



## Role of *Moringa Olifera* Leaf Meal on the Growth Performance of Poultry/African Catfish–A Review

J.O. Alagbe

Department of Animal Nutrition, Sumitra Research Farm, Gujarat, India

\*Corresponding Author E-mail: [demsonfarms@yahoo.com](mailto:demsonfarms@yahoo.com)

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### ABSTRACT

*Moringa oleifera* commonly referred to as the drumstick tree is a plant from the Moringaceae family. It is a medicinal plant that was found to be loaded with different bioactive chemicals or secondary metabolites such as vitamins, minerals, saponins, alkaloids, flavonoids and carotenoids *etc*, which are involved in enhancing a long term health benefits. *M. olifera* is among the most promising species based on their high antioxidant activity, high contents of micro-nutrients, processing properties, ease of growing, and also on palatability, stability and shelf life of animal products. It has a relatively high protein content which varies from 24% - 32%, the leaves are used as a food source for humans and a dry season feed for animals because of the nutrient contents it contains. It has been traditionally used in the treatment of many ailments throughout the world and has been scientifically proven to act as anti-inflammatory, antibacterial, antifungal, anticancer, antiulcer, analgesics and antiepileptic drug. With the increasing popularity on the usage of *Moringa olifera* in the diets of animals and the positive impact recorded, this review is a collection of different works by authors on using *Moringa olifera* in poultry and African catfish (*Clarias gariepinus*).

**Key words:** *Moringa olifera*, Livestock, Growth performance, Poultry, Catfish.

### Introduction

Livestock farming is a profitable business that's widespread across various parts of Nigeria. The high cost of animal feed in semi-arid countries, is a major limitation to animal production which is raised predominately under extensive systems. Therefore, utilization of alternative feed resources may be a logical and suitable strategy in low input systems (Khezri *et al.*, 2011; Amirteymouri *et al.*, 2015). The insatiable demand for fishery products like Tilapia, Catfish, and Mackerel (Salmon) and chicken in Nigeria has constantly self-promoted the steady growth and expansion of the industry. These factors, coupled with the current support of institutions, the Nigerian government, and several other African countries to promote agriculture and also support livestock farmers, make the industries a lucrative agricultural business segments to venture in. In Nigeria alone, the demand for the catfish (*Clarias gariepinus*) is on the increase and its contribution to the gross domestic product (GDP) in 2008 stood at 4.4%. Despite this enormous demand, most farmers have

not been able to meet this demand because the country (Nigeria) is a food deficit nation and it is obvious that protein intake is grossly inadequate in both qualitative and quantitative terms. One of the key cardinals of livestock management is feeding, it accommodates about 70-80% of the total cost of production. There has recently been an increase in competition among ingredients used in the manufacture of livestock feed. There is consequently a great need for alternatives that can supply the high demands for such ingredients, in particular for soya meal (Chisoro, 2015; Garba *et al.*, 2010) suggested partial or complete replacement of expensive and conventional feed ingredients with cheaper non-conventional substitutes. One of the ways of reducing the cost of production and making protein available to people in cheaper prices especially in developing countries is by the use of agricultural by-products and tropical plants (leaf meal) which are not directly used by humans as food to feed livestock (Asar *et al.*, 2010). It has been reported that some leaf meal provides animals with necessary vitamins, minerals, oxycarotenoids and protein (Opara, 1996), for instance *Moringa oleifera* leaves and pods are found to be loaded with vitamins and amino acids (Francis *et al.*, 2005).

*Moringa* leaves have unique qualities that make it a potential replacement for soybean meal or fish meal in non-ruminant diets. *Moringa oleifera* commonly referred to as the drumstick tree is a plant from the Moringaceae family and it is the most widely cultivated species of the genus *Moringa*. *Moringa oleifera* is a fast-growing, deciduous tree. It can reach a height of 10-12 m (32-40 ft) and the trunk can reach a diameter of 45 cm (1.5 ft). The bark has a whitish-grey color and is surrounded by thick cork. Young shoots have purplish or greenish-white, hairy bark. The tree has an open crown of drooping, fragile branches and the leaves build up feathery foliage of tripinnate leaves. The flowers are fragrant and bisexual, surrounded by five unequal, thinly veined, yellowish-white petals. The flowers are about 1.0-1.5 cm (1/2) long and 2.0 cm (3/4) broad. They grow on slender, hairy stalks in spreading or drooping later flower clusters which have a length of 10-25 cm. The tree is often called 'multipurpose' due to the fact that all parts include leaves, pods, seeds, flowers, fruits and roots are edible (Orwa *et al.*, 2009). According to (Onimisi *et al.*, 2007). *M. oleifera* can be included up to 30% in rabbit diet without any adverse effect on the growth performance. It can also be included up to 20% in the diets of laying birds without any adverse effect on their production and performance (Kakengi *et al.* 2007). *Moringa* leaves meal contains 27.51% crude protein, 19.25% crude fibre, 2.23% crude fat, 7.13% ash, 76.53% moisture, 43.88% carbohydrate and 1296.00 Kj/g calories (Oduro *et al.*, 2008). The leaves are non-toxic and found to be loaded with nutrients necessary for the growth and development of animals.

Several studies have shown that *M. oleifera* leaves are highly medicinal as they perform several functions such as being antibacterial (Egbuikwem and Sangodoyin, 2013), antifungal (Prston *et al.*, 2010), antidiabetic, antitumor, anti-ulcer, antioxidant, anti-cancer as they are used in the treatment of the digestive system. Medicinal plants contain a vast range of pharmacologically active ingredients as each herb has its own unique combination and properties. Herbs contain ingredients which possess several effects that are combined in the one medicine (Phondani *et al.*, 2010; Kamboj, 2000). *Moringa* seed powder has antibacterial properties that make it useful as a natural clarifier for water purification systems and fish ponds (Aruna and Srilatha, 2012).

In view of the potentials of *M. olifera*, this work focuses on various researches carried out on the effect of the plant on the growth and performance of African catfish (*Clarias gariepinus*) and poultry.

### Growth performance of African catfish fed *M. olifera* leaf meal

The growth performance ability of dried *M. olifera* leaf meal was examined in the diet of *Clarias gariepinus* (Akinwole *et al.*, 2016; Kittisak *et al.*, 2017). Ninety *Clarias gariepinus* juveniles with individual weight of 10grams were stocked at 10 fish per tank per triplicates. Waste water from fish rearing pond was collected and treated with 120 mg/L of alum and Moringa seed and the supernatant water was decanted and used for fish culture. The growth performance and feed efficiency of catfish cultured with Moringa seed treated water (MSTW) did not differ ( $p>0.05$ ) from those cultured with deep well water but were higher ( $p<0.05$ ) than those of catfishes raised with alum treated water (ATW). The MSTW catfish had higher ( $p<0.05$ ) survival rate of  $93.33 \pm 3.83\%$  as compared to control ( $90.78 \pm 30.64\%$ ) and ATW catfish ( $30.00 \pm 26.40\%$ ). The MSTW exhibited the best performance in terms of total production per cubic metre of water used with the value of  $2.64 \pm 0.46 \text{ Kg/m}^3$  compared with  $0.94 \pm 0.02 \text{ Kg/m}^3$  and  $0.82 \pm 0.61 \text{ Kg/m}^3$  in the control and ATW catfish respectively.

A study was also carried out by Adewumi (2014) on fish fed diet supplemented with dried *M. olifera* leaf meal (MLM) at 0%, 5% and 10% were not significantly different ( $p>0.05$ ) from one another while these were significantly different ( $p<0.05$ ) from the performance of the fish fed diet with MLM at 20% and 30%. Similarly, (Kittisak *et al.*, 2017) conducted an experiment where fish were fed with diets containing isonitrogenous (350 g/kg crude protein) and isoenergetic (3000 kcal/kg) supplemented with dietary Moringa leaf at 0 g/kg fish, 100 g/kg fish, 150 g/kg fish and 200 g/kg fish for 60 days. At the end of the experiment fish fed diet containing Moringa leaf at 100 g/kg demonstrated better growth than the other inclusion levels, but it was not significantly different from the control group. The digestibility coefficient and protein digestibility were lower in fish fed with a higher inclusion of Moringa leaf in the diets ( $p<0.05$ ), the report concluded that up to 100 g/kg fish without any deleterious effect in the growth performance, feed utilization and digestibility of catfish.

The positive growth impact of *M. olifera* could possibly be attributed to the presence of essential nutrients in the plant. According to (Foidl *et al.* 2001; Rweyemamu (2006); Moyo *et al.*, 2011; Rubanza *et al.* 2005; Richter *et al.*, 2003). *M. olifera* contains calcium, phosphorus, magnesium, potassium, iron, selenium, zinc, sodium, copper, manganese, methionine, lysine, threonine, histidine and arginine depending on the stage of harvest and species. (Richter *et al.*, 2013) also reported that the presence of this essential minerals and amino acids improve digestibility, palatability and intake in animals.

### Phytochemicals in plants

Plants produce bioactive chemicals or secondary metabolites also known as phytochemicals. About 10,000 different phytochemicals have been identified, and many still remain unknown. High concentrations of phytochemicals, which may protect against free radical damage, accumulates in plants (Naczka, 2006; Suffredini *et al.*, 2004). Studies have shown that many plants are rich in antioxidants, vitamins especially (A, C and E), flavonoids and tannins which provide several health benefits to human and animals (Valko *et al.*, 2006;

Ammar *et al.*, 2017). The synergistic combination of these phytochemicals in *M. olifera* causes an increase in feed consumption, palatability and disease prevention as presented in Table 1.

Some of the phytochemicals that have been isolated from Moringa preparations are reported to benzylisothiocyanate, 4-(*a-L*-rhamnopyranosyloxy) benzyl glucosinolates, 4-(4'-Oacetyl-*a-L*-rhamnopyranosyloxy) benzyl, isothiocyanate, 4-(*a-L*-Rhamnopyranosyloxy) which confers it the ability to function as antibacterial, anti-inflammatory, antiviral, antioxidant, anti-tumor, anti-cancer (Bennett *et al.*, 2003; Atawodi *et al.*, 2010).

**Table 1.** Phytochemical constituents in extract of *M. olifera* leaf and their benefits

Constituents	Aqueous extract	Methanol extract	Benefits
Tannins	++	+	Bactericidal, anti-inflammatory
Saponins	+	+	Antioxidant, anti-cancer
Alkaloids	+++	+	Treatment of malaria
Flavonoids	+	+	Bactericidal, anti-inflammatory
Glycosides	+	-	Provide energy to the body

\*Key: +++, highly present; ++, moderate present; +, slightly present; -, not present

Source: (Chinwe Christy Isitua *et al.*, 2015)

### Alkaloids

They are heterogeneous group of naturally occurring compounds found in the leaves, bark, roots or seeds of plants. Some alkaloids stimulate the nervous systems others can cause paralysis, elevate blood pressure or lower it. Certain alkaloids act as pain relievers, others act as tranquilizers. Others have also been noted to certain antimicrobial properties (Adesuyi *et al.*, 2012; Rimbach *et al.*, 2000; Terashima *et al.*, 2002).

### Tannins

Tannins are widely found in plant materials, tree and shrubs both leguminous and non-leguminous species. They are complex esters consisting of glucose core surrounded by various combinations of polyphenolic acids. Tannins occur in several plants and are more common in woody and herbaceous species. There are chemically two distinct types of tannins, the condensed tannin and the hydrolysable tannins. According to (Njidda and Ikhimioya 2012), the two types differ in their nutritional and toxic effects; the hydrolysable tannins can be absorbed in the blood stream and can cause (induce) toxicological effects and death when the concentration in the diet are high. It is well documented that the presence of secondary compounds in tannin in a wide range of shrubs species hamper their fodder potential (Makkar *et al.*, 2003). According to (Mahansho *et al.*, 1987), the poor palatability generally associated with high tannin in diet can be ascribed to its astringent property, which is a consequence of its ability to bind with proteins in the saliva and mucosa membrane of the mouth during feed mastication. They have been implicated in the toxicity of *Accacia* and *Desmodium* species (Bodaway and White, 1963; McCosker and Hunter, 1966).

Tannin has both positive and negative effect on the nutritive value of forage. Condensed tannins adversely affect palatability, intake, digestibility and animal performance. Tannins protein/enzyme complexes decrease rumen ammonia concentration thus inhibiting fermentation of structural carbohydrates. (Barry *et al.*, 1987) reported that depression in

protein and organic matter digestibility is due to the presence of tannin and cyanogenic glycosides. Tannin-protein complexes can also render protein unavailable for digestion in the small intestine, increase faecal nitrogen and lower nitrogen retention (Akingbade *et al.*, 2004).

### Phenol

Phenol is a crystalline organic compound. It is a constituents of coal tar. Dilute solutions of phenol are useful antiseptics but strong solutions of phenols are caustic and scarring to tissues. Phenols are widely used in the manufacture of resins, plastics, insecticides, explosives, dyes and detergents and as raw materials for the production of medicinal plants such as Aspirin (Michael, 2008).

### Flavonoids

Flavonoids make up the largest class of phytochemicals (Du *et al.*, 2016). In general, flavonoids can play an important role in decreasing disease risk through various physiologic mechanisms. Some of these include antiviral, anti-inflammatory, cytotoxic, antimicrobial, and antioxidant effects (Somerville *et al.*, 2016). Mechanisms responsible for improvements in heart disease risk include improved endothelial function, decreased blood pressure, and improvements in lipid and insulin resistance (Sansone *et al.*, 2015; Cox *et al.*, 2000). Flavonoids can be divided into the following subclasses flavonols, flavanones, flavones, flavan-3-ols, and flavanonols (Koosha *et al.*, 2016). Certain clinical studies have documented relationships between flavonoid consumption and decreased cancer risk. For example, research has shown a relationship between the reductions of colorectal cancer risk, which is the third most common type of cancer in the world, and the consumption of dietary flavonoids (Boeing *et al.*, 2012; Thangapazham *et al.*, 2016; Kotecha *et al.*, 2016). Flavonoids have protective effects including anti-inflammatory, antioxidant, antiviral and anticarcinogenic properties (Middleton *et al.*, 2000).

### Growth performance of birds fed *M. olifera* leaf meal

Studies on growth performance of broilers fed Moringa leaf meal had a better weight gain when compared to birds fed control diet. (Hassan *et al.*, 2016; Teteh *et al.*, 2013; Donkor *et al.*, 2013; Melesse *et al.*, 2011; Nkukwana *et al.*, 2014; El-Badawi *et al.*, 2014; Onunkwo and George 2015), reported in an experiment that birds fed diets supplemented with Moringa leaf meal at 0%, 0.1%, 0.2% and 0.3%. The result revealed that body weight gain increased significantly ( $p < 0.05$ ) as the level of Moringa increased; also the feed intake followed the same trend. Feed conversion ratio recorded better values as the level of Moringa leaf meal increased. (Gadzirayi *et al.*, 2012) recommends that the inclusion of Moringa leaf meal as protein supplement in broiler diets at 25% inclusion levels produces broilers of similar weight and growth rate compared to those fed under conventional commercial feeds. Similarly, (Nihad *et al.*, 2016; Gakuya *et al.*, 2014; David *et al.*, 2012) reported that broilers fed 20% *M. olifera* meal showed better weight gain and feed conversion ratio than in control group. Birds fed 20% Moringa leaf meal had 2391 grams compared to the treatment with 2133 grams.

(Abou-Elezz *et al.*, 2011) reported that when *Moringa oleifera* leaf meal was supplemented at levels of up to 10% to laying hens it had no significant effect on laying percentage.



Average egg weight significantly increased as a result of the supplementation of *M. oleifera* leaf meal when compared to a control (Ebenebe *et al.*, 2013). Addition of 10% and 20% *Moringa oleifera* leaf meal to the laying hen diet, as a substitute for sunflower seed meal in Isa brown breed, significantly increased feed intake and dry matter intake and Feed conversion ratio (kg egg/kg feed) increased when 20% *M. oleifera* leaf meal was added to the laying hen diet (Kakengi *et al.*, 2007). Increase in feed intake and feed conversion ratio, and at a higher level of *M. oleifera* leaf meal, are mainly due to low digestibility of energy and protein (Olugbemi *et al.*, 2010a).

## Conclusion

One of the ways to minimize the cost of feed, provide animal protein and get maximum production/performance especially in developing countries, is the use of some plants/leaves and seeds that are of high nutritional properties and beneficial when incorporated into livestock feed. The use of local, cheap and readily available materials particularly those that are not utilized by man should be given attention as the only viable alternatives to the use of conventional feedstuffs. Therefore, such potential needs to be maximized for profit maximization with least cost.

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