



Effect of Graded Levels of Moringa Leaf Meal on the Body Weight Gain, Feed Conversion Ratio, Immune Competence Traits and Meat Composition of Coloured Chicken

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Abstract

One hundred and eighty, day old straight run coloured chicken (Chabro) were randomly distributed into six dietary treatments: T1-basal diet (broiler starter diet till 4 weeks, broiler finisher diet till eight weeks), T2-T1+1% Moringa leaf meal (MLM), T3- T1+2% MLM, T4- T1+3% MLM, T5- T1+4% MLM, T6-T1+5% MLM, having three replicates each with ten coloured chicken. During 4-8 weeks of age, T4 birds had significantly higher ($P<0.05$) phase wise body weight gain and better FCR than control. Total immunoglobulin response of T2 was significantly higher ($P<0.01$) than T1, T3 and T4. Percent protein of breast and thigh meat after 8 weeks of age was significantly higher ($P<0.05$) in T3 than T1 and T2. Thus, dietary supplementation of 3% MLM resulted in significantly higher body weight gain and better FCR during 4-8 weeks. 2% MLM resulted in increase in percent crude protein of breast and thigh meat cuts.

Keywords: Body Weight, Coloured Chicken, Immunity, Moringa Leaf Meal

Introduction

Backyard poultry has been a means of earning livelihood for the economically distressed farmers in India due to its promising results in productivity of improved backyard birds. Thus, backyard poultry farming is being promoted for sustainability of poultry production and upliftment of socio-economic condition of Indian farmers. Different Central Government agencies have developed several strains of poultry birds for backyard farming. Chabro, developed by Central Poultry Development Organization (CPDO) especially for the farmers of our country as it is comparatively more adaptive to climatic fluctuations and variable zoo sanitary conditions of the farm as compared to their broiler counterparts. One of the constraints in poultry production in developing nations is an increase in the cost of feed due to high prices of protein and energy sources (Abbas, 2013). Researchers are therefore looking for cheap and safe available alternative sources of protein and energy. Plant leaves are commonly processed into leaf meals for use as poultry feed. Besides, these leaf meals when supplemented in poultry feed may be a viable alternative to use of antibiotics at sub therapeutic levels for augmenting production performance and immunity. Moringa (*Moringa oleifera*) is presently being focused globally as another promising leaf meal in livestock feeding. The feeding value of moringa has been recounted to be analogous to that of soybeans and rapeseed meal (Soliva *et al.*, 2004). Moringa leaf meal has been incorporated in poultry diet by nutritionists to examine its effects on productive performance of broilers and laying hens (Dillard and German, 2000; Teteh *et al.*, 2016; Akhouri *et al.*, 2014; Siddhuraju and Becker, 2003).

However, detail studies are necessary to assess the efficacy of *Moringa oleifera* dry leaf meal at various levels on the productive performance and immunity of different varieties of chicken. Hence, an experiment was designed to study the effect of *Moringa oleifera* dry leaf powder meal at graded levels on the body weight gain, feed conversion ratio, immune competence traits and meat composition of coloured chicken.

Materials and Methods

Fresh *Moringa oleifera* leaves were harvested during early morning from the available plant. The harvested leaves were thoroughly washed in running tap water twice to remove the presence of dirt or surface impurities if any. Fresh leaves were dried under shade or under the sun light in dust free environment to obtain fine powder. The dehydrated leaves were crushed to powder using dry mixer grinder. The powder formed was packed in an airtight container. Representative samples of ground *Moringa oleifera* leaves were analysed for their nutrient composition as per A.O.A.C (2005).

Birds and Feed

One hundred and eighty straight run, day old coloured chicks (Chabro) were divided into six treatment groups comprising three replicates and ten chicks in each replicate. The feed was offered *ad lib* in different experimental group. The birds of the control group, T1 were fed basal or control diet (B.I.S., 2007; broiler starter diet till 4 weeks and there after broiler finisher diet till eight weeks), T2-T1+1% Moringa leaf meal (MLM), T3- T1+2% MLM, T4-T1+3% MLM, T5- T1+4% MLM, T6-T1+5% MLM. The birds were housed in deep litter system. Water was offered *ad lib*.

Body Weight and Feed Conversion Ratio

Weekly body weight and group feed consumption was recorded. Thereafter, phase wise (0-4 weeks, 4-8 weeks and 0-8 weeks) body weight gain and phase wise feed conversion ratio were calculated at the end of the experiment.

Antibody Response to Sheep Red Blood Cells (SRBC)

The microtitre plate haemagglutination procedure as described by Siegel and Gross (1980) with slight modifications was followed to measure total HA antibody titers in birds on day zero and day 5 post injection. The procedure followed is described below.

Immunization and Harvesting of Immune Serum

1% suspension of sheep red blood cells (SRBC) in PBS (V/V) was prepared. 1 ml of 1% (V/V) of SRBC suspension

was injected to 6 birds of each treatment group. About 3 ml of blood on 0 and 5th day post immunization (dpi) were collected from jugular vein. The antibody titer was determined by HA methods (Vander Zijpp, 1983; Siegel and Gross, 1980). Antibodies were determined by means of a mercaptoethanol (ME) HA test as per the method described by Martin *et al.* (1989) with slight modification.

***In vivo* Cell Mediated Immune Response**

The cellular immune response was assessed by cutaneous basophilic hypersensitivity test *in vivo* by using PHA-P (Phytohaemagglutinin, lectin from *Phaseolus vulgaris*) (Corrier and De Loach, 1990). Coloured chicken were injected intra-dermally between 3rd and 4th toe of the right foot with 0.1 mg PHA-P in 0.1 ml of PBS (1 mg PHA-P/ml of PBS). The foot web index (FWI) was determined as the difference between inter-digital swelling values of PHA-P injected and control foot.

Proximate Composition of Breast (*Pectoralis major*) and Thigh (*Ilio tibialis*) Muscle of Coloured Chicken

After 8 weeks of age, 6 birds from each treatment group (3 male and 3 female) were sacrificed and there after fresh samples of breast (*pectoralis major*) and thigh (*ilio tibialis*) muscles were processed and analyzed for moisture, crude protein (CP), ether extract (EE), total ash, calcium and phosphorous (A.O.A.C., 2005).

Statistical Analysis

Data were subjected to one-way analysis of variance in a completely randomized design (Snedecor and Cochran, 1994) using Statistical Package for the Social Sciences (S.P.S.S., 2011). Homogenous subsets were separated using multiple range test described by Duncan (1955). Differences among treatments were considered to be significant when $P \leq 0.05$.

Results and Discussion

Proximate Analysis of Feed and Moringa Leaf Meal

The proximate composition of broiler starter and finisher feed and moringa leaf meal have been presented in Table 1. The proximate values of moringa leaf meal were in order as reported by Nuhu (2010), Oduro *et al.* (2008), Gupta *et al.* (1989) and Makker and Becker (1996) who reported levels of 29.55, 27.51, 26.4 and 25.1%, respectively. The *Moringa oleifera* leaf meal was safe at the levels that were used. This concurred with some other authors who did not report any adverse effects (Ashong and Brown, 2011; Djakalia *et al.*, 2011; Nuhu, 2010). The total ash and ether extract of moringa leaf meal is collaborating with the findings of Zanu *et al.* (2012) as 7.41 and 3.33 respectively. The proximate values of broiler starter and finisher feed were in the same ranges as reported by Ru *et al.* (2003). The ration was adequate in all the nutrients as per B.I.S (2007) requirement.

Table 1: Proximate analysis of broiler starter feed, broiler finisher feed and moringa leaf meal

Category	Dry Matter %	Total Ash %	Ether Extract %	Calcium %	Phosphorous %	Protein %	Crude Fibre %
Moringa	93.16	8.48	3.21	1.65	1.65	24.44	6.22
Broiler Starter feed	88.5	5.35	3.15	1.19	0.69	21.99	3.59
Broiler Finisher feed	88.5	4.94	2.97	1.10	0.59	19.69	3.92

Phase Wise Body Weight Gain

The body weight gain of coloured chicken during 0-4 weeks, 4-8 weeks and 0-8 weeks of growth phases has been tabulated in Table 2. There was no significant difference in phase wise body weight gain during 0-4 weeks but during 4-8 weeks of age, T4 birds had significantly higher ($P < 0.05$) phase wise body weight gain compared to control and T6 and comparatively higher body weight gain than other treatment groups. During 0-8 weeks of age, phase wise body weight gain of T4 and T5 birds were significantly higher ($P < 0.05$) than control and T6 and apparently higher than T2 and T3. In addition, all the MLM supplemented groups had numerically higher body weight gain compared to control. However, in the present study, supplementation of 3% MLM resulted in

significantly higher ($P<0.05$) body weight gain compared to the control group at 4-8 weeks and 0-8 weeks of age. Banjo (2012) also reported significantly higher body weight gain at 1%, 2% and 3% MLM, though the best results were obtained at 2% MLM. The reason for the improved weight gain may be attributed to high protein content of Moringa leaf meal as observed by Kakengi *et al.* (2003) and Olugbemi *et al.* (2010).

Table 2: Effect of dietary supplementation of moringa leaf meal on the body weight gain (g) and FCR of coloured chicken at different phases of growth

Treatment	Body Weight Gain			FCR		
	0-4 weeks	4-8 weeks	0-8 weeks	0-4 weeks	4-8 weeks	0-8 weeks
T1	567	999.00 ^a	1566.00 ^a	1.51	2.33 ^b	2.03
T2	522.8	1090.47 ^{bc}	1613.27 ^{ab}	1.58	2.02 ^a	1.87
T3	555.87	1052.00 ^{abc}	1607.87 ^{ab}	1.51	2.15 ^{ab}	1.93
T4	564	1131.20 ^c	1695.20 ^b	1.5	2.03 ^a	1.85
T5	565.13	1093.47 ^{bc}	1658.60 ^b	1.48	2.07 ^a	1.87
T6	557.07	1015.20 ^{ab}	1572.27 ^a	1.47	2.20 ^{ab}	1.94
Pooled SEM	5.02	13.94	14.79	0.01	0.03	0.02
Significance Level	NS	$P<0.05$	$P<0.05$	NS	$P<0.05$	NS

Means bearing different superscripts within a column differ significantly ($P<0.05$); NS: Not Significant ($P>0.05$), SEM: Standard Error of Means

Phase-wise Feed Conversion Ratio

The feed conversion ratio (FCR) of coloured chicken at different phases 0-4 weeks, 4-8 weeks and 0-8 weeks of growth phase have been tabulated in Table 2. There was no significant difference in phase wise FCR during 0-4 and 0-8 weeks but during 4-8 weeks of age, 1%, 3% and 4% MLM supplemented groups had significantly better ($P<0.05$) FCR than control group. In addition, all the MLM supplemented groups had numerically better FCR than control group during 0-8 weeks of growth phase and numerically best FCR was noted in MLM supplemented group. Banjo (2012) also noted significantly better ($P<0.05$) FCR in 1% and 3% MLM supplemented group compared to control group.

Humoral Immune Response

Total immunoglobulin response of T2 was significantly higher ($P<0.01$) than T1, T3 and T4 and apparently higher than T5 and T6, there was no significant difference in IgG response to 1% SRBC (Log₂ titer) among the treatment groups (Table 3). IgM antibody response of T1, T2, T3, T5 and T6 were significantly higher ($P<0.01$) than T4. Further T2 had numerically better IgM response than other treatment groups. Similar results were also obtained by Younis *et al.* (2016) and Eze *et al.* (2013), who also reported supplementation of moringa leaf extract in chicken resulted in enhanced immunity. Ruckmani *et al.* (1998), reported that moringa leaves contain an active antibiotic principle, pterygospermin which has powerful antibacterial and fungicidal effects. Further, the fresh leaf juice was found to inhibit the growth of microorganisms (*Pseudomonas aeruginosa* and *Staphylococcus aureus*), pathogenic to man (Caceres *et al.*, 1991).

Cell Mediated Immune Response

There was no significant difference in foot web index among the various treatment groups in response to PHA-P (Table 3). Studies on cell mediated immune response pertaining to dietary supplementation of MLM are limited.

Proximate Analysis of Breast (*Pectoralis major*) Muscle

Results pertaining to yield of proximate analysis of breast (*Pectoralis major*) muscle of the carcass at 8th week of age have been presented in Table 4. Percent protein of breast muscle was significantly higher ($P<0.05$) in T3, T4, T5 and T6 than T1 and T2. Percent protein in thigh (*ilio tibialis*) muscle of colored chicken after 8 weeks of age was significantly higher ($P<0.05$) in T3 than T1, T2 and T5 (21.77, vs. 18.93, 19.93 and 19.53) and numerically higher than T4 and T6 (20.63 and 20.27).

Table 3: Effect of dietary supplementation of moringa leaf meal on the humoral immune responses [antibody titer (log 2) values] to 1% SRBC and cell mediated immune response (Foot Web Index) to PHA-P in coloured chicken at 8 weeks of age

Treatment	Total Immunoglobulins	IgG	IgM	Foot Web Index
T1	9.25 ^b	3	6.25 ^b	0.31
T2	10.86 ^c	2.43	8.43 ^b	0.41
T3	9.43 ^b	2.57	6.86 ^b	0.39
T4	6.50 ^a	2.63	3.88 ^a	0.36
T5	9.88 ^{bc}	2.63	7.25 ^b	0.48
T6	10.25 ^{bc}	3.13	7.13 ^b	0.3
Pooled SEM	0.27	0.21	0.34	0.32
Significance Level	P<0.01	NS	P<0.01	NS

Means bearing different superscripts within a column differ significantly ($P<0.01$); NS: Not Significant ($P>0.05$), SEM: Standard Error of Means

Table 4: Effect of dietary supplementation of moringa leaf meal on the proximate analysis of breast (*Pectoralis major*) and thigh (*Ili otibialis*) muscle of coloured chicken at 8 weeks of age

Breast	T1	T2	T3	T4	T5	T6	Pooled SEM	Significance Level
Moisture (%)	72.57	72.41	70.58	71.66	72.6	72.83	0.56	NS
Protein (%)	20.71 ^a	20.63 ^a	22.94 ^b	20.96 ^b	21.30 ^b	20.77 ^b	0.24	P<0.05
Total ash (%)	1.18	1.2	1.24	1.25	1.17	1.1	0.02	NS
Ether extract (%)	2.5	2.32	2.45	2.5	2.58	2.53	0.03	NS
Calcium (mg/100g)	5.62 ^a	5.51 ^a	5.54 ^a	5.72 ^{ab}	5.94 ^b	5.72 ^{ab}	0.04	P<0.05
Phosphorous (mg/100g)	172.86	171.27	172.07	172.25	174.39	133.77	6.65	NS
Thigh								
Moisture (%)	66.19	67.89	66.87	68.5	71.01	72.58	0.98	NS
Protein (%)	18.93 ^a	19.93 ^a	21.77 ^b	20.63 ^{ab}	19.53 ^a	20.27 ^{ab}	0.28	P<0.05
Total ash (%)	1.12	1.18	1.2	1.15	1.18	1.18	0.02	NS
Ether extract (%)	3.33	3.37	3.23	3.43	3.42	3.47	0.04	NS
Calcium (mg/100g)	5.44	5.48	5.67	5.66	5.38	5.47	0.05	NS
Phosphorous (mg/100g)	179.56	179.68	178.21	179.11	179.54	177.3	0.36	NS

Means bearing different superscripts within a row differ significantly ($P<0.05$); NS: Not Significant ($P>0.05$), SEM: Standard Error of Means

Proximate Analysis of Thigh (*Ilio tibialis*) Muscle

Results pertaining to yield of proximate analysis of thigh (*Ilio tibialis*) muscle at 8 weeks of age have been presented in Table 4. Percent protein in thigh muscle of T4 and T6 were numerically higher T1, T2 and T3. This may be attributed to high protein content in MLM which was also reflected in the results pertaining to growth parameters and plasma protein in the present study. Rehman (2018) also noted that dietary supplementation of *Moringa oleifera* leaf powder resulted in increased muscle fiber diameter of breast muscle in broiler chicken. Calcium level (mg/100g) of breast muscle was significantly higher ($P<0.05$) in T5 than T1, T2 and T3 and numerically better than T4 and T6. However, studies on this aspect are limited.

Conclusion

Thus, it may be concluded that dietary supplementation of 3% moringa leaf meal in coloured chicken resulted in significantly higher body weight gain during 4-8 weeks and 0-8 weeks of growth phase. Further, dietary supplementation of 3% moringa leaf meal in coloured chicken resulted in significantly better FCR during 4-8 weeks of growth phase. Dietary supplementation of 1% moringa leaf meal resulted in significantly higher humoral immune response in coloured chicken. In addition, dietary supplementation of 2% moringa leaf meal lead to increase in percent crude protein of breast and thigh meat cuts in coloured chicken.

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Conflict of Interests

There is no conflict of interest.

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