Effect of Graded Levels of *Moringa Oleifera* Leaf Meal on Haematological/Serum Biochemical Indices of Broiler Chickens and Cut Microbial Status

BY

Lawrencia Efiok ASUQUO*, Ph.D*
Department of Agricultural Education
School of Vocational & Technical Education
Akwa Ibom State College of Education
Afaha Nsit Akwa Ibom State, Nigeria,

Joe William EKA, *Ph.D*
Department of Agricultural Education
School of Vocational & Technical Education
Akwa Ibom State College of Education
Afaha Nsit Akwa Ibom State, Nigeria

AND

Ekpo Kufre O., *Ph.D*
Agric. Technology Department
Akwa Ibom State College of Science & Technology
Nnung Ukim Ikono, Ikono, Akwa Ibom State

ABSTRACT

A growth experiment was conducted to ascertain the effect of Graded levels of Moringa oleifera leaf meal on haematological/serum biochemical indices of broiler chickens and cut microbial status. Two research objectives were formulated to guide the study. The study was carried out at 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 levels of Moringa oleifera leaf meal on haematological and serum biochemical indices of broiler chickens and also the effect of graded levels of Moringa oleifera leaf meal on gut microbial status. The methods of Association of Official Analytical Chemists (AOAC), 2010 were used in determining the nutritional compositions of MOLM and experimental diets. The study concluded that Moringa oleifera leaf meal had no significant effect on haematological and serum biochemical indices of broiler chickens although the indices were numerically increased with increase MOLM level. the recommendation made was that Moringa oleifera leaf meal should be added up to 0.3% to foster broiler performance, physiological parameters and enhance the ability to resist heat stress conditions of broiler fed corn-soybean meal diet.

KEYWORDS: ***Moringa oleifera*** **leaf meal (MOLM), Graded levels, Broiler chickens, Gut microbial status, haematological and serum biochemical indices**

Introduction

Natural antioxidants such as vitamin C, tocopherols, flavonoids and other phenolic compounds are known to be present in certain plants. *Moringa oleifera* is one of such plant that has been identified to contain natural antioxidants (Siddhuraju and Becker, 2003). Moreover, the antioxidant effect of *Moringa oleifera* leaf was due to the presence of polyphenols, tannins, anthocyanin, glycosides and thiocarbamates, which remove free radicals, activate antioxidant enzymes and inhibit oxidases (Luqmans et al., 2012). Moringa leaves can serve as a rich source of β-carotene, vitamins C and E and polyphenolics. The growing popularity of the use of *Moringa oleifera* as a feed additive in poultry nutrition necessitates through investigation into its nutritional value, as well its impact on haematological parameters as a measure of both nutritional and medicinal benefits of the leaves in broiler chicks (Ebenebe et al., 2012). *Moringa oleifera* leaves incorporated into maize meal poultry feed led to better growth performance of the chicks and a significant increase in the serum level of biochemical minerals compared to the maize meal feed alone (Donkor et al., 2013). Although, several studies have reported that the use of *Moringa oleifera* leaves as feed supplements in livestock (Ayssiwede et al., 2011; Nkukwana et al., 2014), the optimal concentration of *Moringa oleifera* leaves as a nutritional supplement has not yet been determined and there are only limited reports on the bioactive constituents of *Moringa oleifera* leaves and their impact on meat antioxidant status. Therefore, the objective of this study was conducted to examine the effect of graded levels of *Moringa oleifera* leaf meal on gut microbial status.

Statement of the Problem

Moringa oleifera tree is the preferred source of adequate animal diets. But researchers have proofed that there seem to be low or limited knowledge that exist about the nutritional value of *Moringa oleifera* among poultry farmers. Therefore, this material will serve as a resourceful product for commercial production and as well turn into a mega start in the production of poultry meat beneficial.

Research Objectives

The following objectives were formulated to ascertain the:

1. Effect of graded levels of *Moringa oleifera* leaf meal on haematological and serum biochemical indices of broiler chickens.

2. Effect of graded levels of *Moringa oleifera* leaf meal on cut microbial status.

Literature Review

Efficiency of feed utilization

Associated with egg production and size is the efficiency of conversion of feeds to eggs expressed in kilogram of feed per dozen eggs or a ratio of the kilogram of feed to kilogram of eggs (Oluyemi and Roberts, 2000). Efficient utilization of feed is the key factor affecting

profitability of production, and has a significant positive relationship with the hen-day production (Kenton, 2005). The standards of this measurement according to Oluyemi and Roberts, (2000) are respectively 1.8kg of feed per dozen eggs. Ukachukwu and Akpan (2007), Fafiolu (2006) and Yesmeen (2008) observed a feed conversion ratio of 2.83, 2.33 and 2.07 respectively.

Economics of production of broilers finisher birds fed MOLM:

The cost of production of broiler birds on graded levels of MOLM is showed in Table 1. Significant ($P < 0.05$) effects was observed in the total feed cost per kilogram gain and price per kilogram gain between dietary treatment groups, while the feed cost per kilogram and price per kilogram live weight were not significantly affected. The total feed cost per Kg recorded an increase in values across the dietary treatments with increasing levels of MOLM. This implies that the cost of transportation and milling of MOLM contributed to the total cost of feed, which translated into incremental values as the levels of MOLM increased across the dietary treatments. The values were in the range (₦590.23 – ₦ 774.66 ₦ /kg), which were higher than the range (294 – 410 ₦/Kg) reported by Abeke *et al*. (2013) who fed broiler chickens with graded levels of locust bean (*Parkia biglobosa*) pulp meal. The range of values for total feed cost per Kg gain in this study is also higher than the values (144.49-187. 91 ₦/Kg) reported by Etuk *et al.* (2013) who fed different combinations of yam peel, palm kernel cake and plantain peel meal as partial replacement for maize to broiler birds. The disparity in total feed cost could be attributed to different feed ingredients used as test materials, age of the birds at slaughter and prevailing market prices of feed ingredients in the separate studies. The price per kilogram weight gain also recorded an increase in values up to T_4 as the graded levels of MOLM increased across the diets. The highest value was recorded in birds fed 7.50 percent MOLM (T_4) compared with the value in the control diet (T_1), suggesting that processing cost of the leaf meal impacted negatively on the price per kilogram weight gain of the birds.

Table 1: Economics of production for broiler birds fed graded levels of MOLM

	Dietary Levels of MOLM					
Parameters	**T_1 0.00%**	**T_2 2.50%**	**T_3 5.00%**	**T_4 7.50%**	**T_5 10.00%**	**SEM**
Feed cost / Kg (₦/kg)	5.87	6.01	6.13	7.02	7.12	0.26
Feed consumed (g)	100.55	107.93	108.53	104.40	108.80	1.58
Total Feed cost/kg gain (₦/kg)	590.23^{b}	648.66^{b}	665.29^{b}	732.89^{b}	774.66^{a}	32.33
Cost per Wt. Gain (₦/kg)	6.99	7.81	8.89	9.48	9.54	0.50
Price per Kg L W	275.81^{b}	307.42^{b}	339.43^{ab}	387.71^{a}	358.64^{a}	19.48

Feed Cost/kg = Summation of proportion of each ingredient in the diet x cost per kg of the ingredient ÷ 100 (Ndelekwute *et al.,* 2010)

Total feed cost/bird = Total feed consumed x Feed Cost/kg feed (Uzegbu *et al.,* 2010, Ndelekwute *et al.,* 2014)

Cost/kg weight gain = Cost/kg feed x FCR (Ukachukwu and Anugwa, 1995)

Price/kg live weight = Cost of bird ÷ live weight of bird (Uzegbu, *et al.*,2011)

Feed Conversion Ratio/Feed Efficiency

Feed efficiency in broilers refers to the amount of feed needed to produce one kilogram of live weight. Mortality rate, feed conversion ratios and weight gain are pointers of good potentials of birds (Tom, 2008). Feed conversion ratio according to Oluyemi and Roberts (2000) is affected by a number of factors which include: genetic background of the strain/breed being fed, quality of feed used, temperature, the amount of feed wasted, additives used in the feed and general management operations, while Tom (2008) listed dietary energy level, sex of the birds, birds age and health condition as those factors affecting feed efficiency. Feed efficiency shows the ability of animals in converting feed efficiently into useful products and it determines the growth performance of birds (Oluyemi and Roberts, 2000). Current feed conversion ratio in broilers is 2.1 of feed per kg weight gain. Williamson and Payne (1978), Oluyemi and Roberts (1982) and Kekeocha (1984) reported that cumulative feed intake of a bird at 7weeks of age was 4kg with feed conversion ratio of 2.1. Feed efficiency and feed conversion ratio increase with age thus, in contrast to the views of Hulan and Proudfort (1982). Hulan et al. (1982) noted that older and heavier birds normally demand more feed for body maintenance. Williamson and Payne (1980) pointed out that male broiler birds at 6weeks have a higher feed efficiency than female birds. Obioha (1992) reported a body weight of 1800g and feed to gain ratio of 3.0 for broilers at 10weeks of age. Broiler birds consume between 3000 – 4000g of feed at 8 – 10weeks of age respectively with a corresponding average feed conversion ratio of 2 - 2.5 for the same period respectively (Sainbury, 1980; Olomu and Offiong, 1980). Hill (1982) indicated that the gross efficiency of growth (gain per unit feed intake) decline progressively as broilers grow larger.

Growth rate is measured as the increase in body weight with time and is dependent on the amount of nutrient supply, it also involved with the physiological and metabolic responses depending on its specific tissues (Holness and Chabeuf, 1991). Fahey et al. (1977) pointed out that the quantities of muscles, carcass composition and lean tissues content estimate the rate and efficiency of lean tissues growth in animal during the rearing to finishing phase. It is believed that as an animal grows the carcass increases in proportion with its live weights. Growth does not progress at an equal rate throughout all tissues and parts of the body, Olomu (1979) noted that the growth curves for broiler production show an increase in rate of growth with age. Feed conversion ratio of 1.98 and 2.58 were reported by Emenalom (2004) and Tuleum and Patrick (2007) respectively for broiler chicks at starter diet. Feed conversion ratios of 3.23, 2.93 and 3.43 were reported by Emenalom and Udedibie (2005), Tuleum and Patrick (2007) and Fanimo et al. (2007) for finisher diets respectively. Generally, Oluyemi and Roberts (2000) gave 2 – 2.5 as a standard feed conversion for broiler birds.

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 1000ft with little cumulonimbus 2200ft. 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/Discussion

Haematological indices of the experimental birds:

The result of the haematological indices is showed in Table 2. The haematological indices of broiler birds fed MOLM showed no significant (P>0.05) differences across the treatment groups except the platelets, though without a definite trend that could not be ascribed to diets. The values of haematological indices were haemoglobin concerntration (10.05 – 11.25 g/dl), red blood cell counts (3.15 – 3.27×10^{12}/L), packed cell volume (31.50 - 36.20 percent) and white blood cell counts (1.82 -2.27×10^{9}/L). Platelet counts was significantly ($P < 0.05$) influenced across the dietary diets with increasing levels of MOLM. This finding agrees with the suggestion of Ologhobo *et al*. (2003) who reported based on an earlier study that blood platelets dropped significantly at 10 percent dietary supplementation level of MOLM.

The heamatological indices values were within the ranges considered normal for broiler finisher birds (Mitruka and Rawnsley, 1996). The normal ranges for some haematological indices include: Haematological (7.00 -18.60g/dl), red blood cell counts (3.15 – 3.27 x 10^{12}/L), packed cell volume (31.50 – 36.20 percent) and white blood cell counts (1.82 – 2.27 x 10^{9}/L). platelet counts was significantly ($P < 0.05$) influenced across the dietary diets with increasing levels of MOLM. This finding agrees with the suggestion of Ologhobo *et al.* (2003) who reported based on an earlier study that blood platelets dropped significantly at 10 percent dietary supplementation level of MOLM.

In a study conducted by (Mitruka and Rawnsley, 1996), the haematological indices values were within the ranges considered normal for broiler finisher birds. The normal ranges for some haematological indices include: Haemoglobin (7.00 – 18.60g/dl), red blood cell counts (1.58 – 3.83 x 10^{12}/L) and mean corpuscular haemoglobin concentration (33 – 35g/dl). The results of red blood cell count and packed cell volume reported were similar to the range of values of the corresponding blood indices such as RBC (3.06 – 3.43 x 10^{12}/L) and PCV (35.13 – 37.93 percent) documented by Zanu (2012) who fed MOLM to finisher birds in an earlier study. The similarity in these haematological indices is attributable to the same test material (MOLM) used in the different studies. However, the values reported in this study for other indices (WBC, MCH, MCV and MCHC) were lower than those observed by Zanu *et al.*, (2012). The reason for the disparity could be attributed to the effect of environmental factors peculiar to different ecological zones in the different studies.

TABLE 2: Effect of graded levels of *Moringa oleifera* leaf meal (MOLM) on haematological indices of broiler finisher birds

	Dietary levels of MOLM					
Parameters	**T_1 0%**	**T_2 2.50%**	**T_3 5.00%**	**T_4 7.50%**	**T_5 10.00%**	**SEM**
Haemoglobin (g/dl)	11.12	10.05	11.00	11.25	10.38	0.30
Red blood cells ($x10^{12}$/L)	3.27	3.60	3.20	3.23	3.15	0.08
PCV (%)	33.80	36.20	33.50	34.20	31.50	2.70
White blood cell ($x10^9$/L)	2.02	2.27	1.82	2.67	2.40	0.27
Platelets (mm^3)	290.00^{ab}	331.00^{a}	331.00^{a}	286.00^{ab}	213.00^{b}	49.00
MCH (g/dl)	33.25	33.50	34.00	33.50	32.00	1.50
MCV (fl)	32.92	32.20	31.98	33.23	31.50	1.73
MCHC (g/dl)	103.00	104.40	105.00	99.80	100.00	1.30

^{ab} Means within the same row with different superscripts are significantly different ($P < 0.05$)
SEM = Standard Error of Mean
PCV - Packed Cell Volume
MCH - Mean Corpuscular Haemoglobin
MCV - Mean Corpuscular Volume
MCHC- Mean Corpuscular Haemoglobin Concentration

Serum biochemical components of experimental broiler finisher birds:

The values for serum biochemical indices of broiler finisher birds fed MOLM are presented in Table 3. Total protein content showed no significant ($P > 0.05$) influences across dietary groups. The total protein showed a decrease in content as the MOLM levels increased across the treatments. The values were 4.66, 4.55, 4.45, 4.38 and 4.35 g/dl for Diet 1,2,3,4 and 5 respectively. The albumin content recorded significant influenced among treatments groups. The values were in the range (2.65 -3.12 g/dl) which is higher than the range (1.75 – 180 g/dl) documented by Hassan, *et al*., (2016), who fed MOLM to finisher birds. This range of values of (1.32 – 1.54 g/dl) were lower than the range (2.16 – 2.65 g/dl) reported by Hassan *et al.*, (2016). The variation may be due to method of processing of the leaf meal and ecological factors in the different zones. The creatinine contents were significantly ($P < 0.05$) affected by treatment groups with values in the range of 1.15 – 1.5 mg/dl. The creatinine content in T_3 (5.00 percent) and T_4 (7.50 percent) of MOLM had the highest value among the diets with 1.55 and 1.49mg/dl, respectively compared to 1.15, 1.17 and 1.14 mg/dl for T_1, T_2 and T_5 respectively. The glucose content (1.57 – 1.14) was significant ($P < 0.05$) influenced by treatment diets with respect to glucose (1.57 – 1.73 g/dl). T_1, T_4 and T_5 were comparable but statistical different from T_2 and T_3, T_2 and T_3 were also similar, therefore not significantly different. However, the values for T_1 (1.69g/dl), T_2 (1.57g/dl), T_3 (1.61g/dl), T_4 (1.73g/dl) and T_5 (1.65g/dl) were all within the range (1.50 – 1.80 g/dl) considered normal for poultry birds (Mitruka and Rawnsley, 1997). The urea content was significantly influenced by diets. The range of values for urea was 32.88 – 41.80 g/dl. Cholesterol content (4.26 – 4.76 mg/dl) was not significantly ($P > 0.05$) affected by treatment groups.

TABLE 3: Effects of graded levels of *Moringa oleifera* leaf meal (MOLM) on the serum biochemical indices of layer birds

	Dietary Levels of MOLM					
Parameters	**T_1 0%**	**T_2 2.50%**	**T_3 5.00%**	**T_4 7.50%**	**T_5 10.00%**	**SEM**
Total protein (g/d1)	5.58^{a}	4.74^{b}	4.93^{b}	5.06^{ab}	5.11^{ab}	0.05
Albumin (g/d1)	3.68^{a}	3.13^{b}	3.25^{b}	3.34^{b}	3.50^{ab}	0.16
Globulin (g/d1)	1.88	1.62	1.68	1.81	1.81	0.13
Glucose (g/d1)	7.24^{ab}	7.54^{a}	6.86^{ab}	6.25^{ab}	5.76^{b}	o.57
Creatinine (mg/1)	0.30^{c}	0.50^{ab}	1.33^{a}	0.70^{b}	0.80^{b}	0.53
Cholesterol (mg/1)	4.64	4.76	4.26	4.26	4.51	0.69
Urea (g/d1)	32.05	31.10	30.52	31.22	29.75	0.50

^{a,b,c} Means within the same row with different superscripts are significantly different ($P < 0.05$)
SEM = Standard Error of Mean

Research Objective 4

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

The relative weight values of major cuts of broiler finisher birds are presented in Table 4.

TABLE 4: Carcass characteristics (relative weight of major cuts) of broilers fed graded levels of MOLM

Parameters (% Dressed weight)	**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

$^{a, ab}$ Means within the same row with different superscripts are significantly different ($P < 0.05$)
SEM = Standard Error of Mean

Breast weight: The relative weight of the breast was significantly ($P < 0.05$) affected across the dietary groups. The range recorded was 25.80 – 34.38 percent, which was lower than the ranges 15.01 – 16.25 and 15.01 – 16.45 percent documented by Agunbiade *et al.,* (2011) and Fafiolu *et al.* (2015) who fed hatchery waste meal in cassava products diets and palm kernel extraction residue/palm kernel sludge to broiler finisher birds, respectively. The higher values recorded in this study imply that MOLM has a positive effect in muscle tissue (meat) development in broiler birds.

Back weight: No significant ($P > 0.05$) effect was observed across treatment groups on the relative weight of the back cut from broiler finisher birds fed graded level MOLM. The result recorded a range (8.56 – 9.59 percent), which was lower than the range (12.71 – 13.47 percent) reported by Sogunle *et al.* (2014) who investigated the response of two strains of broiler chickens to feeding through shapes. These observed differences could be attributed to strain and dietary influences in the separate studies.

Thigh: The relative weight of the thigh was significantly ($P < 0.05$) influenced across treatment groups. The values obtained were in the range (13.08 – 15.13 percent) and higher than the values (8.14 – 9.61 percent) reported by Fafiolu *et al.* (2015) who fed palm kernel extraction residue/palm kernel sludge to broiler finisher birds. The higher values of the thigh may be rich nutrient composition of MOLM, which translated to good meat yield of the thigh muscle.

Drumstick: The relative weights of the drumstick showed significant ($P<0.05$) difference across the dietary groups. The values were in the range (10.39 – 14.98 percent) and were similar to the range 10.36 – 11.50 percent earlier reported by Agunbiade *et al.* (2011).

Neck, wings and shanks: The relative weight of the neck showed significant ($P < 0.05$) influence among dietary groups. The values were in the range (4.64 – 6.32 percent) across the treatments. Birds fed diet T_3 (5.00 percent) MOLM recorded the highest weight of the neck, whereas the least value was recorded in birds on T_5. The result obtained in this study is almost similar to the range 4.14 – 4.91 percent earlier documented by Agunbiade *et al.,* (2011). It was observed that the relative weight of the wing and shanks were not significantly ($P>0.05$) affected by dietary groups. The values for the wings and shanks were in the range 10.55 – 11.37 and 4.29 – 6.06 percent, respectively. The values for relative weight of wings and shanks were fairly higher than 7.20 – 7.96 and 3.58 – 4.37 percent respectively reported by Agunbiade *et al.* (2011) in their studies.

Internal organ weight and gastro – intestinal tract morphometry:

The effect of graded levels of *Moringa oleifera* leaf meal on the internal organ weights of broiler finisher birds is presented in Table 15. The weight of the heart, kidney, liver, spleen, lungs, pancreas and gall bladder were not significant ($P > 0.05$) affected between dietary groups. This result indicates that *Moringa oleifera* leaf meal showed no deleterious effect on the viscerals.

The gastro – intestinal tract morphometry (weight and length of oesophagus, brop, proventriculus, gizzard, duodenum, jejunum, ileum and caeca) followed a similar trend, except the weight of crop with content that was significantly ($P < 0.05$) influenced by dietary treatments, where T_2 was higher than the control (T_1) but similar to T_3, T_4 and T_5.

Heart: The weight values of the heart in this study were in the range (15.00 – 17.00g) without a particular trend across the dietary treatments. These values are higher than the range of values (3.60 – 4.20g) and (7.67 – 10.00g) earlier documented by Ayssiwede (2011) and Zanu (2012) respectively, who fed MOLM to broiler birds in their separate studies. The differences in result could be attributed to the age at slaughter of the birds.

Liver: The values for the liver were 39.20, 41.80, 39.10, 44.10 and 40.40g for diets T_1, T_2, T_3, T_4 and T_5 respectively. There was no deleterious effect of MOLM on the liver, suggesting the absence of toxic factors in the leaf meal that would have impacted negatively on organ weight. This funding is similar with the observation of Atuahene *et al.* (1986) who documented that extremely higher values of liver weight are due to the presence of toxic factors in the diets.

Spleen: The result of weight of spleen from broiler finisher birds fed graded levels of MOLM recorded 6.44, 5.71, 5.08, 5.84 and 5.07g for diets T_1, T_2, T_3, T_4 and T_5 respectively.

Gizzard: The values for gizzard with content were 51.60, 57.90, 55.90, 50.60 and 43.80g for T_1, T_2, T_3, T_4 and T_5 respectively. However, birds placed on T_2 had heavier gizzard compared to birds on other dietary treatments. This could be attributed to high muscular movement associated with high fibre diets, as observed by Obikaonu (2009) also T_2 birds were correspondingly heavier.

Abdominal fat: The result showed statistical ($P < 0.05$) difference between dietary diets, with no particular trend, but it was observed that the control group (T_1) has the highest value and lowest value for T_4. This implies that higher inclusion levels of MOLM reduces abdominal fat deposition in broiler finisher birds. However, there was no definite pattern of decrease in abdominal fat as the proportion of soybean reduced in the diet with increasing levels of MOLM. This is in agreement with the report of Abdelsamie *et al.*, (1983) that abdominal fat reduces with increase in fibre content of the diet as a result of the increasing levels of *Moringa oleifera.* Jensen *et al.*, (1974) explained that fibre had a lowering effect on liver lipid metabolism in chickens.

Conclusion

Based on the findings of this paper, it could be concluded that *Moringa oleifera* leaf meal had no significant effect on haematological and serum biochemical indices of broiler chickens although the indices were numerically increased with increase MOLM level. The high level may be attributed to the influence of Moringa on the haematological parameters.

Recommendations

1. Furthermore, this paper, recommends that *Moringa oleifera* leaf meal should be added up to 0.3% to foster broiler performance, physiological parameters and enhance the ability to resist heat stress conditions of broiler fed corn-soybean meal diet.

2. Consumption of *Moringa oleifera* leaf meal should be seen as a very reliable and useful health medicine for broilers and layers and so should be made available to birds always.

REFERENCES

Agunbiade, J. A., Adeyemi, O. A., Salau, K. O. & Taiwo, A. A. (2011). Utilization of hatchery waste meal in cassava products based broiler finisher diets. *Nigerian Journal of Animal Production*, 38: 74-81.

Ayssiwede, S. B., Dieng, H., Bello, C., Chrysostome, C. A. A. M., Hane, M. B., Mankor, A., Dhouda, M., Houinato, M. I., Hornick, J. L. & Missohou, A. (2011). Effects of Moringa oleifera (Lam.) leaves meal incorporation in diets on growth, performance, carcass characteristics and economic results of growing indigenous Senegal chickens. *Pakiskan journal of nutrition*, 10 (12): 1132 – 1145.

Donkor, A.M., R.L.K. Glover, D. Addae and K.A. Kubi, (2013). Estimating the nutritional value of the leaves of Moringa oleifera on poultry. *Food Nutr. Sci*., 4: 1077-1083.

Ebenebe, C.I., C.O. Umegechi, Aniebo and B.O. Nweze, (2012). Comparison of haematological parameters and weight changes of broiler chicks fed different levels of Moringa oleifera diet. *Int. J. Agric. Biosci*., 1: 23-25

Emenalom, O. O. (2004). Comparative Performance of broiler chicks fed diets containing differently processed (Mucuna pruriens) seed meal. *Nigerian Journal of Animal Production*, 31(1): 12-16.

Emenalom, O. O. & Udedibie, A. B. I. (2005). Evaluation of different heat processing methods on the nutritive value of Mucuna pruriens (Velvet bean) seed meals for broilers. *International journal of Poultry Science*, 4(8): 543-548.

Fafiolu, A. O., Jegede, A. v., Teniola, A. A., Olarotimi, I, O., Odukoya, S. O., Alabi, J. O. & Oduguwa, O. O. (2015). Performance, carcass characteristics and apparent nutrient digestibility of broiler chickens fed palm kernel extraction by-products. *Nigerian Journal of Animal Production*, 42 (1): 110-117.

Fafiolu, A. O., Oduguwa, O. O., Ikeobi, C. O. N. & Onwuka, C. F. I. (2006). Utilization of malted sorghum sprout in the diet of rearing pullets and laying hens. *Achivos de zootechnia, diciembre*, 55 (212): 316-371.

Fahey, T. J., Scarefer, D. M. & Episley, F. (1977). A comparison of practical methods of estimating pork carcass comparison. *Journal of Animal Science*, 44 – 48.

Fatimo, A. O., Adebajo, A. J., Oduguwa, O. O. & Biobaku, W. O. (2007). Feedings value of cashew nut for broiler chicken. *Nigerian Journal of Animal production*, 34(1): 83-93.

Hassan, H. M. A., EL – Moniary, M. M., Y, Emman, F., EL – daly, Amani, W., & Youssef, N. A. (2016). Effect of different levels of *Moringa oleifera* leaf meal on productive performance, carcass characteristics and some parameters of some broiler chicks reared under heat stress. *Asian Journal of Animal and Veterinary Advances*, 11:60 – 66.

Hill, D. C. (1982). *Physiological and biochemical response of rat given potassium cyanide or linamarin*. In: Barry Nestel and Micheal Graham (eds) cassava as animal feed. Proceedings of a workshop held at the university of Guelph, 18 – 20.

Holness, H. W. & Chabeuf, N. (1991). *A Textbook on the Tropical Agriculture on pig* (1st ed). Macmillian, London.

Hulan, H. W., Proudfoot, F. G. & Ramey, D. (1982). The performance of male broiler genotypes reared to roaster weight and females reread on protein dietary regimes. *Poultry science*, 61:434-437.

Hulan, H. W., & Proudfoot, F. G. (1982). The effect of dietary energy regimes on the performance of two commercial chicken broiler genotypes reread to roasted weight. *Poultry Science,* 61: 510-515.

Jensen, L. S., Falen, L. & Chang, C. H. (1974). Effects of distillers grains with soluble on reproduction and liver fat accumulation on laying hens. *Poultry Science.* 53:586 – 592.

Kekeocha, C. C. (1948). *Poultry production Handbook* (Revised Edition). London: Macmillan publishing.

Kenton, K. (2005). Optimizing egg size in hot weather. *My-line International,* 1:1-4.

Mitruka, B. M. & Rawnsley, H. M. (1996). *Clinical biochemical and heamatological reference values in normal and experimental animals*. Masson Publishing, Incorporated, USA., 134 – 135.

Ndelekwute, E. K., Okonkwo, A. C., Umoh, B. I. & Nwokoro, C. (2014). Growth performance and economic returns of broiler chickens fed with acetic acid treated diets at finisher phase. *Nigerian Journal of Agricultural. Food and Environment* 10(1):8-12.

Obikaonu, H. O. (2009). *Production Performance of broilers and anti-coccidial effects in deep litter managed chickens fed neem leaf (Azadirachta indica*) *leaf meal.* Ph.D. Thesis, Federal University of Technology, Owerri-Nigeria. P. 50.

Obioha, F. C. (1992). *A Guide to Poultry Production in the Tropics.* Enugu: Acena Publishers.

Ologhobo, A. D., Apata, D. P., Oyetide, A. & Akinpelu, R. O. (1993). A comparison of protein fraction prepared from lima bean fractions for growing chicks. *British Poultry Science,* 34:505 – 522.

Olomu, J. M. (1979). *Production Standards for Poultry in Nigeria.* Zaria: NAPRI.

Olomu, J. M. & Offiong, S. A. (1980). The effects of different protein and energy levels and time of change from starter to finisher ration on the performance of broiler chicken in the tropics. *Poultry Science Journal,* 59:828 – 835.

Oluyemi, J. A. & Roberts, F. A. (2000). *Poultry Production in the Warm Wet Climate.* Ibadan, Nigeria spectrum Book Ltd Spectrum House, pp. 147-165.

Sainsburry, D. (1984). *Poultry Health and Management* (2nd ed.). London: BSP professional Books.

Siddhuraju, P. & Becker, K. (2003). Antioxidant properties of various solvent extracts of total pholonic constituents from three different agro-climatic origins of drumstic tree (*Moringa oleifera* Lam) leaves. *Journal of Agriculture and Food Chemistry*, 51(1): 2144-2155.

Sogunle, O. M., Odekunle, E. T., Adeyemi, O. A., Olaniyi, O. A., Ekunseitan, D. A. & Jege, C. A. V. (2014). Response of two strains of broiler chickens to feeding trough shapes. *Nigerian Journal of Animal Production,* 41: 106 – 115.

Tom, G. T. (2008). Early feed intake and bird performance. *Arian advice,* 5(1):1-8

Tuleun, C. D. & Patrick, J. P. (2007). Effect of duration of cooking *Muccuna utilis* seed on the proximate analysis, level of anti-nutritional factors and performance of broiler chickens. *Nigerian Journal of Animal Production,* 34(1):45-53.

Ukachukwu, S. N. & Akpan, U. O. (2007). Influence of level and duration of quantitative feed restriction on pos-restriction egg laying characteristics and egg quality of pullets. *International Journal of Poultry Science* 6(8): 567-573.

Ukachukwu, S. N. & Anugwa, F. O. I. (1995). Bioeconomics of feeding raw or heat treated soybeans to broilers. *Nigerian Journal of Animal Production* 22(2):137-140.

Williamson, G. & Payne, W. J. A. (1978). *An Introduction to Animal Husbandary in the Tropics, (3rd ed.)* Longman, London.

Yasmeen, F., Mahmood, S., Hassan, M., Akhtar, N. & Yaseen, M. (2008). Comparative reproductive performance and egg characteristics of pullets and spent layers. *Pakistan Veterinary Journal,* 28(1): 5-8.

Zanu, H. K., Asiedu, P., Tampuori, M., Abada, M. & Asante, I. (2012). Possibilities of using *Moriniga oleifera* leaf meal as a partial substitute fish meal in broiler chicken diets. *Online Journal of Animal Feed Resources,* 2:70-75.