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Research Article

Effect of *Moringa oleifera* leaf powder supplementation on carcass characteristics and oxidative stress of broiler chickens

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Abstract

The present study was conducted to evaluate the influence of *Moringa oleifera* leaf powder on carcass traits and oxidative stress of broiler chickens. A total of 250-day-old broiler chicks (Vencobb-430) were randomly distributed into five groups with 5 replicates of 10 birds in each. Different dietary treatments were; basal diet with no supplement (NC-negative control) and basal diet supplemented with antibiotics (PC-positive control), 1.0% *Moringa oleifera* leaf powder (MOLP1), 1.5% *Moringa oleifera* leaf powder (MOLP1.5) and 2.0% *Moringa oleifera* leaf powder (MOLP2). Per cent weight of various cut parts, eviscerated weight, drawn yield and non-edible components were evaluated after 35 days of the experiment. The results showed significantly higher eviscerated weight and drawn yield percentage in MOLP1 and MOLP2 groups compared to NC group. No significant difference in head, blood, feather and shank percentage were observed among the different groups under study. The result revealed significant (P<0.05) reduction in oxidative stress level in Moringa supplemented groups as compared to control group birds. From the above experiment, it was concluded that supplementation of 1.0% *Moringa oleifera* leaf powder significantly increases the eviscerated weight and drawn yield and reduced the oxidative stress of birds.

Keywords: Broiler, Carcass, *Moringa oleifera*, Oxidative stress

Highlights

- Significantly higher eviscerated weight and drawn yield percentage in moringa group
- No significant effect on drumstick weight, neck and wing weight
- Non-edible components showed no significant variation.
- Lower oxidate stress in moringa supplemented birds
- Numerically lower inedible component weight in MOLP2 group birds

INTRODUCTION

The poultry business is among the fastest rising and most flexible among all livestock sectors. Various approaches like feed supplements and additives are being used to get more profits and to curtail the cost of feed. Economical broiler production mainly depends on optimal utilization of feed, enhanced body weight, inhibition of diseases as well as minimum mortality rate. The usage of chemical feed additives as growth promoters has been censured due to harmful effects on consumers, and there is increasing demand for organic meat and eggs.

Leaves of *Moringa oleifera* can be used as a feed additive to enhance feed efficiency and livestock performance, or as an alternative for conventional crops to obtain more economically sustainable, environment friendly and safer production (Aregheore, 2002). There is better feed digestibility in animals fed Moringa leaves, probably due to their nutritional profile, especially the neutral detergent fibre, acid detergent fibre, crude protein, gross energy, ether extract and amino acids (Rubanza *et al*., 2005). The meat obtained from broiler chickens is an excellent source of protein, vitamins, minerals and lower in fat content, so having a great demand among non-vegetarians (Naji *et al*., 2013). Addition of *Moringa oleifera* leaf meal in broilers diet resulted significant highest carcass yield, deboned breast meat, thigh yield, breast yield and total

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edible parts (Mikhail *et al*., 2020). Dietary supplementation of Moringa leaves would be a potential strategy to improve the meat quality in broilers due to its antioxidant potential. Dietary inclusion of Moringa leaves increased the activities of glutathione, catalase, superoxide dismutase and glutathione S-transferase, while decreasing the TBARS (Thiobarbituric acid reactive substances, by-product of lipid peroxidation) levels (Hafsa *et al*., 2020). *Moringa oleifera* leaf meal supplementation in broiler chickens causes a significant reduction in lipid peroxidase in birds (Cui *et al*., 2018). This study was conducted to evaluate the effect of *Moringa oleifera* leaves powder as a feed supplement in broiler diets on carcass characteristics and oxidative stress of broiler birds.

MATERIALS AND METHODS

The present experiment was carried out at the poultry unit of Livestock Farm Complex, Collage of Veterinary Science and Animal Husbandry, ANDUAT, Ayodhya. A total of 250 one-day old Vencobb-430 strain chicks were randomly allocated into five dietary treatment groups with 5 replicates of 10 chicks in each. The chicks were kept on five dietary treatments which included a basal diet without any additive in negative control (NC) or that supplemented with antibiotics (Positive control-PC), 1.0% *Moringa oleifera* leaf powder (MOLP1), 1.5% *Moringa oleifera* leaf powder (MOLP1.5) and 2.0% *Moringa oleifera* leaf powder (MOLP2) in basal diet. Birds were fed ad libitum in different phases of experimental trial. The composition of formulated experimental diets as per BIS (2007) has been given in Table 1.

Table1. Composition of basal diets (per 100 kg)

Ingredient (kg)	Pre-starter	Starter	Finisher
Maize	54.3	55.20	59.1
Soybean meal	34.2	31.60	26.8
Rice polish	2.00	2.20	3.0
Vegetable fat	2.7	3.9	4.6
Sodium bicarbonate	0.55	0.42	0.44
Limestone powder	0.80	0.8	0.8
Common salt	0.25	0.25	0.25
Mustard deoiled cake	1.6	1.7	1.0
DDGS*	3.0	3.4	3.5
DL-Methionine	0.25	0.18	0.16
Lysine	0.2	0.2	0.2
Vitamin premix[1]	0.05	0.05	0.05
Mineral premix[1]	0.10	0.10	0.10

*Dried distillers grain soluble; **Supplies per kg diet: Vitamin A- 12,500 IU, Vitamin D_3- 2200 IU, Vitamin E- 22 mg, Vitamin K- 3 mg, Vitamin B_2- 8 mg, Vitamin B_6- 2.4 mg, Vitamin B_{12}- 11 µg, Niacin- 28 mg, Pantothenic acid- 12 mg, Folic acid- 1.5mg, Mn- 85 mg, Zn- 70 mg, Fe- 50 mg, Cu- 10 mg, I- 1.2 mg, Se- 0.2mg, Co- 0.25mg

The chicks were kept on deep litter system under similar environmental and managemental conditions with availability of clean, fresh and wholesome drinking water along with hygienic feed. At the end of the experiment, one bird per replicate (5 birds/ treatment) was selected randomly for the carcass evaluation and sacrificed after 12 hours of pre-slaughter fast, though drinking water was allowed. The visceral organs were removed by supporting the bird with one hand via the incised abdomen. Eviscerated carcasses were weighed, and cut parts like thigh, drumstick, breast, wings, back, head, neck and shank were also weighed. The relative weight of dressed, drawn yield and different edible cuts were calculated as percentage of live weight.

The blood samples [one bird per replicate (five birds per treatment)] were collected for estimation of lipid peroxidation by the method described by Placer *et al*. (1966). Packed erythrocytes 1 mL (33%) was added with 1 mL of 10% w/v trichloroacetic acid (TCA). After thorough mixing, the mixture was centrifugated at 3000 rpm for 10 min. To 1 mL of supernatant, 1 mL of 0.67% w/v of thiobarbituric acid (TBA) was added and kept in a boiling water bath for 10 min, cooled and diluted with 1 mL of distilled water. The absorbance of samples was read at 535 nm. The amount of lipid peroxidation was expressed as nano-moles of malondialdehyde (MDA) formed per mL of packed erythrocyte cells.

LPO = OD/EC x (Total volume of reaction mixture x 109 x DF x X)/(Amount of Sample taken) x time of incubation. Where, LPO- Lipid peroxidation (nm MDA/mL), OD- Optical density, EC- Extinction coefficient, DF- Dilution factor.

The data were analysed under completely randomized design (CRD) by employing one way analysis of variance (Snedecor and Cocran, 1994), and means of different dietary treatments were compared with Duncan multiple range test.

RESULTS

Carcass characteristics: The analysed data of the carcass traits of broilers presented in Table 2. The results showed that the eviscerated weight and drawn yield of MOLP1 and MOLP2 were significantly (P<0.05) higher than NC group birds, whereas that of PC, MOLP1.5 and MOLP2 was statistically similar. The dressed weight, drumstick weight, and neck and wing weight of different groups were similar and showed no significant (P>0.05) effect of various Moringa leaf powder supplementation. It was found that leg portion of MOLP1.5 group was significantly (P<0.05) lower than rest of the groups while thigh portion of NC and MOLP2 was found significantly (P<0.05) higher than PC, MOLP1 and MOLP1.5 groups.

Non-edible carcass: The results of the non-edible carcass traits of broilers are presented in Table 3. Results showed that the percentage of blood weight in MOLP1.5 group was significantly higher than MOLP2 group. Feather weight percentage of MOLP1 group was significantly higher than MOLP2 group, but there was no significant variation as compared to NC, PC and MOLP1.5 groups. There was no significant difference in head and shank percentages among the different groups under study. Viscera percentage of Moringa leaf supplemented group was significantly lower than NC but similar to PC group. The percentage of inedible components weight of MOLP2 was significantly lower than NC group but varied non-significantly with PC, MOLP1 and MOLP2 group.

Effect of MOLP on oxidative stress: The result revealed (Table 4) significant (P<0.05) reduction in oxidative stress level in Moringa supplemented groups as compared to control group birds. Highest oxidative stress was noticed in NC group followed by PC and least in Moringa treated groups. Among Moringa supplemented group lowest and statistically similar MDA level was found in MOLP1 and MOLP1.5 group birds.

Table 2. Effects of dietary supplementation of *Moringa oleifera* powder on carcass yield (% of live weight) of broiler chickens

Attributes	NC	PC	MOLP1	MOLP1.5	MOLP2	P-value
Dressed wt. (%)	87.32±0.73	87.1±0.45	86.91±0.75	86.36±0.36	87.94±0.22	0.06
Eviscerated wt. (%)	75.29±0.75[a]	76.44±0.49[ab]	78.49±0.739[c]	76.11±0.33[a]	78.06±0.237[bc]	0.002
Drawn yield (%)	70.70±0.798[a]	71.93±0.61[ab]	73.74±0.703[c]	71.28±0.419[a]	73.33±0.118[bc]	0.006
Leg wt. (%)	20.69±0.099[b]	20.11±0.352[b]	19.66±0.155[b]	17.72±1.19[a]	19.83±0.356[b]	0.021
Thigh wt. (%)	11.58±0.42[c]	10.87±0.21[ab]	10.71±0.254[ab]	10.04±0.40[a]	10.96±0.344[c]	0.017
Drumstick wt. (%)	8.99±0.145	9.18±0.138	9.03±0.324	8.53± 0.337	8.86±0.127	0.39
Neck wt. (%)	4.59±0.046	4.36±0.088	4.34±0.198	4.54±0.199	4.17±0.161	0.33
Breast wt. (%)	25.59±0.356[a]	24.74±0.224[a]	27.38±0.38[b]	24.85±0.45[a]	26.26±1.06[ab]	0.023
Back wt. (%)	14.57±0.111	14.25±0.406	15.08±0.109	15.40±0.36	13.96±0.627	0.47
Wing wt (%)	7.16±0.18	7.75±0.385	7.04±0.206	7.19±0.154	7.27±0.109	0.26

Values with different superscripts in a row differed significantly (P<0.05)

Table 3. Effects of dietary supplementation of *Moringa oleifera* leaf powder on non-edible carcass components (% of live weight) of broiler chickens

Attributes	NC	PC	MOLP1	MOLP1.5	MOLP2	P-value
Head wt.	2.47± 0.055	2.48±0.063	2.35±0.078	2.46±0.069	2.43±0.117	0.78
Wing tip wt.	0.816±0.024[bc]	0.78±0.01[ab]	0.76±0.015[a]	0.83±0.28[c]	0.80±0.178[abc]	0.035
Shank wt.	3.20±0.098	3.46±0.012	3.44±0.118	3.43±0.075	3.42±0.11	0.30
Blood wt.	3.40±0.057[ab]	3.28±0.092[ab]	3.26±0.32[ab]	3.66±0.324[b]	2.76±0.151[a]	0.102
Feather wt.	2.79±0.027[ab]	2.90± 0.77[ab]	3.28±0.103[b]	3.26±0.358[ab]	2.65±0.196[a]	0.11
Viscera wt.	12.02±0.55[b]	10.64±0.49[ab]	9.85±0.82[a]	10.24±0.28[a]	9.88±0.36[a]	0.054
Abdominal fat wt.	1.08±0.047[ab]	1.14±0.016[b]	0.869±0.041[a]	0.978±0.089[ab]	1.138±0.102[b]	0.043
Inedible component wt.	24.71±0.75[b]	23.56±0.49[ab]	22.49±1.21[ab]	23.89±0.33[ab]	21.94±0.24[a]	0.074

Values with different superscripts in a row differed significantly (P<0.05)

Table 4. Effects of dietary supplementation of *Moringa oleifera* leaf powder on oxidative stress of broiler chickens

Attributes	NC	PC	MOLP1	MOLP1.5	MOLP2	P-value
LPO-MDAnm MDA/mL	2.77±0.06[d]	2.56±0.04[c]	2.16±0.03[a]	2.11±0.03[a]	2.29±0.02[b]	<0.001

Values with different superscripts in a row differed significantly (P<0.05)

DISCUSSION

The significant variation in eviscerated weight and drawn yield are in agreement with the Mousa *et al.* (2017) and Latif and Latif (2019) who observed significantly higher values of dressing percentage in birds supplemented with 1.5% and 0.1% MOLM in diet respectively. Abou El-Naga *et al.* (2020) also reported significantly higher dressing percentages in broilers supplemented with 0.5 and 0.75% MOLP than in broilers on positive control. Significantly (P<0.05) higher dressed weight and dressing percentage among MOLM enriched groups compared to control were recorded by Alwaleed *et al.* (2020). The improved eviscerated weight and drawn yield of birds fed on MOLM1 and MOLP2 based diets could be attributed to better utilization of nutrients due to presence of many active compounds in Moringa leaves that promote the absorption of various minerals, vitamins and additional micronutrients in the body of birds. The non-significant variations on carcass parameters such as wing weight, back weight, neck and drumstick weight were in consistent with Omar *et al.* (2020) and Alwaleed *et al.* (2020) who found no significant variation in relative weight of gizzard, heart, spleen and neck by MOLM dietary supplementation. Sarkar *et al.* (2017) also observed no significant (P<0.05) difference among the thigh, wing, drumstick, gizzard and abdominal fat of broilers with the dietary MOLM treatment. Adejumo *et al.* (2016) found non-significant variation in most of carcass traits due to MOLM supplementation. On contrary to the present findings, Tamiru *et al.* (2020) found that the dressing yield and dressing percentage were not significantly affected by *Moringa stenopetala*-leaf supplementation.

The current findings on non-edible carcass were consistent with observations of Edu *et al.* (2019), Mikhail *et al.* (2020) and Omar *et al.* (2020), who noticed non-significant difference in head and shank percentage as a result of MOLP supplementation. Imoru (2019) also reported that Moringa supplementation had no significant (P>0.05) difference in the weight of wings, head and shank. On the contrary, Kwame (2017) observed significant differences (P<0.05) among the treatments of shank weight, head weight, lung weight and abdominal fat weight.

The present finding on oxidative stress was in line with Cui *et al.* (2018), who reported a significant (P<0.001) reduction in MDA level in response to dietary *Moringa oleifera* leaf meal supplementation in broiler chickens. Rama Rao *et al.* (2018) also observed significant (P<0.05) reduction in lipid peroxidase in birds supplemented with Moringa leaf meal (MLM) and pomegranate (*Punica granatum*) peel meal (PPM) in the diet as compared to control group birds. Hafsa *et al.* (2020) reported that dietary inclusion of Moringa leaves increased the activities of glutathione, catalase, superoxide dismutase and glutathione S-transferase while decreasing the TBARS (by-product of lipid peroxidation) levels. Reduction in oxidative stress of MOLP supplemented groups may be due to richness of different phytonutrients like carotenoids, tocopherols, polyphenolic compounds and ascorbic acid, which are good sources of dietary antioxidants.

In conclusion, this study revealed that supplementation of 1.0% *Moringa oleifera* leaf powder significantly increases the eviscerated weight and drawn yield, and reduced the oxidative stress of birds.

Conflict of interest: Authors have no conflict of interest in this study.

Author's contribution: AKV, PSP: Conception and design of experiment; AKV, MKV, KDS: Acquisition of data; AKV, MKV: Performed statistical analysis of data; AKV, MKV, VKP: Performed interpretation of the result and provided technical efforts in drafting of the manuscript. The final manuscript was read and approved by all authors.

Data availability statement: Data of research conducted is preserved by the author and will be made available on demand.

Ethics approval: This study was conducted after an approval from "Institutional Animal Ethical Committee (IAEC)" was obtained vide reference number IAEC/CVSc/P-36/2019.

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