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Effect of Dietary Inclusion of *Moringa Oleifera* Leaf Meal on Carcass and Meat Quality Characteristics of Broilers

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ABSTRACT

The present study was carried out to study the effect of dietary inclusion of *Moringa oleifera* leaf meal (MOLM) on meat quality characteristics of broilers. Day old broilers of 180 numbers were distributed randomly to six dietary groups each with five replicates of 6 birds and were maintained under uniform management conditions. Two control diets were prepared, one negative control (C) without any vitamin E, C or Se (T_1) and the another positive control (+C) in which basal diet was supplemented with vitamin E, Selenium and (T_2). Basal diet was Basal diet was supplemented with MOLM at 1.5, 3.0 and 4.5% in groups T_3, T_4 and T_5, respectively. All the rations were made iso-caloric and iso-nitrogenous. The carcass traits like live weight, carcass weight and ready to cook yield were higher (P<0.01) in birds fed with 3.0% MOLM. On the other hand, inclusion of MOLM from 0 to 6.0% in diet had no effect (P>0.05) on dressing percentage, liver heart, gizzard and giblet weights and proximate composition of meat The meat quality parameters of broilers revealed that inclusion of MOLM up to 6% level had no effect on pH, extract release volume (ERV), water holding capacity (WHC) and sensory evaluation of the meat except colour of the meat. Colour of the meat was decreased (P<0.01) at 6.0% level of MOLM in the diet. Results of this study indicate that MOLM can safely be incorporated up to 6% level in diets of broilers without effecting carcass quality for economic benefit.

Key words: Broilers, Carcass traits, Meat quality, *Moringa oleifera* leaf meal, Protein source

INTRODUCTION

The broiler meat is one of the most abundant and cheapest sources of quality protein for human consumption. Unfortunately, broiler industry is facing multiple infectious threats caused by different pathogenic microbes. Quality chicken production needs proper microbial control both at farm as well as processing level. Currently various preparations including antibiotics are being used to control the microbial infection. But at the same time, abundant use of antibiotics resulted in hazardous outcomes in the form of emergence of antibiotic resistance in susceptible microbial populations, drug residues in meat and environmental pollution (eteh *et al.,* 2013). Due to the reason, irrational use of antibiotics is being discouraged/ banned all over the world (Demir *et al.,* 2003; Castanon, 2007). Currently, various phytogenic feed additives are encouraged in animal feed industry as a replacement to antibiotic growth promoters (Awais *et al.,* 2013). Plants are a rich source of bioactive compounds with diverse biological and pharmacological activities (Wallace *et al.,* 2010). The functional properties of these bioactive compounds vary within plant parts starting from leaves, flowers, pods, fruits, stem, bark and roots (Gong *et al.,* 2014; Bravo *et al.,* 2011). These compounds also enhance immune status of birds by reducing endotoxins and proliferation of pathogenic microbes (Wallace *et al.,* 2010). Modern concept of phytogenic feed additives is based on the principle that plant secondary metabolites like carotenoids, flavonoids and essential oils would help in fighting against multiple diseases in human when enriched in animal products through animal feed (Windisch *et al.,* 2007). These compounds express antioxidant activities by scavenging the free radicals and become part of meat and eggs (Awaad *et al.,* 2014; Anwar *et al.,* 2007). Various plant species including oregano, cinnamaldehyde, *Capsicum oleoresin*, garlic, turmeric and *Moringa (M.) oleifera* are rich in

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such bioactive compounds (Bravo *et al.,* 2011). Among these *M. oleifera* is easily available in tropical and subtropical countries of the world including India, Pakistan, Bangladesh, Ethiopia, Kenya and many other countries. Poultry industry in developing countries are continuously looking forward to non-conventional feed resources which could replace the costlier feed ingredients like proteins sources (Moreki and Gabnakgosi, 2014). The *M. oleifera* leaf meal contain fairly high quantities of essential amino acids enriched proteins, fat, minerals, vitamins and other bioactive compounds (Amaglo *et al.,* 2010; Moreki and Gabnakgosi, 2014). Keeping the nutritional quality of *M. oleifera* leaf meal in mind this study was conducted to evaluate the effect of *M. oleifera* leaf meal on meat quality parameters.

MATERIALS AND METHODS

The research work was carried out at Poultry unit attached to the Livestock Farm Complex, N.T.R College of Veterinary Science, Gannavaram (A.P). One hundred and eighty day-old Ross broilers were randomly distributed in to six treatment groups with five replicates containing six birds and fed with six experimental diets: T_1 was a basal diet with no Vitamins C, E or Se (negative control, C), T_2 was a positive control (+C) diet in which the basal diet was supplemented with 0.025% vitamin E, Selenium and Vitamin C Basal diet was supplemented with MOLM at 1.5, 3.0 and 4.5% in groups T_3, T_4 and T_5, respectively. Broiler diets (Table 1) were formulated with locally available feed ingredients like maize, soybean meal and DORB to meet the nutrient requirements (BIS, 2007). All the birds were housed in 4-tier battery cages throughout the experiment under uniform management conditions. Feed and water were provided *ad libitum* from 0 to 6 weeks. At the end of trial period i.e. after 42 days, two birds per replicate and thus a total of ten birds per treatment were randomly selected, weighed and slaughtered. Individual weights of eviscerated carcass (i.e., carcass yield) and edible organs like liver, heart and gizzard were collected and weighed. Thus, relative weights (% of

Table 1. Nutrient composition of experimental diets

Nutrient composition	Pre starter						Starter						Finisher					
	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6
DM	91.17	91.17	91.64	91.33	91.45	91.25	91.98	91.98	91.90	91.93	92.12	91.88	91.13	91.1	91.35	94.43	90.97	91.10
OM	89.46	89.46	88.98	87.83	86.73	86.53	89.78	89.78	90.73	90.63	90.98	90.20	89.85	89.85	70.51	89.21	82.95	87.45
CP	22.89	22.89	22.62	22.62	22.64	22.64	21.86	21.86	21.87	21.63	21.57	21.45	19.98	19.98	19.94	19.98	19.86	19.83
EE	3.13	3.13	3.23	2.76	2.78	2.75	2.47	2.47	3.65	3.67	3.91	4.08	4.3	4.3	3.54	2.89	4.70	4.98
*ME	2935	2935	2936	2943	2941	2939	3100	3100	3106	3108	3100	3104	3209	3209	3224	3212	3193	3202
CF	6.01	6.01	6.99	7.06	7.09	7.19	7.00	7.00	7.09	7.26	7.31	7.86	6.71	6.71	7.27	7.29	7.78	8.35
TA	10.54	10.54	11.02	12.17	13.27	13.47	10.22	10.22	9.27	9.37	9.02	9.80	10.15	10.15	9.49	10.79	11.35	12.55
AIA	2.23	2.23	2.16	2.44	2.62	2.34	2.65	2.65	2.60	2.34	2.38	2.37	2.39	2.39	2.07	2.19	2.06	2.12
NFE	57.43	57.43	56.14	55.39	54.22	53.95	58.45	58.45	57.86	58.07	58.19	56.81	58.86	58.86	59.76	59.05	56.31	54.29
Ca	1.5	1.5	1.23	1.27	1.30	1.65	1.5	1.5	1.18	1.42	1.59	1.85	1.00	0.97	1.06	1.28	1.37	1.40
P	0.70	0.70	0.73	0.70	0.70	0.69	0.87	0.87	0.84	0.87	0.90	0.87	1.28	1.28	1.54	1.29	1.17	1.21

*ME (kcal/kg) - calculated values

Table 2. Effect of dietary inclusion of *Moringa oleifera* leaf meal in broiler diets on live weight, carcass weight, dressing percentage and ready to cook yield

Treatments	Live weight (g)	Carcass weight (g)	Dressing %	Cook yield(g)
T_1	1709.4^{c}±41.81	1242.4^{c}±29.96	72.69±0.10	1322.9^{c}±31.12
T_2	1921.5^{ab}±10.83	1394.5^{b}±8.50	72.58±0.44	1476.6^{b}±7.70
T_3	1853.3^{b}±9.91	1351.0^{b}±9.08	72.90±0.34	1433.2^{b}±9.59
T_4	1978.1^{a}±15.45	1451.8^{a}±10.54	73.40±0.11	1535.1^{a}±11.35
T_5	1775.1^{c}±27.34	1289.4^{c}±25.83	72.61±0.66	1370.5^{c}±26.11
T_6	1716.0^{c}±26.20	1247.6^{c}±19.69	72.70±0.09	1328.4^{c}±19.72
SEM	16.30	12.52	0.14	12.72
Level of significance	**	**	NS	**

Values in column bearing different super scripts differ significantly **(P<0.01).

live body weight at slaughter) of carcass yield plus total edible organs were calculated. pH of the meat sample was determined by following the method of Trout *et al.*(1992) using "*Deluxe"* digital pH meter (model 101E). For estimation of extract release volume (ERV), 20 g meat sample was homogenized with 100 ml distilled water for 2 minutes. The homogenate was poured directly into the funnel lined with Whatman filter paper No.1, folded thrice so as to make eight sections. The homogenate was allowed to seep between the folds and then collected the extract in 100 ml graduated cylinder for 15 minutes. The water holding capacity (WHC) of the meat samples were measured according to the method as described by Grau and Hamm (1953). For the proximate analysis breast meat sample was collected without skin. The fresh samples of breast muscles were separately minced, dried, powdered and utilised to determine the proximate composition as per AOAC (2000), while the calcium and phosphorous contents were estimated as per Talapatra *et al.,* (1940). The meat samples were cooked and subjected to a six member taste panel for sensory evaluation of colour, appearance, flavour, juiciness, tenderness and overall acceptability on a nine point hedonic scale. Data obtained were subjected to one-way analysis of variance, treatment means were separated by using paired "t"- test and significance was declared at P<0.05 (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Data presented in Table 2 shows that live weight, carcass weight and cooking yield were significantly (P<0.01) higher at 3% MOLM fed group. Performance of the birds fed with 1.5% MOLM and positive control were not significantly different. The present findings

Table 3. Effect of dietary inclusion of *Moringa oleifera* leaf meal in broiler diets at varying levels on liver, heart, gizzard and giblet weights

Diet	Liver(g)	Heart(g)	Gizzard(g)	Giblet weight (g)
T_1	36.51±1.99	7.65±0.50	36.36±0.37	80.51±2.59
T_2	37.04±2.07	7.93±0.19	37.13±1.25	82.10±1.86
T_3	36.78±1.28	8.07±0.26	37.46±0.87	82.30±1.42
T_4	37.15±0.51	8.28±0.42	37.94±1.47	83.37±1.57
T_5	36.71±1.46	7.78±0.30	36.54±0.54	81.03±1.68
T_6	36.68±1.37	7.67±0.19	36.49±1.02	80.84±1.71
SEM	0.60	0.13	0.40	0.73
Level of significance	NS	NS	NS	NS

Table 4. Effect of dietary inclusion of *Moringa oleifera* leaf meal in broiler diets on meat quality parameters

Treatment	Colour	Flavor	Juiciness	Tenderness	Overall acceptability
T_1	7.45^{a}±0.29	7.13±0.27	7.00±0.33	7.00±0.33	7.10±0.27
T_2	7.43^{a}±0.19	7.23±0.39	7.27±0.35	7.37±0.42	7.40±0.34
T_3	7.90^{a}±0.17	7.20±0.34	7.10±0.29	7.37±0.29	7.43±0.34
T_4	7.70^{a}±0.28	7.87±0.17	7.50±0.24	7.90±0.23	7.70±0.23
T_5	7.30^{a}±0.27	7.07±0.28	7.13±0.31	7.47±0.24	7.37±0.32
T_6	6.13^{b}±0.35	6.73±0.21	6.57±0.38	6.77±0.16	6.70±0.22
SEM	0.000	0.150	0.467	0.116	0.230
Level of signifcance	**	NS	NS	NS	NS

Values in column bearing different super scripts differ significantly **(P<0.01)

are in line with Ayo-Ajasa *et al.* (2016) who observed that the inclusion of *Moringa oleifera* leaf meal at 15 and 20% levels showed higher live and carcass weight. Level of MOLM had no effect on dressing percentage. Present study is in corroborated with Kumar *et al.* (2018) who reported that inclusion of MOLM at 5, 10, 15 and 20% levels in diet had no effect on the dressing percentage of broilers. Inclusion of MOLM up to 6.0% in the diet had no significant effect (P>0.05) on liver, heart, gizzard and giblet weights in broilers (Table.3). Alshukri *et al.* (2018) also reported that inclusion of 0.25, 0.50, 0.75 and 1.0 % levels MOLM in diets had no effect on the liver weights in broilers.

Meat quality parameters like pH, extract release volume (ERV) and water holding capacity (WHC) was not influenced by inclusion of MOLM up to 6.0% in the diet of broilers. The pH ranged from 5.69 to 5.91, which is within the normal range. Kumar *et al.* (2018) reported that pH values ranged from 5.75 to 5.87. Results indicate that inclusion of MOLM up to 6.0% in the diet had no significant effect (P>0.05) on ERV value in broilers (Table 4). The meat of good organoleptic and microbial quality release large volume of extract, whereas meat of poor quality meat releases smaller volume or none. No significant change WHC was noted due to incorporation of MOLM. Similarly, Wapi *et al.* (2013) who reported that inclusion of MOLM at 1000 g/ton, 750g/ton, 500g/ton had no significant effect on the WHC of broiler meat.

Data pertaining to proximate composition of meat samples are presented in Table 5. The DM ranged from 70.94 to 77.15%; CP (fresh basis) ranged from 44.57 to 52.11%; EE ranged from 3.48 to 5.02%; Ca ranged from 0.23 to 0.69% and phosphorus ranged from 0.89

Table 5. Effect of dietary inclusion of *Moringa oleifera* leaf meal in broiler diets on proximate composition of meat

Treatment	DM (%)	CP (%) **	EE (%)*	Ca (%)*	P (%)*
T_1	77.15	52.11	4.91	0.44	1.61
T_2	71.97	46.10	3.48	0.69	1.38
T_3	72.42	46.75	4.2	0.30	1.19
T_4	72.39	46.25	4.84	0.39	1.35
T_5	74.91	49.79	5.02	0.23	1.04
T_6	70.94	44.57	4.66	0.41	0.89

** Fresh basis; *DM basis

Table 6. Effect of dietary inclusion of *Moringa oleifera* leaf meal in broiler diets on sensory evaluation of meat

Treatment	Colour	Flavor	Juiciness	Tenderness	Overall acceptability
T_1	7.45[a]±0.29	7.13±0.27	7.00±0.33	7.00±0.33	7.10±0.27
T_2	7.43[a]±0.19	7.23±0.39	7.27±0.35	7.37±0.42	7.40±0.34
T_3	7.90[a]±0.17	7.20±0.34	7.10±0.29	7.37±0.29	7.43±0.34
T_4	7.70[a]±0.28	7.87±0.17	7.50±0.24	7.90±0.23	7.70±0.23
T_5	7.30[a]±0.27	7.07±0.28	7.13±0.31	7.47±0.24	7.37±0.32
T_6	6.13[b]±0.35	6.73±0.21	6.57±0.38	6.77±0.16	6.70±0.22
SEM	0.000	0.150	0.467	0.116	0.230
Level of significance	**	NS	NS	NS	NS

Values in column bearing different super scripts differ significantly **(P<0.01)

to 1.61%. These values were within the normal range. Thus, it can be inferred that inclusion of MOLM at 6% showed no adverse impact on nutrient profile of meat. Further, sensory quality of meat was not affected by incorporation of MOLM up to 6.0% in the diet (Table 6). An improvement (P<0.01) in colour of meat was observed up to 4.5% level of MOLM in diet. Similarly, Wapi *et al.* (2013) reported that inclusion of MOLM at 1000 g/ton, 750 g/ton, and 500 g/ton affected the broiler meat colour.

CONCLUSION

It may be concluded that Moringa oleifera leaf meal can be safely incorporated up to 6% level in diets of broilers with no adverse impact on meat quality parameters.

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