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Effect of herbal lysine supplementation on performance of broiler chicken

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Abstract
To evaluate the effect of herbal lysine supplementation on performance of broiler chicken, a study was conducted on 200, one day-old commercial broiler chicks randomly distributed into 20 subgroups means five dietary treatments with four replicates per treatment and each replicate had ten birds. Feeding trial was conducted for 42 days. The control group (T_1) was offered maize-soybean meal based diet without lysine while in second group (T_2) basal diet was supplemented with 100% synthetic lysine. In T_3 group basal diet was supplemented with 50% herbal + 50% synthetic lysine, while in T_4 with 100% herbal lysine and in T_5 with Herbal lysine at 50% Higher Level Than T_4 group. Feed intake (g/bird), body weight gain (g/bird) significantly ($P< 0.05$) increased in T_4 group as compared to the non supplemented group (T_1). Feed conversion ratio was significantly better with herbal lysine supplementation as compared to synthetic lysine and the control. Dietary supplementation of herbal lysine resulted in slightly higher dry matter metabolizability, gross energy metabolizability and nitrogen retention as compared to control group. Thus, it can be concluded that supplementation of herbal lysine at 100% level was found to improve the growth performance in terms of body weight gain, feed conversion ratio, nutrient metabolizability and achieving profitable poultry production.

Keywords: Broilers, herbal lysine, growth performance, nutrients metabolizability

Introduction
Due to increase in the demand for poultry product, researchers are looking for natural alternatives to feed additives due to emergence of drug resistance, residual toxicity and other side effects. Herbal extracts can play a role in supporting both performance and health status of the poultry birds. Development of high yielding broiler varieties along with standardized package of practices on housing, management, disease control and nutrition have contributed to spectacular growth rates of 4-6% per annum in egg and 7-10% per annum in broiler production (Statista, 2017) [1]. In poultry feed industry, amino acids are commonly supplied along with vitamin and minerals. Lysine is worldwide recognized as a limiting amino acid after methionine in broiler diet based on corn and soybean meal. Lysine is necessary for the vital function of body, assists in absorption of calcium, production of antibodies, hormones and enzymes, reduces reactive oxygen and herpes viral growth (Florini *et al.*, 1996) [2]. Lysine deficiency causes de-pigmentation and reduced haemoglobin in birds (Kathirvelan *et al.*, 2016) [3]. Recently, the use of synthetic amino acids supplement is more due to high demand of poultry meat, high cost of such synthetic compound increase the finished feed cost. In addition to this, the safety of such practices has been questioned and their use is becoming restricted in many parts of the world. Moreover synthetic amino acids are listed among the prohibited synthetic substances (Anonymous, 1999 and Fanatico *et al.*, 2009) [4, 5]. Therefore, there is a great renewed interest in developing natural alternative of synthetic supplement to maintain productive performance of poultry and health of consumer (Chattopadhyay *et al.*, 2006) [6]. Keeping in view the benefits of lysine and its vital function on various physiological processes, the present study was planned.

Materials and Methods
Ethical approval
The animal experiment was conducted in accordance with guidelines approved by the Institutional Animal Ethics Committee, 12/CPCSEA Dated 17.10.2019 in the Department of Animal Nutrition, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar.

Birds, experiment design, and management

A total of 200-day-old commercial broiler chicks (Vencobb) maintained for a period of 6 weeks in the Department of Animal nutrition, were randomly allotted to 5 treatments in a completely randomized design and presented in Table-1. Each treatment consisted of 4 replicates with 10 chicks in each. The control group (T_1) was offered maize-soybean meal based diet without lysine which was formulated as per Bureau of Indian standard (BIS, 2007) [7] to fulfill the metabolizable energy (ME) and crude protein requirements of broilers while in second group (T_2) basal diet with 100% synthetic lysine, T_3 with 50% herbal + 50% synthetic lysine, T_4 with 100% herbal lysine and T_5 with herbal lysine @ 50% higher level than T_4. The ingredients and chemical composition of the basal diet as analyzed according to the standards lay down by Association of Official Analytical Chemists (AOAC, 2013) [8] and are presented in Table-2.

Table 1: Experimental design

Treatment Groups	Particulars	Number of replicates	Number of birds/ replicate	Total
T_1	Control- Standard broiler diet as per BIS (2007) specifications	4	10	40
T_2	Control+100% synthetic lysine	4	10	40
T_3	Control+50% synthetic and 50% herbal lysine	4	10	40
T_4	Control+100% herbal lysine	4	10	40
T_5	Control+50% herbal lysine higher level than T_4	4	10	40
			Total	200

The birds were fed the pre starter, starter and finisher diets for 1 to 7, 8 to 21 and 22 to 42 days of age, respectively. The birds were housed in deep litter pans using wheat straw as litter material and reared from day-old to 42 days of age following standard management practices. To study the balance of nitrogen and energy, a metabolism trial was conducted during 6th week of growth period. One bird was randomly selected from each replicate and transferred to metabolic cages. Thus, the feed residue and excreta voided were weighed and properly recorded for final calculations of the total daily feed consumption and excreta voided. Gross energy of oven dried feed was determined by standard procedure using Bomb Calorimeter.

Nitrogen retetion calculated as: (Nitrogen intake-Nitrogen excreted)/Nitrogen intake × 100

Similarly, dry matter metabolizability and gross energy metabolizability were also calculated. Protein efficiency ratio (PER) was calculated as: Body weight gain (g)/Total protein intake (g) × 100. Energy efficiency ratio (EER) was calculated as: Body weight gain (g)/Total ME intake (Kcal/kg) ×100. Feed and water were provided *ad-lib*. All the birds were vaccinated against Ranikhet disease on 4th day and IBD on 13th day of age. Weekly feed intakes, body weight gain were recorded. The data were statistically analyzed (Snedecor and Cochran, 1989) [9] and the means of different experimental groups were tested for statistical significance.

Table 2: Percentage of feed ingredients and chemical composition of the basal diet in different growth periods

Item	Pre-starter	Starter	Finisher
Feed ingredients (%)			
Maize	49.00	51.00	56.00
Soybean meal	20.50	19.00	16.00
Groundnut cake	20.50	19.00	16.00
Fish meal	5.00	5.00	5.00
Vegetable oil	3.00	4.00	5.00
Mineral mixture	2.00	2.00	2.00
Feed additives*	0.39	0.40	0.33
Herbal lysine	0.21	0.18	0.12
Chemical composition			
CP	23.00	22.00	20.00
CF	6.48	6.48	8.06
EE	2.58	2.58	2.59
Ash	6.11	6.12	6.11
Metabolizable energy (Kcal/Kg)**	3014.7	3107.7	3200

*Feed additives – Intermix regular-10g/ quintal (Each g contained vitamin A- 82,500 IU, vitamin D_3-16,500 IU, vitamin B_2- 50mg, and vitamin K- 10mg), Intermix BE-20g/ quintal (Each g contained vitamin B_1- 8.0mg, vitamin B_6 -16mg, niacin- 120mg, vitamin B_{12}- 80mcg, calcium pantothenate- 80mg and vitamin E-80mg), Coxicheck-50g, Choline chloride-50g, Antibiotic(CTC)-100g, DL-Methionine-430g.

**Calculated value as per Singh and Panda *et al*., 2002 [10].

Results and Discussion

Growth performance: During pre starter phase, mean values of average feed intake were significantly ($P< 0.05$) higher in both synthetic as well as herbal lysine supplemented groups than the control (T_1) group. In starter phase, comparatively higher feed intake was observed in 50% herbal+50% synthetic lysine and 100% herbal lysine supplemented groups as compared to the group supplemented with lysine deficit diet. In finisher phase, among all treatment groups, feed intake was significantly ($P<0.05$) higher in T_3 (2540.0 g/bird) group supplemented with 50% herbal + 50% synthetic lysine followed by T_5 (2538.0 g/bird) than other groups. Mean values of average feed intake during the overall experiment; was observed maximum in diet having 50% synthetic+ 50% herbal lysine (3548.3 g/bird) followed by 100% synthetic lysine (3542.6 g/bird) and 50% higher level than T_4 (3542.2 g/bird) compared to synthetic (3537.9 g/bird) and control (3534.4 g/bird) groups. Findings of present study on feed

intake were similar to Sharma and Ranjan, (2016) [11] who studied the comparative effect of herbal and synthetic amino acids on growth performance and biochemical parameters in broiler chickens and reported significantly (P<0.05) increased feed intake in herbal group compared to control. Similarly, Ahmed and Abbas (2015) [12] reported the effects of level of methionine on feed intake during starter period were not significantly (P□0.05) influenced by different dietary treatments. However, during the finisher period, the 0.20% herbal methionine group had significantly (P□0.05) increased feed intake as compared to other treatments. Feed intake is recorded higher in group supplemented with 50% herbal + 50% synthetic lysine group during the overall experiment that may be because of the synergistic effect of herbal and synthetic lysine on the feed intake of broiler birds.

A significant (P< 0.05) increase in body weight gain was observed in groups supplemented with 50% synthetic + 50% herbal lysine (111.9.g/bird) and 50% herbal lysine higher level than T_4 (111.3 g/bird) as compared to group supplemented diet without lysine (107.4 g/bird). However, a comparable difference in average body weight gain was observed in control group and 100% synthetic lysine group in pre starter phase.

Data observed at the starter phase of experiment revealed that herbal lysine addition up to the level of 100% affected body weight gain significantly (P<0.05). In all groups, average weight gain found maximum in 50% synthetic and 50% herbal lysine (470.1 g/bird) supplementation group. Among finisher phase, the average weight gain was significantly higher (P<0.05) in T_4 group (100% herbal lysine) followed by T_5 (50% higher level than T_4) and T_3 (50% herbal + 50% synthetic) as compared to T_2 (100% synthetic lysine) and T_1 (control). Total body weight gain was found to be highest in group supplemented with 100% herbal lysine (1951.7 g/bird). A significantly (P< 0.05) higher average body weight gain was observed in herbal lysine (T_3, T_4 and T_5) supplemented groups as compared to synthetic lysine (T_2) supplemented and control group (T_1) during overall experiment. Similar results were reported by Kanduri *et al.* (2011) [13], Kanduri *et al.* (2015) [14] and Kathirvelan *et al.* (2016) [3].This might be due to more availability of amino acids for protein synthesis which increased the average weight gain of broiler.

At the age of one week, it was observed that feed conversion ratio did not differed significantly among all treatment groups. Data observed at starter phase of experiment revealed that feed conversion ratio improved significantly in treatment groups T_2, T_3 and T_4 which were supplemented with 100% synthetic lysine, 50% synthetic+50% herbal lysine and 100% herbal lysine respectively as compared to T_1. A significant (P<0.05) improvement in feed conversion ratio was noticed among herbal lysine supplemented groups as compared to control group. Minimum feed conversion ratio was observed in group supplemented with 100% herbal lysine in the finisher phase.

Table 3: Average feed intake, body weight gain and feed conversion ratio under different dietary treatments in experimental period

Treatments	Pre-Starter	Starter	Finisher	Overall
	Average feed intake (g/bird)			
T_1	152.3^{a}±0.73	847.0^{a}±0.36	2535.0^{a}±0.39	3534.4^{a}±0.73
T_2	155.1^{b}±0.85	848.8^{ab}±0.96	2534.0^{a}±0.91	3537.9^{a}±1.93
T_3	157.2^{b}±0.43	851.1^{b}±0.51	2540.0^{b}±0.91	3548.3^{c}±1.21
T_4	156.1^{b}±0.44	850.6^{b}±0.85	2535.8^{ab}±0.65	3542.6^{b}±1.16
T_5	155.0^{b}±0.91	849.2^{ab}±0.99	2538.0^{b}±0.79	3542.2^{b}±1.09
	Average weight gain (g/bird)			
T_1	107.4^{a}±0.23	464.0^{a}±0.55	1352.0^{a}±0.77	1923.4^{a}±0.50
T_2	108.6^{ab}±0.62	468.4^{b}±0.49	1359.9^{b}±1.47	1936.9^{b}±1.20
T_3	111.9^{b}±2.18	470.1^{b}±1.09	1369.6^{c}±1.03	1951.6^{d}±2.00
T_4	109.1^{ab}±0.64	469.4^{b}±0.92	1373.2^{c}±1.26	1951.7^{d}±1.39
T_5	111.3^{b}0.64	466.1^{a}±0.55	1370.8^{c}±0.82	1948.2^{c}±0.87
	Feed conversion ratio			
T_1	1.41±0.009	1.82^{b}±0.0029	1.87^{c}±0.0012	1.83^{c}±0.0005
T_2	1.42±0.031	1.81^{a}±0.0016	1.86^{b}±0.002	1.82^{b}±0.0020
T_3	1.40±0.017	1.81^{a}±0.0036	1.85^{a}±0.0003	1.81^{a}±0.0008
T_4	1.43±0.018	1.81^{a}±0.0022	1.84^{a}±0.0021	1.81^{a}±0.0015
T_5	1.39±0.013	1.82^{b}±0.0013	1.85^{a}±0.0013	1.81^{a}±0.0012

During overall experiment in present study, it was observed that diet supplemented with herbal lysine at different level (T_3, T_4 and T_5) showed a significantly better feed conversion ratio when compared with 100% synthetic lysine supplemented group (T_2) and control group (T_1). Results showed that on addition of different levels of herbal lysine in diet of broiler birds, significantly improved the feed conversion ratio and hence the performance of birds as compared to 100% synthetic lysine supplemented group and control group. Results are in collaboration with Chattopadhyay *et al.* (2006) [6] revealed that supplementation of DL-methionine improved feed conversion ratio compared to control whereas supplementation of herbal methionine at the rate of 15g/kg showed better feed conversion ratio compared to DL-methionine supplemented birds. Similarly, Kalbande *et al.* (2009) [15] investigated and found that the supplementation of DL-methionine improved feed conversion ratio compared to control whereas supplementation of herbal methionine @1kg/tonne of feed showed better feed conversion ratio than DL-methionine supplemented birds. In monogastric animals the efficiency of feed utilization is influenced by the levels of lysine and methionine in the diet NRC, 1994 [16].

Nutrient Retention

Among different dietary treatments the percentage of dry matter metabolizability and gross energy metabolizability differed non-significantly as compared to the control group. Highest dry matter metabolizability percentage was noticed in dietary group supplemented with 100% herbal lysine while lowest in control which was supplemented with lysine free diet but the difference was non-significant. Nitrogen retention was recorded maximum in T_4 and minimum in T_1 and the observation in all dietary treatments groups were statistically

non-significant. Protein efficiency ratio among different dietary treatments was statistically non-significant. Highest Protein efficiency ratio was noticed in dietary treatment T_2 and T_3 which were supplemented with 100% synthetic lysine and 50% herbal + 50% synthetic lysine respectively while lowest in T_1 which was fed with a lysine deficient diet. Non-significant difference was observed among different dietary treatment groups in the mean values of energy efficiency ratio. Results are in agreement with Kanduri *et al.* (2011) [13] who observed that the digestibility coefficient of dry matter and crude protein revealed non-significant difference among herbal and synthetic amino acid treatment groups however, it was significantly higher in amino acids treatments groups than control.

Table 4: Mean values of Dry Matter (DM) Metabolizability, Gross Energy (GE) Metabolizability, Nitrogen retention, Protein efficiency ratio (PER), Energy efficiency ratio (EER) under different dietary treatments

Attribute (%)	Treatments				
	T_1	T_2	T_3	T_4	T_5
DM Metabolizability	64.77± 0.26	65.09±0.54	65.09±0.54	65.54±0.38	65.36±0.48
GE Metabolizability	61.90±0.48	62.92±0.83	62.15± 0.73	63.84±0.29	63.34±0.71
Nitrogen retention	62.50±0.35	62.70±0.40	62.72±0.41	62.83±0.37	62.80±0.36
PER	2.79±0.005	2.81±0.019	2.81±0.019	2.78±0.020	2.79±0.017
EER	17.65±0.03	17.77±0.11	17.77±0.11	17.60±0.12	17.66±0.10

Conclusion

Best results were reported on herbal lysine supplementation @ 100 per cent with regards to performance in terms of average body weight gain and feed conversion ratio. Metabolizability of nutrient reported from supplementation of either herbal or synthetic amino acids was with equal competence as that of control group. Thus, it can be concluded that supplementation of herbal lysine at an inclusion level of 100% was found to improve the performance of birds, hence it can be suggested that100% synthetic lysine can be replaced with herbal lysine with a booster effect on the performance of birds in terms of weight gain and feed conversion ratio without any ill effect on metabolizability of nutrients.

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