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ORIGINAL ARTICLE

Effect of Supplementation of *Moringa oleifera* Leaf Powder on Growth Performance of Broilers

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Abstract

The present study was conducted to evaluate the effect of supplementation of *Moringa oleifera* leaf powder on growth performance of broilers. Each treatment was subjected to four replicates with twenty five chicks in each replicates. A control group (T0) was fed basal diet adequate in all nutrients as per BIS (2007) and birds in treatment groups T1, T2 and T3 were offered basal diet containing *Moringa oleifera* leaf powder at 0.2, 0.4 and 0.6 %, respectively. The results showed improvement in live body weight with the inclusion of *Moringa oleifera* leaf powder in the diet. The significantly higher ($p<0.05$) weekly body weight was observed in treatment group T1 and T2 fed *M. oliefera* leaf powder at 0.2% and 0.4% levels as compared to control group. However, slightly reduced mean weekly live body weights were recorded in treatment group T3 in comparison to control group T0. The birds fed 0.2% *M. oleifera* leaf powder recorded significantly higher mean weight gain compared to control and other treatment groups, however, slightly reduced mean body weight gain was observed in T3 group fed *M. oleifera* leaf powder at 0.6%. Slightly reduced feed intake was observed in all treatment groups compared to control. The feed conversion ratio among the all treatment groups was found to be better compared to control. Economically higher profit obtained in *Moringa oleifera* leaf powder at 0.2% inclusion level followed by *Moringa oleifera* leaf powder at 0.4%, 0.6% and control group. It may be concluded that supplementation of *Moringa oleifera* leaf powder in broiler diets at 2-4 g/kg of feed is found to improve growth performance.

Keywords: M*oringa oleifera* leaf powder, Growth performance, Broilers.

1. Introduction

Feed is a major component affecting net return from the poultry enterprise. Various strategies like feed supplements and additives are being used to ensure more net return and to minimize expenditure on feed. Economical broiler production largely depends on optimum utilization of feed, improved body weight, prevention of diseases and reduced mortality rate. Use of chemical feed additives as growth promoters has criticism due to adverse effects on consumers and there is increasing demand for organic meat and eggs. In view of this, herbal and plant derivatives would be a valuable alternative to promote growth and health in poultry as there is no residual toxicity. The leaves of moringa tree have been reported to have an antioxidant activity due to the higher amount of polyphenols (Moyo *et al.*, 2012; Sreelatha and Padma, 2009). The HPLC analysis indicated the presence of phenolic acids (gallic, chlorogenic, ellagic and ferulic acid) and flavonoids (kaempferol, quercetin and rutin) in moringa. *Moringa oleifera* leaves are a rich source of vitamins. Its leaf meal may be a promising source of natural antioxidants for broiler meat. It also possesses antimicrobial activity due to its principle component pterygospermin. The use of affordable alternative plant materials that possess medicinal properties which can be used to replace the expensive modern antibiotics in developing countries becomes a necessity. The nutritional and medicinal property of *Moringa oleifera* leaves suggest it as a good option for the replacement. *Moringa oleifera* leaf is rich in vitamins (especially vitamin A), amino acids, energy, crude protein, low levels of tannins, trypsin and amylase inhibitors (Makkar and Becker, 1996; 1997). Moringa is a potential plant that could be used to enhance immune response and to improve intestinal health of broiler

chicken (Yang *et al.,* 2006). Keeping above facts in view, the present investigation was planned to study the effects of supplementation of *Moringa oleifera* leaf powder on the performance of broilers chickens.

2. Materials and Methods

2.1 Birds and Housing

The present study was conducted to evaluate the effect of supplementation of *Moringa oleifera* leaf powder on growth performance of broilers. Four hundred straight run 'Vencobb 400' strain commercial day-old broiler chicks were equally and randomly distributed in to four treatment groups. Each treatment was subjected to four replicates with twenty five chicks in each replicates. The birds were reared on deep litter system in pens for six weeks period.

2.2 Dietary Treatments

The feed supplement *Moringa oleifera* leaf powder was supplied by Famestar Impex India Pvt. Ltd., Mumbai, and Maharashtra. A control group (T0) was fed basal diet adequate in all nutrients as per BIS (2007) and birds in treatment groups T1, T2 and T3 were offered basal diet containing *Moringa oleifera* leaf powder at 0.2, 0.4 and 0.6%, respectively.

2.3 Management of Birds

Prior to experimental trial, the experimental broiler shed, its premises and the equipments were thoroughly cleaned and disinfected. Saw dust was provided as a bedding material for the birds. Immediately after arrival, all the chicks were provided glucose through drinking water. The desired brooding temperature was maintained using electric bulbs. All the groups were provided similar environmental and managemental conditions throughout the experimental period.

The experimental chicks were offered feed and fresh water *ad-libitum.* The identical floor, feeding and watering space was allotted to the experimental birds during the entire experimental period. The experimental chicks were housed in 16 different pens. Each pen was accommodating 25 birds. The experimental birds were vaccinated against Ranikhet disease through intraoccular route on 7^{th} day with B1 strain, Infectious bursal disease (IBD) on 14^{th} day of age by intraocular route and booster vaccination of Infectious bursal disease (IBD) Invasive intermediate strain (B2K) was carried out on 21^{th} day and vaccination of Ranikhet disease with lasota strain on 28^{th} day through drinking water.

2.4 Statistical Analysis

The data obtained was subjected to statistical analysis as per standard procedures of Snedecor and Cochran, (1994) and Duncan's multiple range test for verifying significance of treatment means were used.

3. Results and Discussion

3.1 Weekly Body Weights

The average weekly body weights under different treatment groups differed significantly ($p<0.05$). The significantly higher ($p<0.05$) weekly body weight was observed in treatment group T1 and T2 fed *M. oleifera* leaf powder at 0.2% and 0.4% levels as compared to control group. However, slightly reduced mean weekly live body weights were recorded in treatment group T3 in comparison to control group T0 (Table 2). The present findings are in accordance with Safa (2012) and Kout *et al.* (2015) who also observed significantly higher body weights on diets containing different levels (0.2, 0.4 and 0.6%) of *M. oleifera* leaf meal. *M. Oleifera* plant was reported to contain various amino acids, a highly potent anti-inflammatory (Ezeamuzle *et al*., 1996), and hepatoprotective properties (Pari and Kumar, 2002). The leaves of the tree have been reported to have an antioxidant activity due to the higher amount of polyphenols (Moyo *et al*., 2012; Sreelatha and Padma, 2009). The leaf extract was found to regulate cholesterol level in rats (Ghasi *et al*., 2000). The HPLC analysis indicated the presence of phenolic acids (gallic, chlorogenic, ellagic and ferulic acid) and flavonoids (kaempferol, quercetin and rutin) in moringa. *Moringa oleifera* leaf meal may be a promising source of natural antioxidants for broiler meat. It also possesses antimicrobial activity due to its principle component pterygospermin.

The improvement in live body weight of broilers observed due to the supplementation of *M. oleifera* leaf powder may also be attributed to the significant quantities of vitamins (A, B and C), calcium, iron and protein. Nkukwana *et al*. (2012) also found that birds supplemented with *M. oleifera* leaf meal had higher body weight than the birds fed the control diets. However, Eze *et al.* (2014) observed no significant differences in the body weight of the 200mg/kg broiler treated with dose of *Moringa oleifera* extract than those of untreated groups. Gadzirayi *et al.* (2012) also found that on supplementation of *Moringa oleifera* leaf meal did not influence the final weights over the control group. These reports indicate that lower level *of M. Oleifera* did not exert significant changes in broiler performance. Divya *et al*. (2014) reported that addition of moringa leaf powder at 0.5%, 1.0%, 1.5% and 2.0% levels or antibiotic slightly decreased body weight.

Table 1: Ingredient and nutrient (%) composition of basal diets

Ingredients (%)	Pre-starter	Starter	Finisher
Maize	53.10	53.82	58.10
Soybean meal	40.27	38.00	32.62
Vegetable Oil	2.74	4.3	5.20
Dicalcium Phosphate (DCP)	1.80	1.90	2.00
Limestone Powder (LSP)	1.20	1.20	1.20
Salt	0.30	0.30	0.30
Vitamin Mix.	0.02	0.02	0.02
DL-Methionine	0.15	0.15	0.15
L-Lysine	0.06	0.00	0.00
Trace mineral	0.15	0.15	0.15
Choline chloride 60%	0.06	0.06	0.06
Toxin binder	0.05	0.05	0.10
Coccidiostat	0.05	0.05	0.05
Soda bicarb	0.10	0.10	0.10
TOTAL	100.00	100.00	100.00
Nutrients (%)			
Crude protein	23.01	22.03	20.00
Calcium	1.00	1.09	1.02
Avl. Phosphorus	0.46	0.45	0.46
Lysine	1.31	1.20	1.10
Methionine	0.50	0.49	0.45
ME, Kcal/kg	2991.91	3097.12	3198.80

**Trace mineral premix 1g and vitamin premix 1g per kg. Trace mineral premix supplied mg/kg diet: Mg, 300; Mn, 55; I, 0.4; Fe, 56; Zn, 30; Cu, 4. The vitamin premix supplied per kg diet: Vit.A, 8250 IU; Vit.D_3, 1200 ICU; Vit.K, 1mg; Vit.E, 40 IU; Vit. B_1, 2mg; Vit. B_2 4mg; Vit.B_{12}, 10mcg; niacin, 60mg; pantothenic acid, 10mg; choline, 500mg.*

Table 2: Weekly live body weight (g/b) of broilers fed different levels of *M oleifera* leaf powder

Means bearing Treatment / Age (week)		T0	T1	T2	T3
	0 Day	44.11±0.82	43.74±0.5	43.48±0.48	43.74±0.28
	I	165.87±0.70	166.27±2.84	165.11±2.57	163.25±0.68
	II	410.01±6.43	415.08±5.82	411.78±14.48	407.32±6.69
	III	808.66±3.67	816.47±7.26	814.72±15.74	796.59±8.36
	IV	1307.12±5.2	1320.41±18.1	1321.15±45.84	1278.32±4.8
	V	1780.09±11	1840.1±23.20	1823.41±45.99	1785.34±11.47
	VI	2281.51±24.62	2352.32±18.30	2327.69±47.09	2307.22±14.78
	Pooled Mean	971.05^{ab}±321.21	993.48^{d}±331.74	986.76^{c}±328.59	968.82^{a}±323.79

different superscripts within a row differ significantly, (P<0.05).
CD Value: Treatment - 17.427

Ochi *et al.* (2015) also observed significant reduction in weight gain and body weight during starter period at inclusion level of 0.5, 1.0 and 2.0% and they predicted that this may be due to the presence of phytates which acted as an anti-nutritional factor. Thus, the higher levels of *Moringa oleifera* leaf powder in diets found to reduce the performance of the birds.

3.2 Cumulative Weekly Body Weight Gain

The result revealed that the cumulative weekly body weight gain differed significantly ($p<0.01$) among various treatment groups. The birds fed 0.2% *M. oleifera* leaf powder recorded significantly higher mean weight gain compared to control and other treatment groups, however, slightly reduced mean body weight gain was observed in T3 group fed *M. oleifera* leaf powder at 0.6% (Table 3). The present findings are in accordance with Okafor *et al.* (2014) who reported that *M. oleifera* supplemented groups recorded a higher –

Table 3: Average cumulative weekly body weight gain (g/b) of broilers fed with different levels of *Moringa Oleifera* leaf powder

Treatment / Age (week)	T0	T1	T2	T3
I	121.76±1.41	122.53±2.37	121.63±2.45	119.51±0.71
II	365.9±6.77	371.34±5.84	368.30±14.23	363.58±6.81
III	764.55±4.49	772.73±6.92	771.243±15.44	752.85±8.31
IV	1263.01±5.00	1276.67±18.39	1277.67±45.46	1234.58±5.05
V	1735.98±11.03	1796.3±22.75	1779.93±45.7	1741.6±11.52
VI	2237.4±24.04	2308.58±17.84	2284.21±46.81	2263.48±15.04
Pooled Mean	1081.43^{a}±333.21	1108.03^{b}±344.95	1100.50^{a}±341.41	1079.26^{a}±336.9

Means bearing different superscripts within a row differ significantly, (P<0.05).
CD value: Treatment - 26.21

daily weight gain. Banjo (2012); Gadzirayi *et al.* (2012); Kout *et al.* (2015) showed that birds fed on Moringa leaf powder gained significantly higher body weights than birds fed the control diet. Talha *and Mohamed* (2012) observed that addition of *M. oleifera* undecorticated seed powder also had significant beneficial effects on weight gain in broilers.

Higher level (0.6%) of Moringa leaf powder found to reduce the gain in broiler weights. Divya *et al*. (2014) reported that addition of Moringa leaves at 0.5%, 1.0%, 1.5% and 2.0% level or antibiotic did not improvement in gain in body weight. Similar reports are also available in the literature (Aderinola *et al.*, 2013). Karthivashan *et al.* (2015) found no significant differences in weight gain at 0.5%, 1.0%, and 1.5% w/v *Moringa oleifera* aqueous leaf extract as a dietary supplement on the growth performance. Zanu *et al.* (2011) and Olugbemi *et al.* (2010) also observed decline in body weight gain when Moringa was included in maize and cassava based broiler ration. Ochi *et al.* (2015) reported that significant reduction in weight gain, feed efficiency and body weight due to addition of 2.0% *Moringa oleifera* seed powder to broilers' diet during starter period may be due to the presence of phytate which acts as an anti-nutritional factor**.**

3.3 Cumulative Feed Consumption

The result revealed that there was significant difference between the treatments in average cumulative feed consumption of broilers. The treatment T1 showed significantly ($p<0.01$) lowered cumulative feed consumption followed by T2 and T3 and highest in control (Table 4). The present result are in agreement with Kout *et al.* (2015) who observed that different levels of *Moringa oleifera* leaf meal (0.0, 0.2, 0.4 and 0.6%) showed lowest feed consumption at 0.2% *Moringa oleifera* leaf meal compared to other groups. Ochi *et al*. (2015) reported that during finisher and the whole period supplying broiler chicks diet with 0.5% *M. oleifera* seed powder resulted in significant increase in feed consumption. However, Paguia *et al.* (2014) studied the influence of *Moringa oleifera* leaf meal basal diet (control), 0.1%, 0.2%, 0.3%, 0.4% on growth performance of broilers and was found to have no effect on average cumulative feed consumption.

Supplementation of Moringa leaf powder at 0.6 % level in broiler diets could not significantly ($p>0.05$) influence the feed intake in broilers. Similar reports are available in the literature. Gadzirayi *et al.* (2012) investigated the effects of supplementing soya bean meals with *Moringa oleifera* leaf meal (25%, 50%, 75% and 100%) as a protein source in poultry and found no significant differences in feed intake of broilers. Okafor *et al.* (2014) observed that a diet contained a 20% replacement level of *Moringa oleifera* leaf protein concentrate for soybean meal did not found to alter the weekly feed intake in broilers. Molepo *et al.* (2014) reported that Moringa seed meal 0, 5, 10, 15 and 20 g supplementation had no significant effect on feed intake. Divya *et al*. (2014) observed that addition of Moringa leaves at this 0.5%, 1.0%, 1.5% and 2.0% any level or antibiotic did not result in significantly change in feed intake on 21st and 42nd of age. Banjo (2012) reported that *Moringa oleifera* leaf meal at 0%, 1%, 2% and 3% did not significantly enhance feed intake. These variations observed may be due to different level used.

3.4 Cumulative Feed Conversion Ratio

The best weekly feed conversion ratio (FCR) was obtained by using 0.2% *Moringa oleifera* leaf powder in all periods compared to control and other treatments. This may be attributed to birds fed *Moringa oleifera* leaf powder based diets adequately utilized the nutrients they consumed. The significantly better –

Table 4: Weekly cumulative feed consumption (g/b) broilers fed different levels of *Moringa oleifera* leaf powder

Treatment / Age (week)	T0	T1	T2	T3
I	145.25±1.37	140.19±4.45	147.26±4.62	150.27±6.02
II	512±9.77	443.59±16.17	477.19±9.02	491.25±9.78
III	1076.2±12.06	963.43±16.54	1038.75±9.24	1038.45±12.61
IV	1971.13±10.78	1747.47±27.48	1856.73±6.11	1817.81±21.68
V	2989.38±33.65	2713.48±17.63	2817.05±10.39	2797.59±19.56
VI	4002.10±38.48	3691.70±18.98	3812.74±19.51	3784.43±18.87
Pooled Mean	1782.6^{c}±611.34	1616.64^{a}±562.98	1691.6^{b}±579.62	1679.9^{b}±573.33

Means bearing different superscripts within a row differ significantly, (p<0.01).
CD value: Treatment - 26.40

Table 5: Weekly cumulative feed conversion ratio of broilers at different age groups fed with different levels of *Moringa oleifera* leaf powder

Treatment / Age (weeks)	T0	T1	T2	T3
I	1.19±0.02	1.14±0.02	1.21±0.02	1.25±0.04
II	1.39±0.01	1.19±0.04	1.3±0.04	1.35±0.03
III	1.40±0.01	1.24±0.01	1.34±0.02	1.38±0.02
IV	1.56±0	1.36±0.01	1.45±0.05	1.47±0.01
V	1.72±0.01	1.51±0	1.58±0.04	1.60±0.01
VI	1.78±0.01	1.59±0	1.67±0.02	1.67±0.01
Pooled Mean	1.51^{c}±0.09	1.34^{a}±0.07	1.42^{b}±0.07	1.45^{b}±0.06

Means bearing different superscripts within a row differ significantly, (P<0.01).
CD value: Treatment - 0.04

(p<0.01) cumulative feed conversion ratio was found in all treatment groups as compared to control group (Table 5). The present results are in agreement with Kout *et al.* (2015) who recorded best feed conversion ratio in birds fed on 0.2% MOLM. Sherief *et al.* (2012) also reported significantly higher feed conversion efficiency in Moringa leaf powder supplemented groups. David *et al*. (2012) observed that replacing antibiotic growth promoters with herbal supplements 0.1% and 0.05% Moringa leaf powder has beneficial effects on the growth performance. Aderinola *et al.* (2013) who reported that using *Moringa oleifera* leaf meal (MOLM) (0, 0.5, 1.0, 1.5 and 2.0%) as a feed supplement results of this study revealed that Control diet had higher feed conversion ratio than *Moringa oleifera* leaves meal based diets. Banjo, (2012) the inclusion of *Moringa oleifera* leaf meal at 1%, 2% and 3% in the diet did not significantly enhance feed conversion. Onunkwo *et al.* (2015) reported significant decrease in the feed conversion ratio of the birds fed *Moringa oleifera* leaf meal levels 0.0%, 5.0%, 7.5% and 10% based diets than birds that are fed without *Moringa oleifera* leaf meal. Ochi *et al*. (2015) Broiler chicks diet with 0.5% *Moringa oleifera* seeds powder resulted in significant reduction feed efficiency during starter period. The results of the present findings are not in agreement with the reports of Divya *et al.* (2014) who reported that no significant difference 51 was observed for FCR of the broiler chickens basal diet with four levels of Moringa leaves powder which might be due to high level of *Moringa oleifera* leaf powder in diets. Paguia *et al.* (2014) also reported that that feed conversion ratio was not relatively better over the control on inclusion of *Moringa oleifera* leaf powder and leaf meal at 0.20%, 0.30%, 0.40% and 0.50% in broiler.

4. Conclusion

It may be concluded that supplementation of *Moringa oleifera* leaf powder in broiler diets at 2-4 g/kg of feed is found to improve growth performance.

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