Graded Level of *Moringa Oleifera* Leaf Meal as a Correlate of Nutrient Digestibility of Finishing Broiler Chickens, Carcass Characteristics and Internal Organ of Broiler Chickens

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ABSTRACT

The study sought to find out if the Graded level of Moringa oleifera leaf meal is a correlate of nutrient digestibility of finishing broiler chickens, carcass characteristics and internal organ of broiler chickens. The area of the study was the Poultry Unit of the Teaching and Research Farm, Department of Animal Science, Faculty of Agriculture, Forestry and Wildlife Resource Management, University of Calabar, Calaber, Cross River State – Nigeria. Fresh Moringa oleifera leaves were harvested from Moringa trees and collected at Ugbo Village in Awgu Local Government Area, Enugu State and transported to Calabar. The test material (Moringa oleifera) leaves were dried under shade at room temperature of 32°C by spreading them on concrete slabs and allowed drying for two (2) weeks after which they were milled with a grinder to produce the meal of 0.35mm sieve size. The processed test material (the mealed sample of Moringa oleifera leaf) was bottled in an air tight container for chemical analysis to ascertain the effect of graded level of MOLM on nutrient digestibility of finishing broiler chickens and the effect of graded levels of MOLM on carcass characteristics and internal organ of broiler chickens. The use of Moringa oleifera leaf meal (MOLM) as an additive on broiler diets had no adverse effects on the growth performance of broilers and its potential as an antioxidant seemed to be effective in improving physico-chemical shelf-life indicators of the meat from broilers. The study also recommended that hat more studies or experiments on Moringa oleifera should be conducted

such as growing its trees in large numbers so that the farmers will be aware of how highly nutritive this tree is.

KEYWORDS: *Moringa oleifera* leaf meal (MOLM), Nutritional Potential, Nutrient Digestibility, Carcass Characteristics

Introduction

According to Alders, (2005) and Dieye et al., (2010), poultry production remains the most wide spread of all livestock enterprises; it constitutes an important pillar of food security improvement as well as socio-cultural and economic development in most countries. Broiler production is a source of income, it is a good source of protein and quick returns on investment (Kekocha, 1994). Antibiotics have been utilized as growth promoters and to prevent outbreak of diseases (Thomke & Elwinger, 1998; Phillips et al., 2004). Furthermore, medication in water using antibiotics helps birds to recover from diseases (Khalafalla et al., 2010). However, the benefit of the use of antibiotics as growth promoters has some disadvantages; these include drug toxicity, residual effects and development of bacteria resistance (Ogbe & John, 2012). Studies have shown that usage of chloramphenicol resulted into bacteria of the genus Salmonella developing resistance to the drug (Gassner & Wuethrich, 1994). The use of Avilamycin as a growth promoter resulted in an occurrence of avilamycin resistant *Enterococcus faecium* in broiler farms (Aarestrup, Bager and Andersen, 2000). These problems have led to the ban on the use of antibiotics as growth promoters by the European Union (Butaye et al., 2000; Catalá-Gregori et al., 2008).

In a study conducted by Siddhuraju and Becker, (2003) *Moringa oleifera* leaves are reported to have potential prebiotic effects and potentially antioxidant phytochemicals, such as chlorogenic acid and caffeic acid. *Moringa oleifera* leaf meal, widely available in many tropical countries, is also a good source of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids (Teixeira et al., 2014). The underlying effects of the bioactive compounds in *Moringa oleifera* leaves are not clear. However, they are believed to induce prebiotic effects, bacterial and immune-stimulant activities (Ghazalah & Ali, 2008) resulting in increased productivity of broiler chickens. Similar effects have been observed in the presence of antibiotic growth promoters (Khalafalla et al., 2010). However, data on the effects of *Moringa oleifera* leaf meal (MOLM) extract inclusion in the diet on growth performance and carcass characteristics of broiler chickens is limited and contradictory. Gakuya et al. (2014) reported a decrease in intake but an increase in feed conversion ratio. Olugbemi et al. (2010) observed a reduction in growth performance of broiler chickens when *Moringa oleifera* leaf meal was beyond 5% level of inclusion in the feed. Generally, Kakengi et al. (2007), Olugbemi *et al.* (2010, and Abou-Elezz et al. (2011) agreed that the use of *Moringa oleifera* leaf meal up to a level of 10% had no negative effect on the productive performance of broiler chicken, however, levels above 10 % produce adverse effects. This might be because the pure leaf meal are not extracted, tinctured, or cooked as a leaf extract, thus, the birds depend solely on the digestive system to extract the medicinal chemicals from the plant. Furthermore, the low performance at higher inclusion level could be due to high level of anti-nutritional factors and dustiness of MOLM and low digestibility of the fibre, energy and protein presence in the raw leaf (Abba, 2013). Safa & El-Tazi (2014) observed significant influence of MOLM on all the carcass parameters measured except the thigh weight.

There are limited studies of the effect of *Moringa oleifera* leaf extracts (MOLE) growth performance and carcass characteristics of broiler chickens. Kachik et al. (1992) reported that the presence of phytate and other anti-nutrients can reduce the bioavailability of certain nutrients and processing can be done for maximum utilization of required nutrients from the leaves.

Statement of the Problem

In Nigeria, commercial poultry meat production is expanding day by day. There is also a tremendous scope and opportunity for the Nigerian poultry industry to make profit. However, the recent hike in the prices of conventional feed ingredients is a major factor affecting net return from the poultry business. This is because 80% of the total cost of the operation is spent on feed. This scenario has compelled animal nutritionists to explore the incorporation of non-conventional feedstuffs in poultry diets. Their inclusion in the diets could help reduce feed cost and competition between man and the livestock industry for the available conventional feedstuffs. The economization of feed cost using cheaper and unconventional feed resources is an important aspect of commercial livestock production.

Research Objectives

The aim of this paper was to ascertain if the Graded level of Moringa oleifera leaf meal is a correlate of nutrient digestibility of finishing broiler chickens, carcass characteristics and internal organ of broiler chickens. Specifically, the following objectives are to determine the:

1. Effect of graded level of *Moringa oleifera* leaf meal on nutrient digestibility of finishing broiler chickens.
2. Effect of graded levels of *Moringa oleifera* leaf meal on carcass characteristics and internal organ of broiler chickens.

Literature Review

Factors affecting growth parameters in poultry production:

Growth components of broiler birds depend on many factors amongst which are the genotype (strains or breeds) and the environment under which the animal are raised. The parameters involved in broiler bird production are growth rate and body conformation. In broilers, feed conversion ratio (FCR) is positively correlated with growth. Environmental factors include; climate, temperature, management practices in terms of nutrition and health/disease management also poses some constraints in the growth of birds.

Energy: The major energy sources are fats and carbohydrates. The high environmental temperature in the hot humid tropics may alter the requirements for maintenance of metabolizable energy (Oluyemi and Alini, 1973). In addition, NRC (1984) stated that an absolute requirement for energy in terms of kilocalories per kilogram of feed (Kcal/kg) cannot be stated because poultry adjust their voluntary feed intake in relation to the environmental temperature, to obtain their necessary daily requirement. Oluyemi and Roberts (1982) noted that broilers require more energy feed than pullets to cope with the relative high rate of physiological activities for growth. Sainbury (1984) classified poultry rations as high energy feed and that broilers need high

energy diets as they have to attain about 2kg body weight within 8 weeks with feed conversion ratio of about 2.00. Olomu and Offiong (1980) argued that broiler birds perform better at lower energy levels in the tropics because of the environmental temperature which probably calls for lower energy needed to maintain basal energy requirement. The same researcher also reported that the energy level of 2,800 – 3000 Kcal/Kg metabolizable energy for broilers is adequate for optimum performance.

Diseases: Financial loss in the livestock industry is cause by disease. Oluyemi and Roberts (1979) indicated that chronic respiratory disease (CRD) occurs more in the wet season and Newcastle disease at about the middle of rainy season. It is worthy to note that coccidiosis and internal worms are potential wet season hazards to poultry flock, therefore birds should be vaccinated at appropriate time with correct vaccines to avoid the outbreak of these diseases. Moreover, the following diseases have been reported to be nuisance to the poultry industry. They include; fowl typhoid, pullorum, Newcastle disease, perosis as well as external and internal parasites like lice, mite, roundworms and tapeworms (Oluyemi and Roberts, 1979; McNitt, 1983). They also reported that losses may result in either death of poor performance.

Gordon (1977) stressed the importance of disease preventive measures such as purchase and administration of appropriate vaccines, good litter management and sanitation. Thear and Fraser (1986) in their view, advised poultry farmers to avoid treatment of diseases but simply pay adequate attention to hygiene, good feeding, general care as well as good liter management. Apparently, strict quarantine measures on occasion of disease outbreak could help as control and preventive measures through vaccination, sanitation, isolation, treatment, destruction of infested birds and invitation of trained veterinarian (Oluyemi and Roberts 1979; Dada, 1988).

Breeds of Birds: The strain of birds to be used is important because of their differences in growth rate and feed utilization. It is important that a broiler strain to be used by a farmer should be genetically fast in growth as well as produce quality carcass at the specified market weight and duration of 8 to 12 weeks. Williamson and Payne (1978) reported that majority of broiler strains are hybrids developed from crosses between pure breeds. According to Oluyemi and Roberts (1982) commercial poultry production should be based on hybrid rather than pure breeds because they produce superior mean and are fast growing. Singh *et al.* (1986) reported that birds with poor genetic potentials cannot perform well even under the best management/feeding practices. This implies that chicken with the right genetic composition, when not adequately fed will generally not do well. Nayor (1981) and Bhargwatt (1982) confirmed that hybrid broilers are capable of fast growth, better feed conversation ratio and development of good body conformation within tha age of 8 and 10 weeks. The main broiler strains used in Nigeria are Anak 2000, Harco, Cob, Starbro and Ross. The Anak 2000 strain which is commonly used for commercial broiler production has the following characteristics or properties; Rapid growth rate, high feed efficiency, white shank and fresh, white plumage and breast width (Oluyemi and Roberts, 1979).

Temperature: The recommended optimum temperatures of broiler birds at first, second and third week of brooding phase fall between 32.2 -35^{o}C, 29.7 - 32.2^{o}C and 26.6^{o} – 29.7^{o}C respectively as reported by Oluyemi and Roberts (1979). Similarly, Obioha (1992) gave a temperature guide for brooder house as 35^{o}, 29^{o}, 26^{o} and 24^{o}C from first to four weeks of

brooding respectively. It was further stated that after the fourth week, 22^{o}C should be the temperature provided at night when the outside temperature would be below 22^{o}C. Summer (1974) and Obioha (1992) pointed out that high temperature leads to reduced feed intake, leading to low performance, poor feather development which may lead to pecking. High temperature on the other hand also results in high mortality through suffocation in chicks due to collapse of the air sacs. Low temperatures also reduce feed efficiency as more feed are needed for maintenance (Summers, 1974; Huritz *et al.*, 1980; Oluyemi and Roberts 1982; Reece *et al.*, 1986; Obioha, 1992).

Empirical Review

Effect of graded level of *Moringa oleifera* leaf meal on nutrient digestibility of finishing broiler chickens.

Apparent digestibility of Feed Nutrients of Broiler Chickens Fed *Moringa Oleifera* Leaf Mean

Apparent nutrition digestibility could be defined as the difference in value between the feed eaten and materials voided by the animals. It is expressed as percentage of feed eaten (Javier, 1995). Digestibility can be interchangeably used as availability but refers to different things (Ravindran and Bryden, 1999; Moughan, 2003). In a research to evaluate the apparent digestibility of feed nutrients of broiler chickens fed quality maize Onimisi *et al.* (2008) reported higher apparent nutrient digestibility which implied that the nutrients in the diet were efficiently utilized. Furthermore, Gakuya *et al.* (2014) observed the effect of supplementing MOLM to broiler chickens, that there was a negative response as the result showed decrease in crude protein and ether free extract values, but Fuglie (1999) reported high digestibility coefficients for crude protein, calcium, iron and vitamin C as the birds were supplemented with *Moringa oleifera* leaf meal.

Low protein and amino-acid intake may cause high concentration of endogenous amino-acids in the stomach of an animal. But, as protein consumption increases, the quality of endogenous amino-acid sources will decrease and apparent digestibility will approach that of the true digestibility (Stein *et al.*, 2007).

Digestibility trial is important because it determines the amount of nutrients retain to meet the requirement of the production purpose. Though, over the years apparent digestibility has failed due to the fact that analysis done was through the quantity of faeces voided by the bird. The assessment of feed nutrient digestibility is necessary if balanced diet will be achieved in poultry production (Short *et al.*, 1999). Insufficient quantity of essential amino acid will lead to poor growth rate thereby affecting the performance of the birds. Excess amino acid in the diets of birds above the required level will also be a waste as the birds will excrete out the surplus thereby causing problem to animal welfare. (McNab,1994).

MOLM have good balance of amino-acid profile, therefore, poultry diets have been generally formulated on crude protein or total amino-acid basis. It has been suggested recently that

formulation of diets on a digestibility amino acid basis may be more advantageous as it decreases cost of feed and also decreases nitrogen excretion in the environment (Applegate *et al.*, 2008).

Growth pattern of poultry birds:

Balama *et al.* (1975) noted that performance of broilers is related to their genetic potential as they build up body tissues from the nutrients in the feed. Growth indices or parameters appear to be a definite order in which major tissues of the animal increases in size with advancing age. Hammond (1984) stated that the order of development and growth is as follows

Cells ⟶ Tissues ⟶ Bone ⟶ Tendon ⟶ Muscle ⟶ Fat

Hammond (1984) reported on the growth differential or heterogenic growth and gave the general principles of growth and development in farm animals in relation to nutrition. However, Hill, (1969) confirmed that the fed intake of birds increases as the birds grows. Growth in shank length, thigh length and breast width have been found to follow precisely the same trend as body weight. This is probably because these traits are correlated with body weight (Singh *eet al.*, 1986). One of the quality traits in poultry production is fast growth rate. Market weight is attained on time with fast growing birds. This confirms the view of Oluyemi and Roberts (1982) who indicated that during the successive stage of development, the chick undergoes drastic weight gain before 6 weeks of age. Sainbury (1984) gave an average market weight for broiler birds as 1400 g at 8 weeks and 2000 g at 12 weeks in the tropics. Moreover, Oluyemi and Roberts (1982) also obtained body weights of 1250g and 1480g for high strains of broiler chicken at 8 to 10 weeks respectively. Olumu (1979) in his work on the production standards of poultry in Nigeria recorded live weight of mixed broilers (males and females) at 1067, 1650 and 2215 g at 6, 8 and 10 weeks respectively.

Adeniji and Ayorinde (1990) and Monsi (1992) reported a mean body weight of 1762.50g and 1807.86g for broiler birds at the same 12 weeks respectively. Ibe (1989) recorded 1800g for mean body weight of starbro stain of broiler chickens at 12 weeks, whereas Obioha (1992) obtained body weights of 1.95kg for male broilers and 1.25kg for female broilers at 10 weeks of age. On the other hand, Williamson and Payne (1980) and Obioha (1992) obtained mean body weight of 1800g for male broilers and 1400g for females at 10 weeks. In most of the studies reported, variation in body weight was also attributed to the stress which the birds may have been subjected to throughout the rearing period.

Effect of graded levels of *Moringa oleifera* leaf meal on carcass characteristics and internal organ of broiler chickens

Carcass characteristics (relative weight of major cuts) of broiler finisher birds fed MOLM (expressed as percent dressed weight):

TABLE 1: Carcass characteristics (relative weight of major cuts) of broilers fed graded levels of MOLM

Parameters	T_1 0%	T_2 2.50%	T_3 5.00%	T_4 7.50%	T_5 10.00%	SEM

Breast	38.38[a]	31.34[a]	28.03[b]	32.00[a]	25.80[b]	1.51
Back	9.59	9.54	9.07	9.32	8.56	0.18
Thigh	13.38[b]	15.13[a]	13.57[b]	13.08[b]	13.55[b]	0.36
Drum stick	12.06[b]	13.71[ab]	14.98[a]	11.91[c]	10.39[b]	0.79
Head	2.68	3.03	3.16	3.16	3.86	0.09
Neck	5.89[ab]	5.67[ab]	6.32[a]	5.89[ab]	4.64[b]	0.28
Wing	10.71	10.55	11.37	11.28	10.79	0.16
Shank	4.29	5.47	6.06	5.27	5.10	0.29

[ab] Means within the same row with different superscripts are significantly different (P < 0.05)
SEM = Standard Error of Mean

Breast weight

The result for breast weight were significantly (P<0.05) influenced by treatment groups. T_1 and T_2 recorded higher breast weight (662.00g) while T_3 had the least weight (550.00g). The range obtained was 500.00 – 662.00 g/bird. The value of T_4 (612.00 g) was statistically similar with T_1 and T_2. Even with these values there was no nutrient deficiency problem that was observed in the breast (Abdurashid *et al.,* 2007).

Back weight: The results of the back weight were significant (P < 0.05) different across treatment groups. T_1 (205.60g) and T_2 (201.40g) were significantly higher than T_3 (178.10g), T_4 (178.30g) and T_5 (185.10g) respectively. The range (178.10 – 205.60 g/bird) was obtained in this study. The range was fairly higher than 80.40 – 179.80 g/bird earlier documented by Gadziraya *et al.* (2012) who fed MOLM to broiler birds in a different ecological zone. The differences could be attributed to the effect of location and method of processing the leaf meal.

Drumstick weight: The result of drumstick weight was significantly (P < 0.05) by across treatment groups. The highest value (294,10 g) was observed in T_3 level of supplementation. Drumstick weight in T_2 was significantly higher than others in T_1, T_4 and T_5. It was observed that birds have different abilities of depositing muscle tissues in their drumstick.

Head weight: The result obtained recorded significant (P < 0.05) influence between dietary groups on the weight of head from birds on graded levels of MOLM. T_2 was significantly higher than T_1, T_3, T_4 and T_5. The range was 57.40-64.10 g/bird, which was higher than the range (30.02-40.36 g/bird) reported by Gadziraya *et al.* (2012).

Methods

The study was carried out at the Poultry Unit of the Teaching and Research Farm, Department of Animal Sciance, Faculty of Agriculture, Forestry and Wildlife Resource Management, University of Calabar, Calaber, Cross River State – Nigeria. As recorded by the GeoNames geographical database by Google Earth (2012), Calabar is located at 4.9517° Latitude and 8.322°

Longitude (in decimal degrees) with the average elevation/ attitude of 42 meters. Also, Akpan *et al.* (2006) had earlier reported that Calabar is located at Latitude 3°N and Longitude 7°E with a landmass of 233.2 sq. miles (604 Km^2) with rainfall of 3000-3500 mm per annum and average daily temperature of 25°C/77°F which increases to 30°C (86°F) in the month of August. The relative humidity ranges from 70-80 percent whereas wind speed direction is 8.10 km/h west and the cloud is broken at 1000 ft with little cumulonimbus 2200 ft. the time zone in Calabar is Africa/ Lagos. Fresh *Moringa oleifera* leaves were harvested from Moringa trees and collected at Ugbo Village in Awgu Local Government Area, Enugu State and transported to Calabar. Other feed ingredients were procured from the local markets in Calabar Metropolis. The test material (*Moringa oleifera*) leaves were dried under shade at room temperature of 32°C by spreading them on concrete slabs and allowed drying for two (2) weeks after which they were milled with a grinder to produce the meal of 0.35mm sieve size.

Results and Discussion

Research Objective 1

Apparent nutrient digestibility of broiler birds fed graded levels of *Moringa oleifera* leaf meal (MOLM)

Table 2 shows the apparent nutrient digestibility of finisher birds fed MOLM. The Results showed non-significant (P > 0.05) differences in crude protein (72.90 – 74.60 percent) and crude fibre (74.00 – 81.50 percent) among the treatments. This result is in line with the observation of Cheeke (1987) who documented that tropical forages are rich in protein which is highly digestible. With increase in crude protein it was the reverse of the report by Das and Waterlow (1974) who noted that if there is a lower level of protein than the normal level feed to broilers, amino-acid catabolic enzymes decreases in the kidneys.

TABLE 2: Apparent nutrient digestibility (A.D) of broiler birds fed graded levels of *Moringa oleifefra* leaf meal (MOLM)

	(Dietary Levels of MOLM)					
Nutrients (%)	**T_1 0%**	**T_2 2.50%**	**T_3 5.00%**	**T_4 7.50%**	**T_5 10.00%**	**SEM**
Crude protein	73.80	73.80	73.70	72.90	74.60	1.75
Ether Extract	97.50	97.00	97.30	97.00	95.50	0.51
Crude fibre	81.50	76.50	77.00	75.00	74.00	1.00
Ash	81.00	87.00	85.00	86.00	83.00	3.00
NFE	67.25	65.75	65.00	68.87	70.87	1.09

Means within the same row with different superscripts are significantly different (P < 0.05)
SEM = Standard Error of Mean

Also there was no significant (P>0.05) increase in nutrients retention of nitrogen free extract at 10.00 percent level of MOLM with 70.87 percent NFE digestibility. This has contradicted the

report of Oduro *et al.* (2008) who reported Nitrogen-free extract (NFE) digestibility of MOLM to be 43.88 percent. No statistical (P>0.05) difference in ash nutrient retention at inclusion levels of MOLM with 81.00, 87.00, 85.00 and 83.00 percent, respectively. This result is similar with the report of Oduru *et al.,* (2008) who documented 71.30 percent ash digestibility which signifies that mineral content in the diet was adequate and could be the reason why the birds grew faster at 3 weeks in production.

Research Objective 2

Carcass characteristics of broiler finisher birds:

Table 3 shows the carcass characteristics performance on broiler finisher birds fed different graded levels of MOLM. The results showed that the dressing percentage, thigh and drumstick weights were statistically different between diets. This result is similar with the findings of Adeyemi *et al.* (2008) who documented that dressing percentage for broiler finisher birds should be in the range of 70-89 percent for maximum profit.

Live weight: The result of live weight (1912.10 – 2162.04 g/bird) of broiler birds fed MOLM recorded statistical difference between treatment groups. The values were in agreement with the findings of Oluyemi and Robert (1988) who stated that when birds utilize nutrients properly, they will attain the required weight of 2kg at eight weeks. However, there was a numerical decrease in live weight in the dietary levels of T_2 and T_4 respectively. This could be attributed to many factors including the individual nature of birds, prevailing environment factors and their ability to utilize feed nutrients adequately in diets.

TABLE 3: Carcass characteristics of broilers fed graded levels of *Moringa oleifefra* leaf meal (MOLM)

	Dietary Levels of MOLM					
Nutrients (%)	**T_1 0%**	**T_2 2.50%**	**T_3 5.00%**	**T_4 7.50%**	**T_5 10.00%**	**SEM**
Live wt.	2144.21^{a}	2112.12^{a}	1962.06^{b}	1912.10^{c}	2162.04^{ab}	50.74
Dressed wt.	1925.12	1544.34	1482.13	1400.22	1528.14	90.63
Dressing percentage (%)	89.78^{a}	73.12^{b}	75.54^{b}	73.23^{b}	70.68^{b}	3.40
Breast	662.00^{a}	662.00^{a}	550.00^{b}	612.00^{a}	558.00^{b}	24.15
Back	205.60^{a}	201.40^{a}	178.10^{b}	178.30^{b}	185.10^{ab}	5.80
Thigh	286.90^{ab}	319.60^{a}	266.30^{ab}	250.20^{b}	293.00^{ab}	11.83
Drum stick	258.60^{ab}	289.60^{a}	294.10^{a}	227.90^{b}	224.70^{b}	14.65

Head	57.40[c]	64.10[a]	62.00[ab]	60.50[b]	61.80[ab]	1.10
Neck	126.50	119.70	123.990	112.70	100.40	4.68
Wing	229.60	222.80	223.10	215.70	233.20	3.02
Shank	92.10[b]	115.50[ab]	118.90[a]	100.70[ab]	110.30[a]	4.91

[a, b, c] Means within the same row with different superscripts are significantly different ($P < 0.05$)

Dressing percentage: The dressed percentage was significant ($P < 0.05$) influenced by treatment groups, though without any particular trend across the treatments. The values obtained in this study were in the range (70.68 – 89.78 percent). The control (T_1) recorded a significantly higher value (89.78 percent) than others in T_2, T_3, T_4, and T_5 with 73.12, 75.54, 73.23 and 70.68 percent respectively. The values are similar to the ranges (74.90 – 72.20 and 79. 70 – 81.82 percent) earlier documented by Ayssiwede (2011) and Zanu (2012) respectively, who fed MOLM to broiler finisher birds in different ecological zones. These findings suggest that the nutrient composition of MOLM was adequate to support optimum carcass yield in the birds.

Conclusion

Feeding broilers diets with different levels of MOLM retarded lipid oxidation of the chicken meat compared to the diet with no MOLM. It was therefore, concluded that MOLM can be used in broiler diets as an additive with a potential to substitute commercial additives usually added in broiler diets, which are quite expensive for communal farmers. The use of *Moringa oleifera* leaf meal (MOLM) as an additive on broiler diets had no adverse effects on the growth performance of broilers and its potential as an antioxidant seemed to be effective in improving physico-chemical shelf-life indicators of the meat from broilers.

Recommendation

After a successful study, the following recommendations were made:

1. It was recommended that more studies or experiments on *Moringa oleifera* should be conducted such as growing its trees in large numbers so that the farmers will be aware of how highly nutritive this tree is.

2. Further research should also be done to determine the effect of using *Moringa oleifera* seeds or leaf meal as an additive (in other livestock diets) on the performance and meat quality. These researches should be conducted in communal areas, working with farmers, in that way they will gain more knowledge about *Moringa oleifera* and its properties

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