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Effect of Supplementation of Amla (*Emblica officinalis*) Fruit Powder on Growth Performance during Different Growth Phases of Broiler Chicken

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ABSTRACT

The aim of the study was to assess the efficacy of phytogenic feed additives as an alternative to antibiotic on growth performance of broiler chicken. A total of 300 commercial broiler chicks were randomly distributed into six treatments having five replicates consisting of ten birds each. The chicks fed with standard basal diet in two different growth phase i.e. starter(0-28d) and finisher (29-42 d) The first group was kept as control (T_1) and given basal diet without antibiotic while in second group (T_2) basal diet was supplemented with antibiotic, third (T_3), fourth (T_4), fifth (T_5) and sixth (T_6) groups were supplemented with amla fruit powder @0.25%, 0.50%, 0.75% and 1%, respectively. Over all feed intake ranged 3860.4 (g) (T_6) to 4059.0 (g) (T_1) and significantly lower feed intake was found in 0.75% and 1% amla fruit powder supplemented group as compared to control. The lower feed consumption in higher levels of amla fruit powder supplemented group might be due to better utilization of nutrients. Over all weight gain at the end of growth period ranged 2105.8 (T_1) to 2240.4 (T_5) and significant higher body weight gain was found in 0.75% (T_5) and 1% (T_6) amla supplemented group results in significantly improved FCR as compared to control. Dry Matter metabolizability and Nitrogen metabolizability was significantly higher in 0.75% (T_5) and 1% (T_6) amla fruit powder supplemented group as compared to control group. Higher gross energy metabolizability was recorded in all amla supplemented and antibiotic supplemented group as compared to control group.

Keywords: Antioxidant, Amla, Nitrogen metabolizability, Phytogenic

Poultry industry in India has emerged as one of the fastest growing segments of the agriculture sector. Broiler production in India is yet very low and has vast scope for growth. Furthermore, the success of poultry industry depends upon its fast growth and low mortality during first two weeks of life, which can be managed by good hygienic and feeding conditions. The production of safer poultry products without any chemical and microbial residues is the order of the day. Feed additives are one of the important tools used for improving feed conversion ratio, growth rate and disease resistance. The additives that hold great promise in the feeding of poultry comprise of antibiotics, coccidiostat, antioxidants, enzymes, hormones, probiotics, buffers, organic acids, mould inhibitors, herbal products, synthetic micronutrients etc. Use of antibiotics has negative effects on animal health and its production such as residues in tissues, withdrawal period and development of resistance in microorganisms (Botsoglou and Fletouris, 2001). Following the ban on the use of antibiotics as growth promoters by the European Union, the nutritionists and researchers attempted other alternatives to enhance the performance of broiler chicken. Herbs, spices and various plant extracts have received increased attention as possible antibiotic growth promoter replacement. In this view, the plants identified with properties of secondary metabolites became interesting due to their antimicrobial, antioxidant effects and their stimulating effects on animal performance and digestive enzymes. At present, there are large numbers of Natural Growth Promoters available in the market including herbs, probiotics, prebiotics and synbiotics etc.

MATERIALS AND METHODS

Ethical approval

The animal experiment was conducted in accordance with guidelines approved by the Institutional Animal Ethics Committee, 12/CPCSEA Dated 6.2.2017 in the Department of Animal Nutrition, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar.

Experimental design

Completely Randomized Design was used as experimental design at uniform and standard management practices.

Birds and management

A total of 300 commercial broiler chicks (Ven Cobb strain) were randomly distributed into six treatments having five replicates consisting of ten birds each. The chicks fed with standard basal diet in two different growth phases i.e. starter (0-28d) and finisher (29-42 d). The first group was kept as control (T_1) and given the basal diet without antibiotic, while in second group (T_2) basal diet was supplemented with antibiotic. The diet in third (T_3), fourth (T_4), fifth (T_5) and sixth (T_6) groups were supplemented with amla fruit powder @ 0.25%, 0.50%, 0.75% and 1%, respectively. The birds were weighed fortnightly to calculate growth performance parameters *viz.* Feed intake, body weight gain and FCR.

Housing and management

The experimental chicks were reared under deep litter system. Weighed amount of feed was offered on paper sheets for first 3 days and thereafter, in the automatic feeders up to 28 days of age. Afterwards, the feeds were offered through hanging feeders maintained at appropriate heights. The chicks were provided *ad lib* clean drinking water throughout the experiment. A metabolism trial was conducted after 6th week of growth period to work out metabolizability of dry matter, nitrogen and energy. One bird from each replicate was randomly selected and transferred to metabolic cages. A preliminary period of two days was given for adaptation to the birds to new system of housing and management, followed by a collection period of three days. The chicks were offered weighed amount of experimental diets at one time in the morning and *ad lib* drinking water was provided. On the next day, the polythene sheets with excreta were removed and weighed after removing feeds and feathers, if any. Samples from thoroughly mixed excreta were drawn daily for dry matter. The new polythene sheets were weighed and spread on the tray to record observations for the next day. Thus, the feed residue and excreta voided was weighed and properly recorded for final calculations of the total daily feed consumption and excreta voided. The chemical composition of feed ingredients and two types of rations has been shown in Table 2 and 3 respectively.

About 50 gm composite sample of mixed excreta was taken in Petri dish, mixed with 10 ml of 2% acetic acid and oven dried till constant weight is obtained. The sample was preserved for further chemical estimations. The feeds offered and weigh back of last day of metabolism trial were also analyzed for their contents of dry matter and other nutrients (AOAC, 2013). The availability of nutrients for each replicate was calculated by dividing the amount of retained nutrients (ingested nutrients - excreted nutrients) with the amount of ingested nutrients. The gross energy of oven dried feed and excreta samples was determined by standard procedures using Bomb Calorimeter.

Statistical Analysis

Data was analysed statistically as described by Snedecor and Cochran (1994). Analysis of variance was used to study the differences among treatment means and they were compared by using Duncans Multiple Range Test (DMRT) as modified by Kramer (1956).

RESULTS AND DISCUSSION

Average feed intake during 0-14 days ranged from 501.5 (T_6) to 527.0 (T_1) and intake does not differ significantly in amla fruit powder supplemented group as compared to control. Feed intake during 15-28 days of age ranged from 1416.5 (T_5) to 1544.2 (T_1) and intake was decreased in amla fruit powder supplemented group as compared to control (T_1) and significantly lower feed intake was found in 0.50%, 0.75% and 1% amla fruit powder supplemented group as compared to control group as well as from antibiotic supplemented group.

Table 1: Experimental Design

Treatment Groups	Particulars	Number of replicates	Number of birds/ replicate	Total
T_1	Control-Standard diet as per BIS (2007) specifications without antibiotic	5	10	50
T_2	Control+ with antibiotic	5	10	50
T_3	Control+0.25%amla fruit powder	5	10	50
T_4	Control+0.50%amla fruit powder	5	10	50
T_5	Control+0.75% amla fruit powder	5	10	50
T_6	Control+1% amla fruit powder	5	10	50
			Total	**300**

Table 2: Chemical composition of feed ingredients used in ration formulation

Ingredient	CP (%)	CF (%)	EE (%)	TA (%)	Lysine* (%)	Methionine* (%)	ME* (kcal/kg)
Maize	9.11	2.44	3.44	2.25	0.18	0.15	3300
Soybean meal	45.15	3.93	3.16	8.47	2.57	0.76	2230
Fish meal	47.40	1.79	5.16	26.62	1.42	1.42	2210

*Calculated values (Singh and panda 1992).

Table 3: Ingredient composition of experimental diets during different phases of growth

Ingredient (kg /100 kg of feed)	0-4 wks	4-6 wks
Maize	58	60
Soybean meal	30	25
Fish meal	7	7
Vegetable oil	3	6
Mineral mixture	2	2
Feed addivites (g/100 kg feed)		
Spectromix[1]	10	10
Spectromix BE[2]	20	20
Veldot[3]	50	50
Choline chloride[4]	50	50
Lysine[5]	50	50
DL-methionine[6]	150	150

Composition, sources and rate of mixing of feed additives/supplements:

1. Spectromix: Powder (Ranbaxy Animal Health, New Delhi). Each gm. contained Vitamin A-82,500 IU, Vit D3-12000 IU, Vit B2-50 mg and Vit.K-10mg.Mixing rate: 10 g/100Kg of feed.
2. SpectromixBE: Powder (Ranbaxy Animal Health, New Delhi). Each gm. Contained Vit.B1- 8mg, Vit.B6- 16mg, Vit.B12- 80mg, niacin-120mg, calcium pentothenate-80mg, Vit. E-160 mg, Lysine hydrochloride-10 mg, DL-methionine-10 mg and calcium 260 mg. Mixing rate: 20g/100kg of feed.
3. Veldot: Venkeys- Dinitro-O-Toluamide (Coccidiostat). Mixing rate: 50g/100kg of feed.
4. Choline chloride: Contain 60 percent choline. Mixing rate: 50g/100kg of feed.
5. Lysine: Contained 98% lysine. Mixing rate: 50g/100kg of feed.
6. DL-methionine: Contained 98% methionine. Mixing rate: 150g/100kg of feed.

Average feed intake was significantly higher at 0.25% amla fruit powder supplemented group (T_3) as compared to other groups during 29-42 days ranged from 1916.2 (T_2) to 2031.0 (T_3) and lowest feed intake was found in antibiotic supplemented group (T_2), 0.75% (T_5) and 1% (T_6) amla fruit powder supplemented group. Feed intake decreased as the level of inclusion of amla fruit powder increased. Over all feed intake ranged between 3860.4 (T_6) to 4059.0 (T_1) and lowest feed intake was found in 0.75% and 1% amla fruit powder supplemented group followed by 0.50% (T_4) amla fruit powder supplemented group and differs significantly as compared to control group. The lower feed consumption in higher levels of amla supplemented group than control group might be due to better utilization of nutrients. Similar observations were made by Emadi and Kermanshaki (2006). The feed intake of all the chicks receiving amla fruit powder was lower than control and there was a linear decrease with the level of addition (Kumari *et al*., 2012). Similarly, decrease in feed consumption as above was also reported by (Wadhwa *et al*., 2007 and Bisht *et al*., 2005) who supplemented amla powder in broiler ration. However (Pande, 2000; Ghavate *et al*., 2009 and Patil *et al*., 2014) observed significantly increased feed consumption with supplementation of amla powder.

Average body weight gain

Data pertaining average body weight gain of the experimental birds under different dietary treatments are presented in Table 5. Mean body weight gain at the age 0 to 14 days ranged from 290.7(T_1) to 314.5 (T_6) and body weight gain does not differ significantly in amla fruit powder supplemented group as compared to control. Body weight gain at age of 15 to 28 days ranged from 873.4 (T_1) to 920.7 (T_5) and significantly higher body weight gain was found in antibiotic and amla fruit powder supplemented group as compared to control group.

Mean body weight gain from 29 day to 42 day of growth period ranged from 941.7 (T_1) to 1016.7 (T_6) and significantly higher gain was found in 0.75% and 1% amla fruit powder supplemented group followed by 0.50% (T_4), 0.25% (T_3) amla fruit powder supplemented group and antibiotic supplemented group as compared to control group (T_1). Over all body weight gain at the end of growth period ranged from 2105.8 (T_1) to 2240.4 (T_5) and

Table 4: Average feed intake (g/bird) during different growth periods under different dietary treatments

Treatments	0 to 14 d	15 to 28 d	29 to 42 d	0 to 42 d
T_1	527.0±1.1	1544.2^{a}±15.8	1988.0^{b}±14.5	4059.0^{a} ±6.4
T_2	519.5±3.2	1507.6^{b}±8.4	1916.4^{d}±9.9	3943.5^{b} ±5.0
T_3	517.1±14.5	1495.0^{b} ±14.0	2031.0^{a}±3.9	4042.3^{a} ±5.8
T_4	508.1±9.8	1423.9^{c}±4.4	1970.8^{bc}±14.8	3902.9^{c}±5.5
T_5	524.4±4.1	1423.2^{c}±8.9	1929.2^{d}±5.2	3876.0^{d}±4.6
T_6	501.5±8.9	1416.5^{c}±8.4	1942.4^{cd}±3.8	3860.4^{d}±6.5

^{a,b,c} means bearing different superscripts in a column differ significantly (P<0.05).

Table 5: Average body weight gain (g) under different dietary treatments

Treatments	0 to 14 d	15 to 28 d	29 to 42 d	0 to 42 d
T_1	290.7±3.6	873.4^{c}±5.5	941.7^{d} ±5.8	2105.8^{d} ±8.4
T_2	298.9±5.9	911.2^{ab} ±4.0	985.0^{bc} ±5.5	2195.2^{b} ±6.1
T_3	292.6±5.3	894.7^{b}±7.8	985.3^{bc} ±3.3	2172.6^{c} ±4.6
T_4	298.4±5.9	907.3^{ab} ±8.7	975.4^{c} ±6.5	2181.2^{bc} ±5.1
T_5	314.5±11.0	920.7^{a} ±5.6	1005.1^{ab} ±8.5	2240.4^{a} ±5.5
T_6	305.5±11.6	910.3^{ab} ±5.8	1016.7^{a} ±8.1	2232.7^{a} ±6.6

^{a,b,c} means bearing different superscripts in a column differ significantly (P<0.05).

significant higher body weight gain was found in 0.75% (T_5) and 1% (T_6) amla fruit powder supplemented group as compared to control. The higher body weights observed in amla fruit powder supplemented groups may be attributed to anabolic and antioxidant effect of ascorbic acid, gallic acid and tannic acids present in *E. officinalis* (McDowell, 1989). Similar findings were reported by Maini *et al*., (2007), Kumari *et al.* (2012) and Patil *et al.* (2014). In another studies, Sujatha *et al*. (2010) and Kumar *et al.* (2013) reported increase in body weight when birds were supplemented with polyherbal feed premix containing *E. officinalis*. Similarly the improvement in the body weight gain in broilers fed amla powder has also been reported in the literature (Pande, 2003; Daisy *et al.,* 2007; Maini *et al*., 2007; Wadhwa *et al.,* 2007) showed increased body weight gain during 0-4 weeks. Enhancement of intestinal activities of trypsin, lipase and amylase (Lee *et al.,* 2004) and improved gut morphological characteristics (Jamroz *et al.,* 2003) are the major mechanisms through which phytoadditives exert their beneficial effect on the nutrient digestibility. The beneficial influence of the phytogenic feed additives on improved performance and feed conversion ratio could be also explained due to the antioxidant activity of bioactive compounds such as carvacrol, thymol, cineol and pinene (Faleiro *et al*., 2005; Hazzit *et al*., 2006) as well as from improved enzyme activity in the alimentary tract, stimulation of useful and inhibition of pathogenic microflora which eventually resulted in improved absorption and utilization of nutrients (Windisch *et al*., 2008). Phytogenic additives has antibacterial, antioxidant, antistress, gut microflora manipulation, immune enhancement properties and digestive enzymes stimulation could be the probable reasons for the positive effects exerted by them on the growth and health performance of animals (Durrani *et al.,* 2007; Hashemi and Davoodi, 2011).

Feed Conversion Ratio

Data pertaining to Feed Conversion Ratio of the experimental birds under different dietary treatments are presented in Table 6. Feed Conversion Ratio during 0-14 days of the experiment does not differ significantly in amla fruit powder supplemented group as compared to control and antibiotic supplemented group FCR during 15-28 days ranged from 1.54 to 1.76 the difference was statistically significant (P>0.05) and improved FCR was found as the level of inclusion of amla fruit powder was increased as compared to control and antibiotic supplemented group.

Table 6: Feed conversion ratio under different dietary treatments

Treatments	0 to 14 d	15 to 28 d	29 to 42 d	0 to 42 d
T_1	1.81 ±.12	1.76 ^{a} ±.01	2.11 ^{a} ±.01	1.92^{a}±.01
T_2	1.74 ±.09	1.65 ^{a} ±.01	1.94 ^{d} ±.01	1.79 ^{c} ±.00
T_3	1.76 ±.05	1.67 ^{b} ±.02	2.06 ^{b} ±.00	1.86 ^{b} ±.01
T_4	1.70 ±.07	1.56 ^{c} ±.00	2.02 ^{c} ±.00	1.78 ^{c} ±.02
T_5	1.67 ±.02	1.54 ^{c} ±.01	1.92 ^{d} ±.02	1.73 ^{d} ±.01
T_6	1.65±.06	1.55 ^{c} ±.01	1.91 ^{d} ±.01	1.72 ^{d} ±.01

^{a,b,c} means bearing different superscripts in a column differ significantly (P<0.05).

Significant better FCR was recorded in 0.75% and 1% amla fruit powder supplemented group as compared to control group during 29-42day of the growth period followed by 0.25% and 0.50% amla fruit powder supplemented group. At the age of 6th weeks, highest (1.92) FCR was obtained in the basal diet (T_1) and difference was significantly higher in comparison to amla fruit powder supplemented groups and lowest FCR was obtained in 0.75%, and 1% amla fruit powder supplemented groups (T_5) and (T_6). The feed conservation efficiency was improved as level of amla increased similar observation have noted by Rekhate *et al.* (2010). The feed intake of all the chicks receiving amla was lower than of control and there was a linear decrease with level of addition (Kumari *et al.,* 2012). The results showed that the cumulative feed conversion efficiency at the end of experiment was better in group T_6 and T_5 followed by T_4 and T_2. The improvement in cumulative feed conversion efficiency obtained in this study is in agreement with the reports of Kumari *et al*. (2012).

Metabolizability of nutrients

Data pertaining to nutrients metabolizability of the experimental birds under different dietary treatments as presented in Table 7. Supplementation of amla powder @ 0.75% (70.60) and 1% (70.75) amla powder resulted in significantly (P<0.05) higher dry matter metabolizability among all different dietary treatments. Other supplemented groups also showed significantly higher dry matter metabolizability as compared to control group (T_1). Nitrogen metabolizability ranged 64.84% to 70.08% and significantly higher in 0.75% and 1% amla fruit powder

Table 7: Dry matter metabolizability, nitrogen metabolizability and gross energy metabolizability under different dietary treatments

Treatments	DM Metabolizability (%)	Nitrogen Metabolizability (%)	GE Metabolizability (%)
T_1	$66.36^{d}\pm.19$	$64.84^{d}\pm.23$	$65.48^{b}\pm.18$
T_2	$69.17^{b}\pm.16$	$67.61^{b}\pm.10$	$66.94^{a}\pm.48$
T_3	$68.04^{c}\pm.16$	$65.56^{c}\pm.10$	$67.14^{a}\pm.27$
T_4	$69.43^{b}\pm.22$	$67.64^{b}\pm.07$	$67.04^{a}\pm.22$
T_5	$70.60^{a}\pm.26$	$69.72^{a}\pm.07$	$66.92^{a}\pm.28$
T_6	$70.75^{a}\pm20$	$70.08^{a}\pm.32$	$67.07^{a}\pm.34$

^{a,b,c} means bearing different superscripts in a column differ significantly ($P<0.05$).

supplemented group as compared to control and antibiotic supplemented group. Other treatment also significantly improves nitrogen metabolizability as compared to control group.

Gross energy metabolizability in different dietary treatments ranged between 65.48 % (T_1) to 67.14 % (T_3) and significantly higher gross energy metabolizability was recorded in all supplemented group as compared to control group. Our study are in consonance with Hernandez *et al*. (2004) recorded effect on dry matter digestibility due to incorporation of extract from herbal plant in the diet of broilers and with findings of Meena (2015) recorded improvement in digestibility due to incorporation of Fenugreek in diet of broilers. Ahmed, (2013) reported that the supplementation of blends of oregano, anise, orange peel and chicory essential oils in the diet of weaned pig improved protein digestibility. Phytogenic additives improves the gut microflora (Peric *et al.,* 2008), modify the digestive secretion, morphology (Jamroz *et al.,* 2003), which increases the digestibility of the nutrients and ultimately the performance.

CONCLUSION

Phytogenic additives has antibacterial, antistress, gut microflora manipulation, immune enhancement properties and digestive enzymes stimulation could be the probable reasons for the positive effects exerted by them on the growth and health performance of animals. Enhancement of intestinal activities of trypsin, lipase, amylase and improved gut morphological characteristics are the major mechanisms through which phytoadditives exert their beneficial effect on the nutrient digestibility. Growth performance and nutrients utilization in 0.75% and 1% amla fruit powder supplemented groups has been improved as compared to control group due to better utilization of nutrients results in better FCR and weight gain so it can be conclude that amla fruit powder can be effectively used as an alternative to antibiotic in poultry feed. The beneficial influence of the phytogenic feed additives on improved performance and feed conversion ratio could be also explained due to antioxidant activity of bioactive compounds.

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COMPETING INTERESTS

The author has no competing interests to declare.

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