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Original Research Article

Effect of Feeding *Moringa oleifera* Leaf Meal on Production Efficiency and Carcass Characteristics of Vanaraja Chicken in Tropics

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Keywords

Carcass characteristics, *Moringa oleifera* leaf meal, Production economy, Vanaraja birds

A B S T R A C T

Present study investigated the dietary inclusion of *Moringa oleifera* leaf meal (MOLM) on production efficiency and carcass traits of Vanaraja birds under tropical condition. The experiment was conducted for a period of 56 days on three hundred Vanaraja birds divided in to five different treatment groups of 60 birds each. T_1 served as control group and fed only with basal ration whereas, other treatment groups such as T_2, T_3, T_4 and T_5 were supplemented with 5, 10, 15 and 20% *Moringa oleifera* leaf meal along with basal ration. Carcass characteristics were significantly ($p<0.05$) affected in diet containing MOLM. Sensory evaluation parameters like appearance, flavour, tenderness, juiciness and palatability were highly significant ($p<0.01$) with increasing level of MOLM which inferred that inclusion of MOLM will improve meat quality. However, the maximum profit per kg live weight was recorded in T_2 group and least profit observed in 20% MOLM fed group. It was concluded that the overall performances improved significantly with 5% followed by 10% *Moringa oleifera* leaf meal supplemented birds with achieving maximum profit and healthy meat production for human consumption.

Introduction

Poultry farming can play a major role to mitigate the challenges of nutritional security, poverty alleviation, women empowerment, employment generation, improvement in living standard of farmers etc. The acute shortage of animal protein supply in developing countries justifies such research into the potentials of some locally cultivated feed resources as leaf meals which could be included into the poultry ration in order to sustain the enterprises and to improve the profit margin of farmers through reducing the use of the conventional protein sources (Atawodi *et al.*, 2008). *Moringa oleifera* leaf meal (MOLM) could be used as alternative feed resource in poultry ration in the tropics (Agbede, 2003). Moringa plant named as miracle tree has been reported to have many medicinal properties such as hypocholesterolemic properties, rich in essential amino acids, vitamins, antioxidant activity (Moyo *et al.*, 2012; Daba, 2016). Now a days people are more aware about the quality products and protein source is one of the essential components of diet which affect the overall

performance in many ways. This experiment was therefore, conducted to study the dietary inclusion of *Moringa oleifera* leaf meal on production efficiency, carcass characteristics and economy of dual purpose Vanaraja chicken.

Materials and Methods

Feeding and management

The present experiment was conducted for a period of 56 days to investigate the dietary inclusion of *Moringa oleifera* leaf meal (MOLM) in Vanaraja birds at Poultry Nutrition Research unit of Animal Nutrition Department, Bihar Veterinary College, Patna, India. Three hundred day old chicks of Vanaraja strain were procured from DPR, Hyderabad during early winter season (32˚C temperature).

The experimental birds were weighed and randomly divided into five experimental groups including control of 60 chicks in each group, replicated with 20 chicks in each replicate. All the standard managemental practices were followed during experimental period including vaccination schedule. Group 1 served as control fed with basal ration, birds in group 2 basal ration mixed with 5% MOLM, group 3 basal ration mixed with 10% MOLM, group 4 basal ration mixed with 15% MOLM and group 5 were fed basal ration mixed with 20% MOLM. Feed intake, live weight gain, feed conversion ratio, carcass traits and economy of production were examined.

Preparation of leaf meal

Moringa oleifera leaves were harvested from Bihar Veterinary College Campus, Patna, India. Branches were cut from the mature Moringa trees over twelve months old. The cut branches were spread out on a floor and allowed to dry for a period of 3-4 days under shady and aerated conditions. Thereafter, branches were threshed carefully to separate leaves from twigs before milling in a hammer mill. The dried leaves were milled to make a leaf meal. The leaf meals were stored in the airtight nylon bags during entire period of the study to avoid any possible contamination from foreign material.

Laboratory analysis

The DM, OM and ash, CP (N×6.25) and EE, CF and NFE of the feed offered, residue left and chemical composition of chicken meat were analyzed by methods (AOAC, 2005) along with calcium and phosphorus using the method modified by Talapatra *et al.* (1940) before compounding the experimental ration and feed formulation was done as per BIS (2007). Organoleptic evaluation of chicken was done using eight point Hedonic scale by 11 member semi-trained judge.

Statistical analysis

Data were analyzed as a complete randomized design using the GLM procedures of SPSS (2011). Differences in mean between treatments were compared by Duncan's multiple range tests.

Results and Discussion

Production performance

The effect of dietary inclusion of *Moringa oleifera* leaf meal (MOLM) on production performances in Vanaraja chicken showed significant ($p<0.05$) effect and good fluctuation was observed among the different treatment groups (Table 3). As a whole after the end of 8th week it was found

that inclusion of MOLM had significant effect on feed intake in comparison to control. With the increased supplement beyond 5% of MOLM higher feed intake was noted. The average body weight gain of T_2 group was significantly ($p<0.05$) higher while T_3 group was comparable with control (Table 3). However, feed conversion ratio for T_2 group was found to be significantly ($p<0.05$) lower than all other treatment group, while none of the group was comparable with each other.

The above results indicated that chicken diet containing MOLM having better production performance, improved meat quality and economic in production, respectively. The present result agreed well with the finding of Gadzirayi *et al.* (2012) reported that feed intake increased as MOLM inclusion increased probably due to increased bulk concentration.

Tesfaye *et al.* (2013) worked on MOLM as an alternative protein feed ingredient in broiler ration and found that there was significantly increase in feed intake with supplemented groups as compared to the control group when they used *Moringa oleifera* leaf meal. However, Divya *et al.* (2014) found that the addition of MOL powder at any level slightly decrease feed intake on 21 and 42 days of age as compared to control, although the decrease was not significant ($p<0.05$).

From finding of result he suggested that MOL powder could be a potential growth promoter for chicken. The result of our study was an agreement with the above study conducted by various researchers on commercial and backyard chicken. The increased feed intake with increased level of MOLM level in treatment groups might be due to faster passage rate of excreta due to increasing level of fibre content in the diet.

Carcass characteristics, organoleptic evaluation and its chemical composition

The data pertaining to carcass characteristics and sensory evaluation is presented in Table 3. The relative weight of liver and spleen was significantly reduced ($p<0.05$) with increased dietary level of MOLM in ration as compared to control group. There was significant ($p<0.05$) reduction in abdominal fat deposits in MOLM fed groups as compared to control. Probably occurred may be due to better metabolic status of birds and has antioxidant compound as well as hypo-cholesterolemic properties of MOLM.

However, dressing percentage was not much influenced with treatment among the groups. The size of bursa was decreasing on increasing level of MOLM. It might be due to presence of some important antioxidant compounds such as vitamin C, E, carotenoids, flavanoids, selenium, zeatin etc. These antioxidant compounds have immune-modulation properties. Due to which size of bursa decreases on increasing level of MOLM.

The organoleptic evaluation of cooked meat was done by semi trained judges for sensory attributes, viz. appearance, flavor, juiciness, tenderness and overall palatability, showed appreciable significant ($p<0.001$) variation due to feeding of MOLM without affecting cooking loss percentage among the different groups (Table 3). Tenderness of meat products might be improved by activation of protein and palatability was improved by enhancing natural flavor, juiciness and protein solubilization. The result of the present experiment indicated that MOLM supplemented groups have better acceptability for consumption in all respect and had no any untoward effect of feeding on sensory attributes of chicken.

The effect of MOLM on chemical composition of thigh and breast muscle is presented in Table 4. The percentage of organic matter, ether extract and ash content of the chicken was significantly different ($p<0.05$) of MOLM fed group as compared to control. The fat content of chicken was significantly decreased ($p<0.001$) with increased level of MOLM supplementation. However, total ash content was increased ($p<0.05$) at higher level of MOLM as compared to control groups, whereas, crude protein content was not much affected with treatment.

Table.1 Chemical composition of feed ingredients used in experiment (%, on DM basis)

Ingredients	**DM**	**CP**	**EE**	**CF**	**TA**	**AIA**	**NFE**	**Ca**	**P**	**ME (kcal kg^{-1})**
Yellow maize	91.5	9.50	4.70	2.08	2.80	1.20	80.92	0.08	0.36	3330
Soyabean meal	92.5	45.0	0.24	5.85	7.05	1.10	41.86	0.23	0.58	2450
Wheat bran	90.5	14.0	3.61	10.50	6.60	1.40	65.29	0.21	1.18	2010
De-oiled rice bran	93.5	13.0	1.80	13.25	6.40	4.70	65.55	0.07	0.98	1815
Moringa oleifera leaf meal (MOLM)	94.53	25.27	6.84	9.92	11.50	1.45	46.46	1.70	0.30	2852

DM-Dry matter, CP-Crude protein, EE-Ether extract, CF-Crude fibre, TA-Total ash, AIA-Acid insoluble ash, NFE-Nitrogen free extract, Ca-Calcium, P-Phosphorus, ME-Metabolizable energy

Table.2 Percentage composition of different experimental diets

Ingredients	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
Moringa oleifera leaf meal (MOLM)	0.00	5.00	10.0	15.0	20.0
Yellow maize	54.0	51.0	48.0	46.0	44.0
Soya bean meal	32.0	30.0	28.0	26.0	24.0
Wheat bran	5.00	5.00	5.00	4.00	4.00
De-oiled rice bran	5.00	5.00	5.00	5.00	4.00
Soya oil	0.50	0.50	0.50	0.50	0.50
Common salt	0.30	0.30	0.30	0.30	0.30
Calcite	1.00	1.00	1.00	1.00	1.00
Mineral mixture	1.50	1.50	1.50	1.50	1.50
Premix	0.70	0.70	0.70	0.70	0.70
Calculated value					
CP (%)	20.88	20.96	21.04	21.08	21.12
ME (kcal kg^{-1})	2810.7	2804.3	2797.9	2804.8	2813.7
Calcium (%)	0.70	0.74	0.77	0.80	0.83
Available Phosphorus (%)	0.50	0..49	0.48	0.47	0.46
Available Methionine (%)	0.41	0.43	0.44	0.45	0.47
Available Lysine (%)	0.91	0.95	0.99	1.06	1.11

Table.3 Effect of different level of Moringa oleifera leaf meal on production efficiency, carcass traits and sensory evaluation of Vanaraja birds

Attributes	T_1	T_2	T_3	T_4	T_5	SEM	p value
Production parameters							
Feed intake (g)	3042.6 ^{a}	3110.4 ^{b}	3191.3 ^{c}	3249.8 ^{c}	3218.1 ^{c}	25.5	<0.001
Body weight gain (g)	1396.9 ^{c}	1468.3 ^{d}	1398.2 ^{c}	1305.4 ^{b}	1154.9 ^{a}	17.4	<0.001
Feed conversion ratio	2.18 ^{b}	2.12 ^{a}	2.28 ^{c}	2.49 ^{d}	2.79 ^{e}	0.019	<0.001
Carcass traits							
Liver (g)	39.97 ^{c} ±1.33	29.22 ^{ab} ±0.09	31.69 ^{b} ±0.56	28.06 ^{a} ±1.30	28.19 ^{a} ±0.71	1.306	<0.001
Heart (g)	8.40 ^{b} ±0.11	7.25 ^{a} ±0.21	6.99 ^{a} ±0.15	6.81 ^{a} ±0.44	6.66 ^{a} ±0.07	0.336	0.003
Gizard (g)	23.06 ±0.11	23.41 ±1.09	24.31 ±1.66	23.58 ±0.29	22.81 ±0.81	1.369	0.836
Intestine (g)	68.91 ±6.09	62.43 ±4.35	67.51 ±3.48	62.08 ±5.11	59.36 ±2.45	6.332	0.553
Abdominal fat (g)	20.45 ^{b} ±4.76	21.01 ^{b} ±2.92	13.42 ^{ab} ±3.11	5.56 ^{a} ±0.48	4.30 ^{a} ±0.55	4.068	0.004
Spleen (g)	7.02 ^{b} ±0.16	3.41 ^{a} ±0.69	3.76 ^{a} ±0.54	2.83 ^{a} ±0.09	3.96 ^{a} ±0.02	0.567	<0.001
Bursa (g)	2.17 ^{ab} ±0.22	4.52 ^{c} ±0.46	3.41 ^{bc} ±0.14	2.77 ^{ab} ±0.45	1.60 ^{a} ±0.73	0.636	0.008
Giblet %	6.42 ^{b} ±0.10	5.47 ^{a} ±0.07	5.83 ^{a} ±0.04	5.72 ^{a} ±0.21	6.44 ^{b} ±0.06	0.163	<0.001
Dressing %	70.42 ±1.37	70.60 ±0.56	69.03 ±0.35	70.72 ±0.86	69.35 ±1.51	1.461	0.694
Evicerated %	66.92 ^{bc} ±0.39	68.82 ^{c} ±1.08	65.15 ^{ab} ±1.09	66.26 ^{abc} ±0.41	63.85 ^{a} ±1.10	1.244	0.024
Sensory evaluation							
Appearance	5.93 ^{a} ±0.07	6.30 ^{b} ±0.10	6.43 ^{b} ±0.03	6.37 ^{b} ±0.07	6.43 ^{b} ±0.03	0.092	0.001
Flavour	5.67 ^{a} ±0.03	6.33 ^{b} ±0.07	6.37 ^{b} ±0.03	6.43 ^{b} ±0.07	6.50 ^{b} ±0.10	0.092	<0.001
Tenderness	5.23 ^{a} ±0.03	5.97 ^{b} ±0.07	6.27 ^{c} ±0.07	6.47 ^{d} ±0.03	6.57 ^{d} ±0.07	0.079	<0.001
Juiciness	5.33 ^{a} ±0.03	6.13 ^{b} ±0.07	6.37 ^{c} ±0.03	6.53 ^{d} ±0.03	6.63 ^{d} ±0.03	0.060	<0.001
Palatability	5.50 ^{a} ±0.10	6.13 ^{b} ±0.07	6.43 ^{c} ±0.03	6.73 ^{d} ±0.03	7.03 ^{e} ±0.03	0.084	<0.001
Cooking loss %	40.67 ±0.67	40.33 ±0.33	42.33 ±0.33	41.33 ±0.33	42.00 ±1.00	0.843	0.166

Mean values within a row with different superscripts differ ($p<0.05$; $p<0.01$)

Table.4 Effect of different level of *Moringa oleifera* leaf meal on meat chemical composition (% on fresh basis) of Vanaraja birds

Attributes	T_1	T_2	T_3	T_4	T_5	SEM	p value
Thigh muscle							
Moisture	77.50 ^{b}	75.64 ^{a}	77.34 ^{b}	76.22 ^{ab}	77.19 ^{b}	0.539	0.065
Dry Matter	22.50 ^{a}	24.37 ^{b}	22.67 ^{a}	23.79 ^{ab}	22.81 ^{a}	0.539	0.065
Organic Matter	98.94 ^{b}	98.82 ^{ab}	98.86 ^{ab}	98.53 ^{a}	98.56 ^{a}	0.123	0.066
Crude Protein	21.22	20.56	21.87	22.13	22.15	1.105	0.588
Ether Extract	7.70 ^{e}	7.25 ^{d}	6.40 ^{c}	5.35 ^{b}	4.88 ^{a}	0.135	<0.001
Total Ash	1.07 ^{a}	1.18 ^{ab}	1.15 ^{ab}	1.47 ^{b}	1.45 ^{b}	0.123	0.066
Breast muscle							
Moisture	77.55	77.31	76.56	76.19	76.85	0.634	0.328
Dry Matter	22.46	22.69	23.44	23.82	23.15	0.634	0.328
Organic Matter	98.84 ^{c}	98.77 ^{bc}	98.73 ^{abc}	98.60 ^{ab}	98.57 ^{a}	0.069	0.045
Crude Protein	24.33	25.34	24.56	25.46	24.63	1.395	0.892
Ether Extract	7.40 ^{c}	6.95 ^{c}	5.85 ^{b}	5.25 ^{b}	4.60 ^{a}	0.235	<0.001
Total Ash	1.16 ^{a}	1.24 ^{ab}	1.28 ^{abc}	1.41 ^{bc}	1.44 ^{c}	0.069	0.045

Mean values within a row with different superscripts differ ($p<0.05$; $p<0.01$)

Different scientists worked on these aspects as on the performance of broiler chickens fed on mature *Moringa oleifera* leaf meal as a protein supplement to soyabean meal and reported that there was significant difference ($p<0.05$) on carcass yield between the different treatments of birds fed on different MOLM inclusion. He found different carcass parts, liver, head, neck, wing, back, thighs, shanks, breast, gizzard and lung, were weighed and exposed to significant tests. The general trend was that treatment five, with 100% inclusion level of MOLM, was significantly different from the rest of the treatments ($p<0.05$). The breast part showed more variability and the head had minimum variation Gadzirayi *et al.* (2012). Aderinola *et al.* (2013) worked on the utilization of *Moringa oleifera* leaf as feed supplement in broiler diets and they observed that the proportion of abdominal fat decreased as the inclusion level of MOLM increased. Hence they reached on conclusion that the utilization of MOLM in broiler diet could be adopted when the motive is production of broiler meat with low fat deposit is targeted. However, Etalem *et al.* (2014) worked on the *Moringa olifera* leaf meal as an alternative protein feed ingredient in broiler ration and they reported that the slaughter weight, dressed weight, eviscerated weight, breast weight, thigh weight, drumstick weight and giblet weight were lower ($p<0.05$) in birds that received dietary MOLM than those in control. Safa (2014) worked on the effect of feeding different levels of *Moringa oleifera* leaf meal on the performance and carcass quality of broiler chicks and he reported that the inclusion of MOLM in broiler diets significantly ($p<0.05$) improved hot and cold eviscerated carcass weight, dressing percentage, tenderness and juiciness scores for both breast and thigh meat. Zanu *et al.*

(2012) found that none of the parameters measured for carcass characteristic was affected significantly ($p>0.05$) by inclusion of MOLM. Incorporation of MOLM in the diets however affected meat quality significantly ($p<0.05$). The moisture, crude protein and fat of the meats analyzed were significantly ($p<0.05$) affected by the dietary treatments.

Therefore, the results of present study can be concluded that the birds performance and carcass quality improved significantly with 5 percent followed by 10 percent *Moringa oleifera* leaf meal with achieving maximum profit. Present investigation also help to use MOLM as alternative feed resources to reduce feed cost and healthy meat production for human consumption.

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Conflict of interest

The authors declare that there is no any conflict of interests regarding the publication of this paper.

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