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EFFECT OF FEEDING MORINGA OLEIFERA LEAF MEAL WITH OR WITHOUT ENZYME ON THE PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKS

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Abstract

A study was carried out to investigate the effect of *Moringa oleifera* leaf meal (MOLM) as a plant protein source with and without enzyme (Avemix – xg 10) on the growth performance and carcass characteristics of broiler chicks. A total of 320 one day-old broiler chicks (Cobb500) were randomly assigned to four dietary treatments containing MOLM at 0, 2.5, 5, and 7.5% (treatments 1, 2, 3 and 4) inclusion levels respectively, in a complete randomized design experiment. The basal diet were formulated as control according to strain guide recommendations and used for the starter, grower and finisher. The effect of dietary treatments on the performance and carcass characteristics of the broilers was determined. The obtained results revealed that supplementation of diets containing different levels of moringa with commercial enzyme improved the performance of broiler chicks and positively affected percentages of carcass yield, total edible parts, breast yield and deboned breast meat, while those of heart and abdominal fat were decreased but relative weights of giblets, liver and gizzard were not affected compared with their control counterparts. Treatment effect on average final body weight, average daily gain, average daily feed intake and feed conversion ratio were significant ($P<0.05$). Birds fed on MOLM gained significantly ($P<0.05$) higher weight and superior feed conversion ratio than birds fed the control diet. However, birds fed on (5% MOLM) diet showed heaviest body weight, highest total feed intake with the best feed conversion ratio. However, the inclusion of moringa leaf to broiler chick's diet at different levels recorded significantly ($P.> 0.05$) low performance compared to those fed on diet containing moringa meal supplemented with enzyme.

Key words : Broilers, *Moringa olifera* leaf, Avemix–xg 10 enzyme, Performance, Carcass quality.

Introduction

Researchers have great interest in finding natural growth promoters to enhance poultry production and to reduce feed cost. Plant products have been used for centuries by humans as food and to treat ailments. Natural medicinal products originating from herbs and spices have also been used as feed additives for farm animals (Guo, 2003).

The rising cost of the protein rich feeds has encouraged search for protein sources to formulate adequate-least-cost diets for broiler which can satisfy the bird's requirements for maintenance and production. The incorporation of protein from leaf sources in diets for broilers is fast gaining grounds because of its availability, abundance and relatively reduced cost (Onyimonyi and Onu, 2009).

Moringa oleifera leaf contains 86% DM, 29.7% CP, 4.38% CF, 29.9% EE, 3,056 kcal/kg energy, Calcium 0.26%, phosphorus and negligible amount of tannin (1.23g/kg) Kakengi *et al.,* (2003).

(Olugbemi *et al.,* 2010) observed that Moringa plant has been reported to have many medicinal uses such as possession of hypocholesterolemic properties.

Impaction of carotenoid compound into the poultry muscle and could as such substitute conventional feedstuffs as it possesses useful characteristic (Sarwalt *et al.,* 2002) among others.

Carbohydrates such as xylanase and amylase have

been primarily used with high viscosity feeds such as wheat and barley (Cowieson *et al.*, 2006). Corn is not considered a viscous grain, and therefore has not had the attention with enzymes that wheat, barley, and rye have had. However, in recent years, corn has been given a considerable amount of attention as various studies, have shown benefits from exogenous enzymes (Cowieson and Ravindran, 2008a, b).

The previous thinking was that corn would not benefit as readily from exogenous enzymes as corn contains less NSP compared to wheat or rye. The mode of action proposed for exogenous enzymes on corn is that the carbohydrases added to the diet assist in additional starch digestibility. Research suggests that the improved starch digestibility is associated with the augmentation of endogenous α-amylase and improved digestion of resistant starches, improved access to cell resistant starches, improved access to cell contents via a reduction in cell wall integrity (Cowieson and Ravindran, 2008a,b). Several studies have reported that the use of *Moringa oleifera* leaf meal as feed supplements in livestock, the optimal concentration of *Moringa oleifera* leaf meal as a nutritional supplement has not yet been determined and there are only limited reports on the bioactive constituents of *Moringa oleifera* leaf meal and their impact on meat antioxidant status Hassan *et al.*, (2016).

The objective of the current experiment was to test different levels of *Moringa oleifera* leaf meal (MOLM) with or without enzyme supplementation in broiler diets on performance, nutrients digestibility, carcass characteristics, Blood parameters, sensory evaluation and economical efficiency.

Materials and Methods

The experimental work of the present study was conducted at the Poultry farm in Nahda Alexandria, Agricultural Research Center, for a period of five weeks between April and May, 2017. The analytical part was performed in the laboratories of the Regional Center for Food and Feed, Agricultural Research Center, Ministry of Agriculture, Giza, Egypt.

Experimental design

One day-old chicks were divided into 8 experimental groups each with 4 equal replications and kept in brooding batteries, and fed the starter, grower and finisher diets described in Table 1. The diets were composed to meet the nutritious requirements of broiler chicks throughout starting, growing and finishing periods according to the strain guide**.** Chicks were fed a starter diet from 1 to 12 days of age, consisted of 23% crude protein and 3000 kcal metabolizable energy (ME)/kg diet. From 12 to 24 days of age, the birds were switched to a grower diet containing 21.76% crude protein and 3100 kcal ME/kg ration. However, during 24 to 36 days of age, they were fed a finisher diet consisted of 20.86% crude protein and 3200 kcal ME/kg diet (Tables 1, 2 and 3).

The first experimental group of chicks was fed the control diets and the second experimental group of chicks was fed the control rations which contained only enzyme while the other six groups were fed the diets in which the added MOLA with or without enzyme. The diets contained MOLA levels of 2.5, 5 and 7.5% in starter, grower and finisher periods, respectively. Composition and calculated chemical analysis of the basal diets during the three phases of growth are presented in Table 2, 3 and 4.

Table 1: Replacement ratios of *Moringa oleifera* Leaf Meals (MOLM) with and without enzyme in the experimental diets.

Treatments	MOLM%	Enzyme
T_1	0	0
T_2	0	+
T_3	2.5	0
T_4	2.5	+
T_5	5	0
T_6	5	+
T_7	7.5	0
T_8	7.5	+

Experimental diets and water were offered *ad-libitum* all over the experimental period. Chicks in all treatments were kept under similar management system. Normal lighting was provided all over day during the whole experimental period. Electric heaters were used to provide chicks with heat needed for brooding, in addition to a digital thermometer to measure the heat degree. After finishing of each feeding period, the body weight has been measured (at 12, 24, and 36 days) besides, feed intake and mortality rate were recorded throughout the experimental period. All chicks were vaccinated against different **diseases** according to the vaccination programs adopted in most Egyptian broiler farms.

Growth performance of chicks

All broilers chicks were weighed individually to the nearest gram. Live body weights and gains (g) of broiler chicks were registered at three intervals (1-12, 13-24 and 25-36 days of age) and overall experimental period (1-36 days of age). Feed conversion ratio (FCR) was calculated, including the weight gain of the dead birds

According to the equation of Persia *et al*., (2003) Protein efficiency ratio (PER) was calculated during each studied growth periods as follows: Protein efficiency ratio:

Table 2: Composition and calculated chemical analysis of basal diets during the Starter periods.

Ingredients	Control	MOLM		
		2.5	5	7.5
Yellow corn	54.400	52.00	48.800	45.900
Soybean meal	31.00	29.850	28.403	27.800
Corn gluten meal	8.00	8.400	9.200	9.220
Sunflower oil	2.483	3.153	4.500	5.483
Dicalcium phosphate	1.870	1.850	1.850	1.850
Limestone	0.750	0.750	0.750	0.750
Vit. & Min. Mixture (1)	0.400	0.400	0.400	0.400
NaCl	0.400	0.400	0.400	0.400
L-Lysine-HCl	0.410	0.410	0.410	0.410
DL-Methionine	0.205	0.205	0.205	0.205
Choline chloride	0.082	0.082	0.082	0.082
Moringa oleifera leaf meal	.....	2.5	5	7.5
Total	100.000	100.000	100.000	100.000
Calculated values (2)				
ME (kcal/kg)	3025.21	3003.4	3022.93	3009.43
CP	23.13	23.08	23.8	24
EE	3.91	3.91	3.91	3.91
CF	3.73	3.73	3.84	3.92
Calcium	0.980	0.980	0.990	1.002
Available P	0.480	0.480	0.480	0.480
Lysine	1.360	1.360	1.360	1.360
Methionine	0.580	0.580	0.580	0.580
Methionine + Cystine	0.970	0.970	0.970	0.970

(1)Vitamins - minerals mixture provided per kg of diet: vitamin (A), 12000 I.U.; vitamin (D_3), 2010 I.U; vitamin (E), 12 mg; vitamin (K_3), 2.5 mg; vitamin (B_2), 5 mg; vitamin (B_6), 1.7 mg; vitamin (B_1), 1.2 mg; vitamin (B_{12}), 11 µg; Biotine, 51 µg; B complex, 10mg; Niacine, 30 mg ; Manganèse, 60 mg; Zinc, 50 mg; Iron., 30 mg; ; Folié Acid, 1 mg; Copper, 10.2 mg; Idoine, 1.1 mg; Sélénium, 0.11 mg and Cobalt, 0.1 mg.(2)According to NRC, 1994.

Crude protein consumed (g) / Body weight gain (g)

Performance index (PI) was calculated according to the equation of North. (1984) by using the following equation:

PI = Live body weight (Kg) / feed conversion ratio x100.

Efficiency of energy utilization (EEU) was calculated according to the equation of

Ali. (1999) as follows:

EEU = ME consumed kcal / g body weight gain.

Mortality rate (MR%) was recorded daily and calculated at the end of each age interval for each replicate throughout the experimental period. It was also calculated as a cumulative mortality.

Carcass characteristics

At the end of the experiment (36 d of age), two chicks from each replicate were taken randomly and starved for 12 hr., then individually weighed and immediately slay and handheld until complete bleeding to evaluate carcass characteristics. They were defeatherd and weighed to get the weight of feathers. The individual weights of carcass with neck, giblets (Liver, empty gizzard and heart) and abdominal fat were estimated and expressed as percent of the live body weight.

The head and shanks were then removed and the carcasses were eviscerated and reweighed to determine the carcass weight.

The dressing percentage was calculated by using the following equation:

Dressing percentage = (Carcass weight in grams / live body weight in gram) x 100.

Statistical analyses

Data from all response variables were submitted to one-way analysis of differences using General Linear Mod.(GLM) of SAS/STAT software (SAS Institute, 2004). Significant variance among treatment means of different variables were separated using Duncan's multiple range procedure (Duncan, 1955) at 5% probability.

Results and Discussion

Growth performance

The effect of feeding diets added moringa leaf meal without or with enzyme on live body weight, weight gain, feed intake and feed conversion during the studied growth periods of broilers are presented in (Table 5). The results indicated that feeding the diets containing moringa leaf meal without enzyme positively affected 36-days-old live body weight (LBW) of broiler chicks compared with their control group. The highest LBW was achieved by chicks fed 2.5% MOLM with enzyme and control with enzyme when compared with other dietary treatments followed by those fed the diet containing control without enzyme and then those fed the diet containing 5% MOLM with enzyme in a descending order, respectively.

The same trend of response was observed in body weight gain (BWG) of chicks fed on the diets in which added MOLM with and without enzyme during the whole experimental period compared with their control counterparts.

Table 3: Composition and calculated chemical analysis of basal diets during the Grower periods.

Ingredients	Control	MOLM		
		2.5	5	7.5
Yellow corn	57.00	54. 00	51.600	48.100
Soybean meal	28.300	27.770	25.800	25.900
Corn gluten meal	7.500	8. 00	8.900	8.900
Sunflower oil	3.300	4.200	5.170	6.150
Dicalcium phosphate	1.850	1.600	1.600	1.550
Limestone	0.600	0.480	0.480	0.450
Vit. & Min. Mixture (1)	0.400	0.400	0.400	0.400
NaCl	0.400	0.400	0.400	0.400
L-Lysine-HCl	0.320	0.320	0.320	0.320
DL-Methionine	0.248	0.248	0.248	0.248
Choline chloride	0.082	0.082	0.082	0.082
Moringa oleifera leaf meal	.....	2.5	5	7.5
Total	100.000	100.000	100.000	100.000
Calculated values (2)				
ME (kcal/kg)	3105.54	3100	3106.53	3086.90
CP	21.76	22.00	21.89	22.06
EE	4.42	4.42	4.42	4.42
CF	3.75	3.75	3.85	3.90
Calcium	0.860	0.860	0.890	0.910
Available P	0.450	0.450	0.450	0.450
Lysine	1.230	1.230	1.230	1.230
Methionine	0.540	0.540	0.540	0.540
Methionine + Cystine	0.920	0.910	0.930	0.920

(1)Vitamins - minerals mixture provided per kg of diet: vitamin (A), 12000 I.U.; vitamin (D_3), 2010 I.U; vitamin (E), 12 mg; vitamin (K_3), 2.5 mg; vitamin (B_2), 5 mg; vitamin (B_6), 1.7 mg; vitamin (B_1), 1.2 mg; vitamin (B_{12}), 11 µg; Biotine, 51 µg; B complex, 10mg; Niacine, 30 mg ; Manganèse, 60 mg; Zinc, 50 mg; Iron., 30 mg; ; Folié Acid, 1 mg; Copper, 10.2 mg; Idoine, 1.1 mg; Sélénium, 0.11 mg and Cobalt, 0.1 mg.(2)According to NRC, 1994.

As indicated in table 5, the effects of dietary treatments on feed intake (FI) of broilers during the starter, grower and finisher phases of growth were inconclusive. While results of overall period (1-36 days) showed that the highest FI values were recorded for chicks fed 2.5% MOLM and the lower FI values were recorded for chicks fed 7.5% MOLM. Such slight differences among the different experimental groups of broiler chicks in FI, observed herein, seemed erratic and perhaps are not related to the effect of dietary treatments. However, dietary fed MOLM with enzyme led to superior means of feed conversion ratio of broilers during the three phases of growth and the whole experimental period to those attained by the control group.

The effect of feeding different levels of *Moringa oleifera* leaf meal (MOLM) is shown in (Table 4). The inclusion of MOLM in diet of broilers significantly (P<0.05) enhanced the weight gain as compared to control group. The improved weight gain of birds fed on MOLM based diets could be attributed to higher protein content of the diets which were efficiently metabolized for growth. This result was in line with the finding of Kakengi *et al.*, (2003); Olugbemi *et al*., (2010) and Banjo (2012) who mentioned that the inclusion of *Moringa oleifera* leaf meal in the diet of the broilers significantly (P<0.05) enhanced their weight gain at 1% level which was significantly higher than the control. The birds fed on the diet that contained 5% MOLM obtained significantly (P<0.05) higher weight gain as compared to those fed on the diet that contained 7% MOLM. This result may be attributed to higher crude fibre content which may impair nutrient digestion and absorption (Aderemi, 2003; Onu and Otuma, 2008; Onu and Aniebo, 2011). The lower weight gain of birds fed on 7% MOLM diet despite its higher crude protein content might also be due to the negative effect of the anti-nutritional factors present in MOLM on the birds. Moringa oleifera contain 1-23g of tannin in every 1 kilogram of leavers (Kakengi *et al.*, 2003). Tannin has been reported to interfere with the biological utilization of protein and to a less extent available carbohydrate and lipids (Esonu *et al.*, 2001). The depressed weight gain of birds fed on control diet may be due to the lower crude protein content of the diets which have been inadequate to enhance growth of the birds.

There were significant (P<0.05) difference in the feed intake of the birds among the treatments. The feed intake increased significantly (P<0.05) with the increasing level of MOLM. However, there was a marked reduction in the feed consumption of birds fed on 7% MOLM diet. This reduction could be due to reduced palatability of the diet (Kakengi *et al.*, 2003).

There was a significant (P<0.05) improvement in the feed conversion ratio of the birds fed on MOLM based diets as compared to control group. This may be attributed to that, birds fed MOLM based diets adequately utilized the nutrients they consumed. The results coincided with the finding of) Ebenebe *et al.*, 2012) who reported that, chicks fed on Moringa based diets performed significantly (P<0.05) better than the birds of control group in term of higher weight gain and better feed conversion ratio. This improvement in body weight gain and feed conversion ratio may be attributed to rich content of nutrients in MOLM (Sarwatt *et al.*, 2004; Kakengi *et al.*, 2003) and

Table 4: Composition and calculated chemical analysis of basal diets during the Finisher periods.

Ingredients	Control	MOLM		
		2.5	5	7.5
Yellow corn	58.500	53.618	51.600	49.300
Soybean meal	25.500	27.500	25.00	23.800
Corn gluten meal	8.00	6.700	8.100	8.370
Sunflower oil	4.600	6.00	6.618	7.418
Dicalcium phosphate	1.818	1.600	1.600	1.600
Limestone	0.700	0.700	0.700	0.360
Vit. & Min. Mixture (1)	0.400	0.400	0.400	0.400
NaCl	0.400	0.400	0.400	0.400
L-Lysine-HCl	0.320	0.320	0.320	0.320
DL-Methionine	0.180	0.180	0.180	0.180
Choline chloride	0.82	0.82	0.82	0.82
Moringa oleifera leaf meal	—	2.5	5	7.5
Total	100.000	100.000	100.000	100.000
Calculated values(2)				
ME (kcal/kg)	3209.89	3189.79	3184.65	3171.73
CP	20.86	21.03	21.01	20.87
EE	5.11	5.11	5.11	5.11
CF	3.56	3.56	3.56	3.56
Calcium	0.770	0.770	0.770	0.770
Available P	0.410	0.410	0.410	0.410
Lysine	1.130	1.130	1.130	1.130
Methionine	0.470	0.470	0.470	0.470
Methionine + Cystine	0.840	0.840	0.840	0.840

(1)Vitamins - minerals mixture provided per kg of diet: vitamin (A), 12000 I.U.; vitamin (D_3), 2010 I.U; vitamin (E), 12 mg; vitamin (K_3), 2.5 mg; vitamin (B_2), 5 mg; vitamin (B_6), 1.7 mg; vitamin (B_1), 1.2 mg; vitamin (B_{12}), 11 µg; Biotine, 51 µg; B complex, 10mg; Niacine, 30 mg ; Manganèse, 60 mg; Zinc, 50 mg; Iron., 30 mg; ; Folié Acid, 1 mg; Copper, 10.2 mg; Idoine, 1.1 mg; Sélénium, 0.11 mg and Cobalt, 0.1 mg.(2)According to NRC, 1994.

antimicrobial properties of Moringa (Fahey *et al.*, 2001).

Mortality%

The mortality rates as of broiler chicks affected by dietary treatments are presented in Table 4. It could be noticed that all birds appeared health and total mortality rates were within the normal range among treatments and ranged between 1.76-2.55% (birds), indicating that mortality rates were not related to the effect of dietary treatments. The obtained means of mortality rates are lower than those previously reported by (Tollba *et al.;* 2004), who found that mortality rate was 5% when they reared broiler chicks in normal conditions (24ºC).

In respect of dietary treatments, the results showed that birds fed the control ration recorded, the highest mortality rate. Among all dietary treatments studied, inclusion of 5% and 7.5% MOLM instead of added dietary methionine had lower mortality rates when compared to those of other treatments. It is of interest to note that use the enzyme produced intermediate mortality rates.

Carcass characteristics

Table 5 shows the effect of feeding diets in which added MOLM without and with enzyme on carcass characteristics for the chicks slaughtered at 36 days of age. The results obtained indicated that feeding the diets containing MOLM with enzyme positively affected carcass yield of 36-days-old broiler chicks compared with their control group. The highest carcass yield was achieved by chicks fed MOLM 5% with enzyme and control with enzyme when compared with other dietary treatments, followed by those fed the diet containing MOLM without enzyme in a descending order, respectively.

The corresponding values for percentages of total edible parts ranged between (carcass yield + giblets weight) percentages 75.18 and 76.98%, where the highest values of chicks were fed on MOLM 5% while the lowest values were achieved by that chicks were fed MOLM 7.5% with enzyme and the differences were significant ($P<0.05$) compared with the control group.

On the other hand, the results showed that treatment fed MOLM 2.5% and 5% with enzyme led to a significant increase in relative weights of abdominal fat, breast yield and thigh yield ($p<0.05$) than other treatments and the control.

As shown in table 5, the hot and cold eviscerated carcass weights were significantly ($P<0.05$) increased for birds fed on MOLM based diets as compared to control group. On the other hand, birds fed on MOLM based diets produced significantly ($P<0.05$) higher breast and drumstick percentages as compared to control group. These results are consistent with the increasing the growth rate which resulted in heavier slaughter weight. Similar results have been obtained by Preston and William (1973) who indicated that heavier birds at slaughter would have greater dressing percentage and higher eviscerated yield than lighter birds. The results are in agreement with those reported by) Ologhobo *et al.*, 2014) who mentioned that, higher mean values of slaughter weights were recorded for birds fed diets containing *Moringa oleifera* leaf meat as compared to those fed on the control diet which had the lowest mean value. Dressed weight had a similar

Table 5: Effect of feeding different levels of moringa leaf meal on growth performance and mortality rate (%) of broilers chicks during the experimental periods.

Items	Without enzyme				With enzyme			
	Level of Moringa (%)							
	Control	2.5	5	7.5	Control	2.5	5	7.5
Initial weight (g)	42	42	42	42	42	42	42	42
LBW (g) at:								
12 days old	231^{a}	242^{a}	238^{a}	223^{a}	235^{a}	246^{a}	249^{a}	223^{a}
24 days old	949^{ab}	881^{cd}	913^{bc}	855^{d}	968^{ab}	979^{a}	961^{ab}	881^{cd}
36 days old	1834^{ab}	1800^{ab}	1780^{bcd}	1685^{d}	1835^{ab}	1899^{a}	1814^{abc}	1715^{cd}
BWG (g) at:								
12 days old	189^{a}	200^{a}	196^{a}	181^{a}	193^{a}	204^{a}	207^{a}	181^{a}
24 days old	718^{ab}	639^{c}	675^{bc}	632^{c}	733^{a}	733^{ab}	711^{ab}	658^{c}
36 days old	885^{ab}	919^{a}	866^{ab}	830^{ab}	867^{ab}	920^{a}	853^{ab}	834^{b}
0-36 days old	1792^{ab}	1758^{abc}	1738^{bcd}	1643^{cd}	1793^{ab}	1857^{a}	1769^{abc}	1673^{d}
FI (g) at:								
12 days old	230^{a}	249^{a}	234^{a}	224^{b}	229^{a}	237^{a}	237^{a}	228^{a}
24 days old	1061^{a}	1080^{a}	1027^{a}	1026^{a}	1070^{a}	1078^{a}	1035^{a}	1052^{a}
36 days old	1440^{ab}	1482^{a}	1390^{ab}	1361^{b}	1430^{ab}	1426^{ab}	1428^{ab}	1416^{ab}
0-36 days old	2731^{ab}	2812^{a}	2651^{b}	2612^{b}	2730^{ab}	2741^{ab}	2700^{ab}	2697^{ab}
FCR (g) at:								
12 days old	1.21^{c}	1.24^{b}	1.18^{c}	1.24^{b}	1.20^{c}	1.15^{d}	1.14^{b}	1.26^{a}
24 days old	1.43^{b}	1.46^{b}	1.50^{b}	1.55^{ab}	1.49^{b}	1.49^{b}	1.45^{b}	1.66^{a}
36 days old	1.63^{a}	1.60^{a}	1.60^{a}	1.63^{a}	1.61^{a}	1.71^{a}	1.67^{a}	1.70^{a}
0-36 days old	1.51^{a}	1.51^{a}	1.52^{a}	1.55^{a}	1.52^{a}	1.55^{a}	1.56^{a}	1.63^{a}
Mortality rate (%) at:								
0-36 days old	2.55^{a}	2.40^{b}	2.20^{cd}	2.00^{cd}	2.40^{c}	1.92^{cd}	1.76^{d}	1.80^{d}

a, b, c and d Means at the same row with different superscripts differ significantly (P<0.05) different.

Table 6: Effect of feeding different levels of moringa leaf meal on carcass traits of 36-day-old broiler chicks.

Items	Without enzyme				With enzyme			
	Level of Moringa (%)							
	Control	2.5	5	7.5	Control	2.5	5	7.5
Live body weight (g)	1834^{ab}	1899^{a}	1780^{bcd}	1715^{cd}	1835^{ab}	1800^{ab}	1814^{abc}	1685^{d}
Carcass traits (%)								
Carcass yield	70.97^{cd}	72.36^{bc}	71.08^{cd}	71.56^{c}	72.41^{b}	71.73^{c}	73.04^{a}	70.68^{d}
Liver	2.18^{a}	2.08^{b}	2.03^{bc}	2.04^{bc}	2.07^{b}	1.90^{cd}	1.88^{d}	2.13^{ab}
Gizzard	1.78^{b}	1.68^{cd}	1.70^{bc}	1.64^{cd}	1.80^{ab}	1.82^{a}	1.60^{d}	1.80^{ab}
Heart	0.43^{b}	0.52^{a}	0.37^{d}	0.50^{ab}	0.43^{b}	0.40^{bc}	0.42^{d}	0.47^{ab}
Giblets	4.48^{a}	4.28^{bc}	4.20^{c}	4.24^{bc}	4.40^{ab}	4.24^{bc}	3.94^{d}	4.50^{a}
Total edible parts*	75.45^{cd}	76.64^{b}	75.28^{d}	75.80^{c}	76.81^{ab}	75.97^{bc}	76.98^{a}	75.18^{d}
Abdominal fat	1.77^{a}	1.48^{cd}	1.72^{ab}	1.58^{c}	1.62^{bc}	1.48^{cd}	1.42^{d}	1.67^{b}
Breast yield	23.44^{d}	25.30^{b}	23.87^{cd}	23.92^{cd}	24.06^{c}	24.10^{c}	25.68^{ab}	23.41^{d}
Deboned breast meat	17.74^{d}	20.04^{b}	18.48^{cd}	18.97^{c}	18.73^{c}	19.32^{bc}	21.04^{a}	17.75^{d}
Thigh yield	24.62^{d}	25.04^{c}	25.16^{bc}	24.88^{cd}	25.08^{c}	25.36^{b}	25.57^{ab}	24.54^{d}

a, b, c, d Means at the same row with different superscripts are significantly (P<0.05).

***** Total edible parts = Carcass yield + Giblets

trend. In addition to, he concluded that, feeding *Moringa oleifera* leaf meal at 0.2, 0.4 and 0.6 levels had no negative influence on the carcass quality but rather improved the breast and drumstick of broiler chicks. Hence, it is recommended as a good feeding ingredient for broiler birds.

No significant difference in all parameters measure (abdominal fat, heart, liver and head and shanks percentages) among the experimental treatments. The mean values within the normal range. This result similar to the finding of) Zanu *et al.*, 2012) who indicated that, none of the parameter measured for carcass characteristics in birds fed diets containing *Moringa oleifera* leaf meal was affected significantly by inclusion

of Moringa leaf meal and the mean values for slaughter weights, heart, thigh, breast and drumstick were within the range reported by (Asafa *et al.*, 2012).

Conclusion

The effect of *Moringa oleifera* leaf meal used in this study was pronounced in the weight gain of the birds and it is also use of *Moringa oleifera* leaf meal at 2.5% with enzymes recorded the best results compared to other treatments. Whoever, the results obtained cleared that Moringa Oleifera leaf meal can be successfully fed at levels up to 7.5 % as replacement for soybean meal in broiler diets without enzymes supplementation without adverse effect on their performance, nutrient digestibility and carcass yield.

Conflict of Interest

The authors declared that present study was performed in absence of any conflict of interest.

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Author contributions

All authors contributed equally in all parts of this study.

References

Aderemi, F.A. (2003). Effect of enzyme supplemented cassava siviete in cassava based diet on some visceral organs of pullet chicks. Proc. Of the 8th Annual Conference of the Animal Science Society of Nigeria, 57-59.

Ali, M.A. (1999). Effect of probiotics addition to broiler rations on performance and some blood constituents. *Egypt Poult. Sci. J.*, **19:** 161-177.

Asafa, A.R., A.D. Ologhobo and I.O. Adejumo (2012). Performance and carcass characteristics of broiler finishers fed different levels of poultry offal meal and crayfish waste meal as replacement for fishmeal. *American Journal of Experimental Agriculture*, **(4):** 690-699.

Banjo, O.S. (2012). Growth and performance as affected by inclusion of *Moringa oleifera* leaf meal in broiler chicks diet. *Journal of Biology, Agriculture and Healthcare*, **(9):** 35-38.

Cowieson, A.J., M. Hruby and E.M. Pierson (2006). Evolving enzyme technology: impact on commercial poultry nutrition. *Nut. Res. Reviews*, **19:** 90-103.

Cowieson, A.J. and V. Ravindran (2008a). Effect of exogenous enzymes in maize-based diets varying in nutrient density for young broilers: growth performance and digestibility of energy, minerals and amino acids. *Brit. Poult. Sci*., **49:** 37-44.

Cowieson, A.J. and V. Ravindran (2008b). Sensitivity of broiler starters to three doses of an enzyme cocktail in maize-based diets. *Brit. Poult. Sci.*, **49:** 340-346.

Duncan, D.B. (1955). Multiple range and multiple F-tests. *Biometrics*, **11:** 1-42.

Esonu, B.O., O.O. Emenalom, A.B.I. Udedibie, U. Herbert, C.F. Ekpor, I.C. Okolie and F.C. Iheukwumere (2001). Performance and blood chemistry of weaner pigs fed raw mucuna (velvet bean). *Tropical Animal Production Investigations*, **4:** 49-54.

Fahey, J.W., A.T. Zakmann and P. Talalay (2001). The chemical diversity and distribution of glucosinolates and isothiocyanaes among plants. *Corrigendum Phytochemistry*, **59:** 200-237.

Guo, F.C. (2003). Mushroom and herb polysaccharides as alternative for antimicrobial growth promoters in poultry. Ph. D. Dissertation, Wageningen Institute of Animal Sciences, Department of Animal Nutrition, Wageningen University, Netherlands.

Hassan, H.M.A., M.M. El-Moniary, Y. Hamouda, F.E. Eman, W.Y. Amani and A.A. Nafisa (2016). Effect of Different Levels of *Moringa oleifera* leaf Meal on Productive Performance, Carcass Characteristics and Some Blood Parameters of Broiler Chicks Reared Under Heat Stress Conditions. *Asian J. of Anim and Vet Advances*, **11(1):** 60-66.

Kakengi, A.M.V., M.N. Shem, S.V. Sarwatt and T. Fujihara (2003). Can *Moringa oleifera* be used as a protein supplement to ruminants*? Asian- Australasian Journal of Animal Sciences*, **18(1):** 42-47.

National Research Council (1994). Nutrient Requirements of Poultry. 9th edition. National Academic Press. Washington D.C.

North, M.O. (1984). Commercial Chicken Production Manual. 3rd Ed. AVI.; Publishing Company. I.N.C. Westport Connecticut, USA.

Olugbemi, T.S., S.K. Mutayoba and F.P. Lekule (2010). Effect of Moringa (*Moringa oleifera*) inclusion in cassava based diets fed to broiler chickens. *International Journal of Poultry Science*, **9(4):** 363- 367.

Olugbemi, T.S., S.K. Mutayoba and F.P. Lekule (2010). *Moringa oleifera* leaf meal as a hypocholesterolemic agent in laying hen diets. *Livestock Research for Rural Development*, **22(4)**.

Ologhobo, A.D., E.I. Akangbe, I.O. Adejumo and O. Adeleye (2014). Effect of *Moringa oleifera* leaf meal as replacement for oxytetracycline on carcass characteristics of the diets of broiler chickens. *Annual Research and Review in Biology*, **4(2):** 423-431.

Onyimonyi, A.E. and E. Onu (2009). An assessment of Pawpaw-leaf meal as protein ingredient for finishing broiler. *International Journal of Poultry Science*, **8(10):** 995-998.

Onu, P.N. and M.O. Otuma (2008). Utilization of heat treated

sheep dropping in the diets of broiler finisher chicks. *International Journal of Poultry Science*, **7(2):**169-173.

Onu, P.N. and A.O. Aniebo (2011). Influence of *Moringa oleifera* leaf meal on the performance and blood chemistry of starter broilers. *International Journal of Food Agriculture and Veterinary Science*, **ICD:** 38-44.

Persia, M.E., C.M. Parsons, M. Schang and J. Azcona (2003). Nutritional evaluation of dried tomato seeds. *Poultry Science*, **82(1):**141-146.

Preston, L.H. and W.M. William (1973). Eviscerated yield, component parts and meat, skin bone ratios in chicken broiler. *Poult. Sci.*, **52:** 718-722.

Sarwalt, S.V., S.S. Kaparge and A.M.V. Kakengi (2002). Substituting sunflower seed cake with *Moringa oleifera* leaves as supplement feed in Tanzania. *Agro Forestry System*, **56:** 241-247.

Sarwatt, S.V., M.S. Milangha, F.P. Lekule and N. Madalla (2004). *Moringa oleifera* and cottonseed cake as supplements for small holder dairy cow fed napier grass. *Livestock Research for Rural Development*, **16:** 38-44.

SAS Institute (2004). SAS /STAT User's Guide. Release 9.1. SAS inst. Inc.; Cary NC.; USA.

Tollba, A.A.H., M.M. Sabry and S.M.M. Abuzead (2004). Effect of microbial probiotics on performance of broiler chicks under normal or heat stress conditions: 1- *Lactobacillus* or *Pediococcus*. *Egypt. Poultry Sci*., **24(2):** 351-367.

Zanu, H.K., P. Asiedu, M. Tampuori, M. Asada and I. Asante (2012). Possibilities of using Moringa (*Moringa oleifera*) leaf meal as a partial substitute for fishmeal in broiler chickens diet. *Online Journal of Animal Feed Resources*, **2(1):** 70-75. URL address: http://www.science line.com/ index.