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Effect of Feeding Different Levels of Moringa Oleifera Leaf Meal on the Performance and Carcass Quality of Broiler Chicks

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Abstract: ***The effect of feeding broiler chicks on diets containing different levels of Moringa oleifera leaf meal (MOLM) on productive performance and carcass quality was studied. A total of one-hundred and sixty one-day old, unsexed (Ross) broiler chicks were randomly divided into four experimental groups. Each group was further subdivided into five replicates at the rate of eight chicks per pen in complete randomized design. Four levels of Moringa oleifera leaf meal (0.0, 3, 5 and 7%) were fed during the experimental period for 7-weeks duration. Healths of the stock and performance parameters were recorded. At the end of the experiment, the birds were slaughter, dressing and used for different parameters. The results showed that, treatment effect on average final body weight, body weight gain, total feed intake, 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 ration. Inclusion of MOLM in broiler diets significantly (P<0.05) improved hot and cold eviscerated carcass weight, dressing percentage, breast and drumstick percentages and tenderness and juiciness scores for both breast and thigh meat.***

1. Introduction

In the Sudan, 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). According to Opara (1996) leaf meal do not only serve as protein sources but also provide some necessary vitamins, minerals and also oxycarotenoids which causes yellow colour of broiler skin, shank and egg yolk. Moringa oleifera is one of the plants that can utilize in the preparation of poultry feeds. The plant apart from being a good source of vitamins and amino acids, it has medicinal uses (Makkar and Becker, 1999; Francis *et al*., 2005). Moringa oleifera, otherwise regarded as a "miracle tree" has been used in the treatment of numerous diseases (Gbasi *et al*., 2000; Matthew *et al*., 2001) including heart disease, and obesity due to its hypo-cholesterolemic property (Gbasi *et al*., 2000; Olugbemi *et al*., 2010). The leaves and green pods are rich carotene and ascorbic acid with good profile of amino acids (Makkar and Becker, 1996). Kakengi *et al*. (2003) observed that, Moringa oleifera leaf meal contains 86% DM, 29.7l% C.P., 22.5% CF, 4.38% EE, 27.9% calcium, 0.26% phosphorus and negligible amount of tannin (1.23g/kg). In addition, Odura *et al*. (2008) reported that Moringa oleifera leaves contained crude protein 27.51%, crude fibre 19.25%, crude fat 2.23%, ash 7.13%, moisture 76.53%, carbohydrate 43.88% and caloric value 1296.00 Kj/g (305.62 cal/g). Calcium and iron content in mg/100g (DM) were 20.09 and 28.29, respectively. Foidl and Paull (2008) reported that, the protein content of leaves is high (20-35% on a dry weight basis) and most important is that, the protein is of high quality having significant quantities of all the essential amino acids. Murro *et al*. (2002) reported that, the leaves are highly nutritious containing significant quantities of vitamin A, B and C, Ca, Fe, P and protein. However, despite the high nutrient content of Moringa oleifera leaf meal, there are few reports in the literature on feeding trials with broilers. Therefore, the objective of this study to evaluate the effect of feeding diets containing different level of Moringa oleifera leaf meal on productive performance and carcass quality of broiler chicks.

2. Materials and Methods

A total of one hundred and sixty, one-day old unsexed (Ross) broiler chicks were randomly distributed into 4 groups of 40 chicks. Each group was further subdivided into 5 replicates with 8 chicks per each. The chicks of each replicate were housed in a pen (1 square meter) in an open-sided deep litter house. Four levels of Moringa oleifera leaf meal (MOLM) 0.0, 3, 5 and 7% (treatments A, B, C and D) were fed during the experimental period for 7-weeks duration. All the experimental diets were formulated to meet the nutrient requirements of broiler chicks according to NRC (1994) which were formulated from the local feed ingredients commonly used for poultry feed in the Sudan. The Moringa oleifera leaves were harvested and air dried under shade for 4 days and milled using a hammer mill to produce Moringa oleifera leaf meal which suitable for incorporation into the experimental diets, calculated analysis of the experimental diets was done according to feedstuff analysis outlined by Ellis (1981), while determined chemical analysis was conducted by the method of AOAC (1995). Formulation and proximate analysis and calculated analysis for the experimental diets are shown in Tables (1 and 2) respectively, while chemical composition of the super concentrate used in the diets is shown in Table (3). Feed and water were offered ad-libitum. The light was continuous throughout of the experimental period. The performance of the experimental birds in term of feed intake, live weight gain and feed conversion ratio were recorded weekly. Health of the experimental stock and mortality rate were closely observed and recorded daily.

At the end of 7th week the experimental birds were individually weight after overnight fast (except for water)

then slaughtered without stunning. They were then scalded, manually plucked, washed and allowed to drain on wooden tables. Evisceration was performed by a ventral cut and visceral as well as thoracic organs were removed. The heart, liver, abdominal fat and head and shanks were weighed individually and expressed as percentage of slaughtered weight. Eviscerated carcasses were weight and then chilled in a refrigerator for 24 hours at 4°C. Cold carcasses were recorded.

Table 1: Formulation and proximate analysis of the experimental diets (percent as fed)

Treatments / Ingredients (%)		A	B	C	D
A:	**Formulation:**				
	Grain sorghum	65.00	65.00	65.00	65.00
	Wheat bran	5.00	2.00	-	-
	Groundnut meal	11.00	11.00	11.0	9.00
	Sesame meal	9.00	9.00	9.00	9.00
	Moringa oleifera leaf meal (MOLM)	0.00	3.00	5.00	7.00
	Super concentrate	5.00	5.00	5.00	5.00
	Oyster shell	2.75	2.75	2.75	2.75
	Common salt	0.25	0.25	0.25	0.25
	Vegetable oil (corn)	2.00	2.00	2.00	2.00
	Total	100	100	100	100
B:	**Determined analyses**				
	Dry matter	95.00	94.82	94.60	94.00
	Crude protein (N% x 6.25)	20.43	20.62	21.11	21.31
	Ether extract	6.72	6.74	6.77	6.73
	Crude fibre	4.40	4.46	4.48	5.42
	Ash	8.74	8.73	8.73	8.74
	Nitrogen free-extract	53.71	53.72	53.74	53.76

Table 2: Calculated analysis of the experimental diets dry matter basis (DM)

Item	A	B	C	D
Metabolizable energy (Kcal/kg)	3027	3035	3063	3050
Crude fat	6.57	6.51	6.52	6.53
Crude protein	20.09	20.41	20.92	21.01
Lysine	1.03	1.05	.08	1.09
Methionine	0.44	0.54	0.54	0.54
Cystine	0.29	0.28	2.29	2.28
Methionine + cystine	0.73	0.75	0.76	0.77
Calcium	0.97	1.00	1.10	1.10
Available phosphorus	0.65	0.64	0.64	0.63
Caloric-protein ratio	151	150	150	150
ME Kcal/kg: protein %				

Metabolizable energy: calculated according to Ellis (1981)

Table 3: Chemical composition of the super concentrate used in the experimental diet formulation (Hendrix broiler concentrate)

Metabolizable energy	1900 (Kcal/kg)
Crude protein	32.00%
Lysine	11.00%
Methionine	2.80%
Methionine + cystine	2.25%
Calcium	8.00%
Available phosphorus	5.00%

All the slaughtered birds were used for dissection. The breast, thigh and drumstick of the left side of each carcass were dislocated, weighed and expressed as percentage of cold carcass weight. Taste panel was done for broiler's breast and thigh meat after wrapped individually in aluminum foil, and roasted in an electric oven at 175oC for 90 minutes. Ten taste panelist were used to score colour, flavour, tenderness and juiciness of the meat, according to the guidelines of Cross et al. (1978). Statistical analyses were made by analysis of variance for a completely randomized design, according to Stell and Torrie (1986).

3. Results

The effect of feeding different levels of Moringa oleifera leaf meal (MOLM) is shown in Table (4). Body weight gain, feed intake and feed conversion ratio were improved significantly ($P<0.05$) with the inclusion of MOLM in the broiler's diet. The diet supplemented with 5% MOLM showed significantly heaviest body weight gain and the highest total feed intake with better feed conversion ratio as compared to the other experimental diets. The experimental treatments had no significant ($P>0.05$) effect on the mortality rate. Only one bird from each treatment died, which cannot be related in any way to the experimental treatments.

Table 4: Performance of broiler chicks fed on different levels of Moringa oleifera leaf meal (MOLM)

Parameter	*A*	*B*	*C*	*D*	*SEM*
Initial live weight (g/chick)	45.10	45.50	45.39	45.21	-
Final live weight (g/chick)	1742.0^{c}	1940.00^{a}	1976.50	1873.00	46.50
Body weigh gain (g/chick)	1696.90	1894.50^{a}	1931.11	1827.79	43.20
Total feed intake (g/chick)	3480.00	3617.54^{b}	3669.10	3491.07	41.20
Feed conversion ratio	2.05^{b}	1.91^{a}	1.90^{a}	1.91^{a}	0.50
Mortality %	1.00	1.00	1.00	1.00	0.001^{N}

A: Control (without MOLM)
B: 3% MOLM
C: 5% MOLM
D: 7% MOLM
SEM: Standard error of the mean
N.S. Not statistically significant ($P>0.05$)

Means on the same raw with the same superscripts are not significantly different ($P>0.05$).

Table (5) shows the effect of feeding different levels of MOLM on carcass characteristic of the broilers. There was significant difference ($P<0.05$) in all parameters measure except thigh percentage. Birds fed on diets supplemented with MOLM gave significantly ($P<0.05$) heaviest hot and cold eviscerated carcass weights and the highest breast and drumstick percentages with the higher dressing percentage as compared to control group.

Table 5: Means values for dressing percentages and commercial cut of broiler carcasses fed on different levels of Moringa oleifera leaf meal (MOLM)

Parameters	*A*	*B*	*C*	*D*	*SEM*
Eviscerated carcass weight (g/chick)	1223.62[b]	1369.50[a]	1389.35[a]	1352.30[a]	19.13
Cold eviscerated carcass weight (g/chick)	1185.35[b]	1348.30[a]	1365.71[a]	1335.62[a]	18.8
Dressing Percentage	69.10[b]	70.45[a]	70.83[a]	70.40[a]	0.06
Breast as % of cold carcass	25.00[b]	26.40[a]	26.75[a]	26.32[a]	0.26
Drumstick as % of cold carcass	14.20[b]	15.59[a]	15.92[a]	15.32[a]	0.13
Thigh as % of cold carcass	17.92	17.73	18.20	17.84	0.03[NS]

Table (6) shows the effect of feeding different levels of MOLM on the non-carcass components as a percentage of body weight. There was no significant difference (P>0.05) in all the parameters measure among the experimental treatments.

Table 6: Body weight and organ proportions of broiler carcasses fed on different levels of Moringa oleifera leaf meal (MOLM)

Parameters	*A*	*B*	*C*	*D*	*SEM*
Final body weight (g/chick)	1742.00[c]	1940.00[ab]	1976.50[a]	1873.00[b]	46.5
Abdominal fat as % of body weight	1.15	1.36	1.40	1.32	0.03[NS]
Liver as % of body weight	2.03	2.02	2.07	2.08	0.02[NS]
Heart as % of body weight	0.50	0.50	0.51	0.50	0.01[NS]
Heat and shanks as % of body weight	7.26	7.05	7.21	7.13	0.03[NS]

Panel rating for tenderness, juiciness, flavour and colour of the broiler's breast and thigh meat are given in Table (7). The result indicated that the breast and thigh meat from the experimental treatments had significantly affect (P<0.05) on tenderness and juiciness while there were no significant differences obtained for flavour or colour. Birds fed on MOLM diets attained the highest tenderness and juiciness scores for both the breast and thigh meat as compared to control group.

Table 7: Subjective scores for the breast and thigh of broiler meat

Parameters	*A*	*B*	*C*	*D*	*SEM*
Tenderness					
Thigh	5.65[b]	6.60[a]	6.86[a]	6.63[a]	0.06
Breast	5.01[b]	6.51[a]	6.74[a]	6.50[a]	0.08
Juiciness					
Thigh	5.15[b]	6.52[a]	6.71[a]	6.66[a]	0.07
Breast	5.06[b]	6.40[a]	6.65[a]	6.41[a]	0.08
Flavour					
Thigh	5.69	5.81	5.90	5.82	0.04[NS]
Breast	6.11	6.15	6.20	6.06	0.03[NS]
Colour					
Thigh	5.36	5.55	5.38	5.71	0.05[NS]
Breast	6.23	6.25	6.33	6.26	0.04[NS]

4. Discussion

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 inline 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, 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 anti-microbial properties of Moringa (Fahey *et al.*, 2001).

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 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.

As shown in Table (6) there was 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, non 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).

As shown in Table (7) the inclusion of MOLM did not significantly affected the flavour and colour for both breast and thigh meat. Birds fed on MOLM based diets attained significantly ($P<0.05$) the highest tenderness and juiciness scores. Similar results were reported by Ologhobo *et al*. (2014) who stated that, the inclusion of Moringa oleifera leaf meal did not significantly affected flavour and colour. Birds fed on high level of MOLM (0.6%) had significantly ($P<0.05$) the highest mean values for juiciness and tenderness.

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