at 10% inclusion level in the diet. The authors mentioned that in areas where MOLM can be obtained for free and quality of eggs fetch higher premium price, inclusion of MOLM at 20% is highly recommended. The study concluded that MOLM could be used as a source of plant protein since it was highly accepted by the birds even at high dietary inclusion levels. Another study by Abou-Elezz *et al*. (2011) assessed the effects of 0%, 5%, 10% and 15% MOLM inclusion levels on egg production and quality traits of Rhode Island Red hens and reported that MOLM linearly decreased the egg laying rate (60.00, 59.72, 56.13, and 51.87 %) and egg mass and had a quadratic effect on the feed intake (111.15, 111.93, 107.08 and 100.47g/hen/d) when including 0, 5, 10, and 15 % of MOLM, respectively. The authors concluded that MOLM could be acceptable as sustainable feed resource up to 10 % in laying hen diets. Similarly, Tesfaye *et al*. (2012) in a 56 days fed broilers diets containing five inclusion levels of MOLM (*i.e.*, 0%, 5%, 10%, 15% and 20%) and reported significantly higher DM intake, CP intake, body weight and average daily gain for 0% MOLM (control) than other treatments. The authors concluded that MOLM could replace soybean in poultry diets up to 10% inclusion level in the total ration of broilers suggesting that the shrub has some potential in poultry feeding.

Banjo (2012) investigated the effects of inclusion of four levels (*i.e.*, 0%, 1%, 2% and 3%) of MOLM on growth performance of Anak 2000 strains of broilers and found that inclusion of 2% significantly enhanced weight gain. It was found that inclusion of MOLM did not significantly enhance feed intake and feed conversion. Furthermore, the effect of MOLM inclusion in cassava chip based diets fed to broiler chickens was studied in Nigeria and a reduction in performance with increasing inclusion level of MOLM above 5% was observed (Olugbemi *et al*., 2010a). It was concluded that broilers could be safely fed cassava-based diets containing MOLM at a maximum level of 5% without deleterious effects. In a related study, Olugbemi *et al*. (2010b) found that MOLM can be safely included in cassava-based layer diets up to 10% without negatively affecting productivity. These results suggest that the inclusion level of MOLM is lower for broilers compared to layers. In another study, Olugbemi *et al*. (2010c) investigated the potential of MOLM as a hypocholesterolemic agent using layers fed cassava-based diets and reported that *M. oleifera* possesses hypocholesterolemic properties and that it can be included in layers diets to facilitate reductions in egg cholesterol content.

CONCLUSIONS

Dietary inclusion levels of 5 to 20% MOLM in broiler diets and 10% in layer diets have been found to improve bird performance in terms of growth rate and egg production (including egg size). However, if MOLM can be obtained for free and the price of eggs is high, the inclusion level of MOLM can also be increased to 20% in layer diets. The results from previous researches indicate that MOLM could partially replace soybean meal and sunflower seed cake as a protein source in diets for chickens.

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