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Original Research Article

Supplementation of L-Tryptophanin Reduced Dietary Crude Protein Levels of Commercial Broilers on Growth and Economic Indices

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ABSTRACT

The present study aimed to evaluate the effect of reduced dietary crude protein and supplementation of tryptophan on Economic feasibility of inclusion of L-Tryptophan in commercial broiler diets. A total of 460 broiler chicks were randomly assigned to 7 dietary treatments of six replications of 11 birds each. The dietary Crude protein was reduced by 0.75, 1.50 and 2.25 per cent units. The treatments with reduced Crude protein level were supplied with synthetic tryptophan to need desired level of tryptophan as in control. The cost of production per kilogram live body weight was non significant among the 0.75 and 1.5 percent reduced crude protein diets and 2.25 percent reduced crude protein with L-tryptophan supplementation showed higher cost of production per kg live weight. Performance index score significantly improved at the CP reduction of 1.5 and 2.25 per cent units. Economic index score was higher at 0.75 percent reduced CP diets as compared to 2.25 percent reduced CP diets.Net returns per kg live weight was significantly higher in 0.75 percent reduced CP diet group with L-tryptophan supplementation as compared with 2.25 percent reduced CP group. Dietary crude protein could be lowered upto 1.5 percent level at all growing phases of commercial broiler birds safely and the results were economical.

Keywords

Broilers, Crude protein, Tryptophan, Body weight, Economic indices

Introduction

Broiler production in India has continuously faced challenges of providing optimum environment for maximum growth, production, disease control and finally the cost benefit ratio involved for a successful poultry husbandry practises. It is estimated that 25 per cent of the world's meat supply is derived from poultry. India being in tropical region is most congenial for poultry production. India is the 5th largest producer of poultry meat in the world, producing about 2.337 million tonnes of chicken meat annually. Poultry industry in India is growing at the rate of 8 to 15 per cent annum. The per capita availability of poultry meat is 2.15 kg as against the recommendation of the National Institute of Nutrition at 11 kg of meat per annum (Prabakaran, 2012). In order to sustain growth and profitability, it is becoming essential to create new innovative ways to stay competitive within the industry and decrease the cost of production as much as possible and at the same time to produce high quality products for consumers. Feed is a major input cost in poultry accountable for more than 70% of the production cost and it is becoming an issue of greater significance as the price of feed ingredients continue to rise. Protein is among the most expensive nutrient of the feed and broilers have high dietary CP requirements. Proteins and AA perform different functions such as biosynthesis of tissues and animal products. In poultry nutrition, the essential AA are off great concern and of which, tryptophan even though required in lesser, still plays a vital role in tissue protein accretion when the dietary crude protein is reduced.

L-Tryptophan is a nutritionally essential AA for poultry and other mono gastric animals because it cannot be synthesized in the body. Tryptophan is a critical nutrient for protein synthesis. However, emerging evidence from recent studies shows that tryptophan and its metabolites (serotonin and melatonin) can regulate feed intake reproduction, immunity, neurological function and anti-stress responses. Additionally, tryptophan modulate gene expression and nutrient metabolism to impact whole-body homeostasis in organisms. Thus, adequate intake of this AA from the diet is crucial for growth, development, and health of birds. Tryptophan reduces stressful behaviour and provides a nutritional means to improve carcass quality and increase product value. High crude protein diets for broilers results in amino acid excess and elevated nitrogen excretion. Nitrogen retention efficiency may be increased if low crude protein broiler diets are supplemented with CAA in a pattern that matches maintenance and tissue accretion needs. In addition, lowering crude protein content in broiler diets may reduce feed cost, allow use of alternate feed stuffs and improve tolerance to heat stress (Kidd, 2000). Poultry nutritionists have decreased the use of protein rich feed ingredients by supplementing critical AA such as DL-methionine and L-lysine and L-threonine which are widely used in poultry industry. Although the tryptophan requirement has been precisely established with many dose response studies with graded levels of tryptophan, yet there are many contradictory reports to state the extent of CP reduction when amino acids are balanced up to the level of L-tryptophan limiting and Hence, this study was conducted with the objectives to establish the level of CP reduction that can be achieved with supplementation of L- tryptophan in diets on growth and Economic indices in commercial broilers.

Materials and Methods

All experimental procedures and animal care were approved by Institutional Animal Ethics Committee (IAEC) of the Karnataka Veterinary Animal and Fisheries Sciences University, Bidar.

Birds, management and experimental design

Four hundred and sixty-two day-old Vencob broiler chicks of uniform weight were obtained from a Venkateshwara hatcheries, wing banded, weighed and randomly assigned to seven dietary treatments according to a completely randomized design. Each treatment had six replications of 11 birds each. The broiler chicks were housed in deep litter system with Paddy husk as litter material. Standard management practices were adopted during the experimental period with *adlibitum* access to feed and water for a period of forty-two days. Chicks were vaccinated as per the standard vaccination programme schedule commonly practised in India.

Chemical analysis of the feed ingredients and feed samples

Prior to formulating the diets, all the basal ingredients and the feed samples used in the experimental diets were analysed for crude protein, ether extract, crude fibre, and ash content as per the standard procedures of AOAC (1995). The AA composition of the ingredients used in formulation of the experimental diets were analysed at Evonik SEA Pte. Ltd, Singapore and the AA composition of the experimental diets was calculated based on the analysed AA composition of ingredients. A commercial feed grade L-tryptophan procured from standard supplier was prior tested for purity in reference laboratory and its contribution for CP and energy value were taken into consideration while formulating the test diets.

Experimental diets

The experimental diets were divided into three phases *viz.*, pre-starter (0-14 days), starter (15-28 days) and finisher (29-42 days) and feed was offered in mash form. The control (T_1) was formulated to meet the minimum requirement for all AA as per the NRC (1994). The dietary CP was reduced by 0.75 per cent unit in treatment groups (T_2& T_3), 1.5 per cent unit in treatment groups (T_4& T_5) and 2.25 per cent unit in treatment groups (T_6& T_7) and in the treatment groups T_3, T_5, and T_7, L-tryptophan was supplemented to match the levels present in the control group. The tryptophan to lysine ratios was maintained in all the test diets to meet the minimum requirement as per Baker (1997) except for negative control groups (T_2, T_4 & T_6). The ingredient, nutrient and amino acid composition under pre-starter, starter and finisher diets is presented in Tables 2, 3, 4, 5, 6 and 7 respectively.

Growth and Economic Indices

Cumulative body weights of individual birds were recorded at the end of each phase. The cost incurred in formulating the pre-starter, starter and finisher phase diets of the experiment were calculated based on the market price of the different ingredients used in the rations. The cost of production included cost incurred for day old chick, feed cost, brooding, vaccination, medication, disinfection, litter material, labour, transportation, rearing and miscellaneous costs in all the treatments. Gross return and net return were calculated based on the market price of the chicken. Performance index score is the relationship of the body weight, feed conversion ratio and number of days reared and economic index score is the relationship of performance index score with the cost the diet. Performance index score (PIS) and Economic index score (EIS) were calculated using the following formulae.

$$\text{Performance Index Score} = \frac{\text{Average body weight (g) x Per cent livability}}{\text{Feed Conversion Ratio x Number of days reared x 10}}$$

$$\text{Economic Index Score} = \frac{\text{Performance index score}}{\text{Cost of the diet (Rs/kg)}}$$

The data collected in the study was analysed using Graph Pad Prism 5.01. The data pertaining to body weight and economic feasibility parameters for the trial were subjected to statistical analysis by one-way analysis of variance (ANOVA). Significant mean difference between the treatments was determined by using Duncan's new multiple range tests.

Results and Discussions

The effect of supplementation of L-tryptophan by lowering dietary crude protein levels on the weekly mean body weight gain of commercial broilers from first to sixth week of age is presented in the Table 7. On cumulative basis, broilers fed 1.5 and 2.25 percent unit CP reduced (T_4 and T_6) without L-tryptophan showed significant reduction in Body weight gain (BWG) on cumulative basis at the end of six weeks and with L-tryptophan supplementation (T_7) improved the BWG similar to that of 0.75 per cent unit reduced CP group with L-tryptophan supplementation group (T_3) but could not perform on par with the control group (T_1). The findings of the 1.5 per cent unit reduced CP treatment group (T_4) without the supplementation of L-tryptophan also resulted in significantly reduced body weight gain as that the control group (T_1).

The reduction of the BWG in T_4 and T_6 could be due to reduction of feed intake significantly and feed efficiency leading to inadequate levels of Non-essential amino acids (NEAA) in the diet of the birds (Sklan and Plavnik, 2002) for which the requirement is not yet known or there could be imbalance of amino acid requirement on digestibility basis leading to altered ratio of Essential amino acids (EAA) to NEAA. Supplementation of L-tryptophan may provide optimum amino acid balancing leading to adequate nitrogen pool to provide for the synthesis of non-essential amino acids and balance among the certain essential amino acids which might have resulted in higher performance similar to that of the 0.75 percent unit reduced crude protein group with supplementation of L-tryptophan (T_3).

The effects of the L- tryptophan deficiency observed in this study are in accordance with the observations of the previous studies (Corzo *et al*., 2005c; Hsia *et al*., 2005, Rogers and Pesti, 1990and Warnick and Anderson, 1968).

The cost of production and economic indices *viz*, performance index score, economic index score, cost of production per bird, cost of production per kg live weight, net returns per bird and net returns per kg live body weight were significantly influenced by the supplementation of L-tryptophan in reduced dietary CP levels and is presented in the Table 8.

Cost of production/bird

The reduced CP diets by 0.75 per cent unit with the supplementation of L-tryptophan group showed a non-significant reduction in the cost of production per bird as compared to the control group. This is attributed to non-significant differences in the feed intake and feed conversion ratio and there is no considerable reduction in the feed cost as compared to that of control diet. However, 1.5 and 2.25 per cent unit reduced CP groups with L-tryptophan supplementation groups (T_4, T_6 and T_7) showed significant difference with the control group (T_1) and 0.75 per cent reduced CP group (T_2), respectively which is in accordance with Burnham (2003) and Bade et al (2014)

Cost of production/Kg live weight

The cost of production per Kg LW of the birds among the various treatment groups did not differ significantly as compared to the control group. This is attributed to relatively higher feed consumption, poor FCR offsetting the feed cost incurred and relatively lesser body weight in lower CP diets at 1.5 and 2.25 per cent unit reduced CP groups might have contributed to non-significant differences in the cost of production of broilers per Kg live weight. This indicated that supplementation of L-tryptophan led to higher expenditure incurred towards feeding the broilers.

Performance Index Score (PIS)

Performance index score was significantly influenced among the various treatment groups. There was no significant difference up to 2.25 per cent units reduced CP group with L-tryptophan supplementation group (T_7) as compared to that of the control group (T_1).The Performance Index Score indicate that birds in the treatment groups at 1.5 and 2.25 per cent unit reduced CP group without L-tryptophan supplementation group showed significant inferior in the Performance Index Score as that of the control group. Supplementation of L-tryptophan showed PIS improved as that of the control group.

The better PIS in L-tryptophan supplemented reduced CP treatment groups are mainly attributed to better body weight gain, superior feed to gain ratio as well as good liveability percentage in L-tryptophan supplemented reduced CP groups. This indicated that supplementation of L-tryptophan is beneficial in reducing the CP in the diet of commercial broilers.

Economic Index Score (EIS)

Statistical analysis revealed significantly high EIS in T_3 as compared to that of the lowest in T_6 group. All other treatment groups remained non-significant as compared to that of control group.

The L-tryptophan supplemented groups showed non-significant higher economic index scores than un-supplemented group at each level of CP reduction and are statistically similar to that of the control group. This indicate that supplementation of L-tryptophan was economical in the diet of commercial broilers at 0.75 per cent unit reduced CP group than at the further lower level of CP reduction with L-tryptophan supplementation.

Net returns/bird

Statistical analysis showed no significant differences between control group and all other treatment groups but there was a significant decrease in the net returns per bird in T_7 as compared to 0.75 per cent unit reduced CP with L-tryptophan supplementation group (T_3). However, there was a numerical increase in the net returns per bird in L-tryptophan supplemented at 0.75 and 1.5 per cent unit of CP reduction as compared to its counterpart group. The results indicate that maximum returns per bird at 0.75 per cent unit reduced CP group with L-tryptophan supplementation is significantly higher than 2.25 per cent unit reduced CP group with supplementation of L-tryptophan group. This may be due to better FCR at T_3 resulting in lesser feed cost of feeding and relatively higher body weight gain, which is on par with the control group.

Net returns/kg live weight

All though Statistical analysis showed no significant differences between control group and all other treatment groups, there was a significant increase in the net returns per kg live weight in T_3 as compared to 2.25 per cent unit reduced CP with L-tryptophan supplementation group (T_7). The highest net returns of Rs 8.62 per kg live weight was obtained at 0.75 per cent unit reduced CP group with L-tryptophan supplementation group (T_3) as compared to Rs 7.04 in the T_7 group which indicate that supplementation of L-tryptophan is beneficial in getting the maximum returns per kg live weight at 0.75 per cent unit reduced CP group than with the further lower CP diet groups. This results attributed may be due to the better FCR, higher body weight gain which is similar to the control group.

Table.1 Description of the experimental treatment diets

Experimental Diets	Broiler Pre-Starter		Broiler Starter		Broiler finisher	
	CP %	TRP	CP %	TRP	CP %	TRP
T_1	23.00%	Basal Level	21.00%	Basal level	19.00%	Basal level
T_2	22.25%	-	20.25%	-	18.25%	-
T_3	22.25%	+	20.25%	+	18.25%	+
T_4	21.50%	-	19.50%	-	17.50%	-
T_5	21.50%	+	19.50%	+	17.50%	+
T_6	20.75%	_	18.75%	-	16.75%	-
T_7	20.75%	+	18.75%	+	16.75%	+

Note:- indicates no Tryptophan supplementation
+ indicates Tryptophan supplementation as in control group T_1
L-Tryptophan was supplemented to meet basal tryptophan level of 0.24 per cent in pre-starter, 0.21 per centin starter and 0.19per centin finisher diets.

Table.2 Per cent Ingredient composition of pre-starter diets (0-14 days of experiment)

Ingredients	Treatments						
	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Maize (yellow)	54.62	56.01	56.01	57.40	57.40	58.83	58.85
R. Polish	0.0	1.50	1.50	3.00	3.00	4.50	4.50
DORB	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MBM	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Soybean meal	34.98	32.37	32.34	29.71	29.65	27.02	26.93
Veg. Oil	2.80	2.40	2.40	2.00	2.00	1.60	1.60
DCP	0.75	0.75	0.75	0.75	0.75	0.75	0.75
LSP	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Salt	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Soda Bicarb	0.05	0.05	0.05	0.05	0.05	0.05	0.05
***TM Mix**	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Pot. carbonate	-	0.05	0.05	0.12	0.12	0.18	0.185
Lysine	0.090	0.170	0.170	0.251	0.252	0.333	0.335
DL-Methionine	0.292	0.314	0.314	0.336	0.337	0.359	0.360
L-Threonine	0.028	0.064	0.064	0.099	0.100	0.136	0.138
Valine	0.00	0.00	0.00	0.016	0.017	0.058	0.060
Isoleucine	0.00	0.00	0.00	0.015	0.016	0.059	0.061
Tryptophan	0.00	0.00	0.013	0.00	0.026	0.00	0.039
****Additives**	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

***Trace mineral mixture**: Fe-90000ppm, I–2000ppm, Cu–15000ppm, Mn–90000ppm, Zn-80000ppm, Se–300ppm.

****Additives**: Vit A-10mIU, D_3-2.0 mIU, E-30.0g, C-50 g, B_1-2.0g, B_2-10.0g, B_6-3.0g, B_{12}-0.015, Niacin-30.0g, Calcium-D-Pantothenate 15.0g, Biotin-0.10g, Folic Acid- 2.0g and Vit-K-4.0g; Herbal Liver stimulant-1700g; Semduramicin- 30.0g; Tetracyclin-30.00g; a commercial Toxin binder-200

Table.3 Calculated nutrient and amino acid composition of the pre-starter experimental diets

Nutrient	Treatments						
	T_1	T_2	T_3	T_4	T_5	T_6	T_7
C.Protein	23.000	22.252	22.251	21.500	21.501	20.752	20.751
ME Kcal/Kg	2976	2977	2977	2978	2979	2981	2982
Calcium	0.992	0.986	0.986	0.980	0.980	0.973	0.973
T.Phos.	0.747	0.749	0.749	0.752	0.752	0.754	0.754
A.Phos.	0.452	0.451	0.451	0.450	0.450	0.449	0.449
Fat	2.849	3.072	3.072	3.295	3.295	3.518	3.518
L.Acid	1.371	1.447	1.447	1.523	1.523	1.599	1.600
C.Fibre	3.270	3.389	3.389	3.508	3.507	3.625	3.623
Amino acid composition							
Lysine	1.265	1.265	1.265	1.265	1.265	1.265	1.265
Methionine	0.576	0.586	0.586	0.596	0.597	0.607	0.607
Met+Cys	0.914	0.914	0.914	0.914	0.914	0.914	0.914
Threonine	0.851	0.852	0.851	0.851	0.851	0.851	0.851
Valine	1.040	1.002	1.001	0.977	0.977	0.977	0.977
Isoleucine	0.917	0.875	0.875	0.847	0.847	0.847	0.847
Tryptophan	0.244	0.232	0.244	0.220	0.244	0.208	0.244
Arginine	1.550	1.483	1.482	1.414	1.413	1.345	1.342
Histidine	0.587	0.564	0.564	0.542	0.541	0.519	0.518
Leucine	1.867	1.807	1.806	1.745	1.744	1.682	1.680
P.Alanine	1.094	1.049	1.048	1.002	1.001	0.955	0.953
Tyrosine	0.677	0.650	0.649	0.622	0.621	0.593	0.592
Serine	1.017	0.972	0.972	0.927	0.926	0.880	0.879

Table.4 Per cent Ingredient composition of starter diets (14-28 days of experiment)

Ingredients	Treatments						
	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Maize (yellow)	60.15	61.58	61.58	63.14	63.12	64.50	64.55
R. Polish	0.00	1.50	1.50	3.00	3.00	4.50	4.50
MBM	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Soybean meal	29.36	26.72	26.70	24.00	23.95	21.30	21.22
Veg. Oil	3.00	2.60	2.60	2.10	2.12	1.70	1.70
DCP	0.50	0.50	0.50	0.50	0.515	0.52	0.52
LSP	0.40	0.40	0.40	0.40	0.40	0.42	0.42
Salt	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Soda Bicarb	0.05	0.05	0.05	0.05	0.05	0.05	0.05
TM Mix	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Pot. carbonate	-	0.05	0.05	0.12	0.12	0.18	0.185
Lysine	0.170	0.198	0.198	0.281	0.283	0.363	0.366
DL-Methionine	0.283	0.305	0.306	0.328	0.329	0.351	0.352
Threonine (98%)	0.058	0.094	0.095	0.131	0.132	0.168	0.170
Valine	0.00	0.017	0.018	0.060	0.061	0.102	0.104
Isoleucine	0.00	0.017	0.016	0.061	0.063	0.108	0.108
Tryptophan	0.00	0.00	0.130	0.00	0.260	0.00	0.400
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*__Trace mineral mixture__: Fe-90000ppm, I–2000ppm, Cu–15000ppm, Mn–90000ppm, Zn-80000ppm, Se–300ppm.

**__Additives__: Vit A-10mIU, D_3-2.0 mIU, E-30.0g, C-50 g, B_1-2.0g, B_2-10.0g, B_6-3.0g, B_{12}-0.015, Niacin-30.0g, Calcium-D-Pantothenate 15.0g, Biotin-0.10g, Folic Acid- 2.0g and Vit-K-4.0g; Herbal Liver stimulant-1700g; Semduramicin- 30.0g; Tetracyclin-30.00g; a commercial Toxin binder-200

Table.5 Calculated nutrient and amino acid composition of the starter experimental diets

Nutrient	Treatments						
	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Crude Protein	21.002	20.251	20.254	19.501	19.500	18.751	18.750
ME Kcal/Kg	3050	3052	3052	3049	3051	3050	3052
Calcium	0.788	0.781	0.781	0.775	0.778	0.780	0.779
T.Phosphorus	0.685	0.688	0.688	0.690	0.692	0.696	0.695
A.Phosphorus	0.404	0.403	0.403	0.402	0.404	0.404	0.404
Sodium	0.218	0.218	0.218	0.218	0.218	0.218	0.218
Chloride	0.287	0.287	0.287	0.288	0.288	0.289	0.289
Fat	3.076	3.299	3.299	3.526	3.525	3.748	3.748
Linoleic Acid	1.460	1.536	1.536	1.614	1.614	1.690	1.690
Crude Fibre	3.224	3.342	3.342	3.462	3.460	3.578	3.576
Amino acid composition							
Lysine	1.150	1.150	1.150	1.150	1.150	1.150	1.150
Methionine	0.548	0.558	0.559	0.569	0.569	0.579	0.580
Met + Cys	0.863	0.863	0.863	0.863	0.863	0.863	0.863
Threonine	0.806	0.806	0.806	0.806	0.806	0.806	0.806
Valine	0.946	0.923	0.923	0.923	0.923	0.923	0.923
Isoleucine	0.821	0.778	0.778	0.735	0.734	0.691	0.690
Tryptophan	0.217	0.205	0.217	0.192	0.217	0.180	0.217
Arginine	1.385	1.317	1.316	1.247	1.245	1.177	1.174
Histidine	0.534	0.511	0.511	0.488	0.488	0.465	0.464
Leucine	1.736	1.674	1.674	1.612	1.610	1.549	1.546
P.Alanine	0.989	0.943	0.943	0.896	0.894	0.848	0.846

Table.6 Per cent Ingredient composition of finisher diets (29-42 days of experiment) –

Ingredients	Treatments						
	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Maize(yellow)	63.66	65.05	65.05	66.45	66.47	67.87	67.90
R. Polish	0.00	1.5	1.50	3.00	3.00	4.50	4.50
MBM	5.00	5.00	5.00	5.00	5.00	5.00	5.00
SBM	24.55	21.93	21.91	19.26	19.21	16.56	16.48
Vegetable Oil	4.2	3.80	3.80	3.40	3.40	3.00	3.00
DCP	0.70	0.70	0.70	0.70	0.70	0.70	0.70
LSP	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Soda Bicarb	0.05	0.05	0.05	0.05	0.05	0.05	0.05
TM Mixture	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Pot. carbonat	-	0.05	0.05	0.12	0.12	0.18	0.185
Lysine	0.082	0.161	0.162	0.243	0.244	0.325	0.328
Methionine	0.210	0.232	0.232	0.255	0.255	0.278	0.278
Threonine	0.025	0.061	0.061	0.097	0.098	0.1340	0.135
Valine	0.00	0.000	0.000	0.022	0.023	0.066	0.068
Isoleucine	0.000	0.000	0.000	0.045	0.046	0.092	0.094
Tryptophan	0.00	0.000	0.013	0.000	0.026	0.000	0.039
Additives	0.600	0.600	0.600	0.600	0.600	0.600	0.600
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*__Trace mineral mixture__: Fe-90000ppm, I–2000ppm, Cu–15000ppm, Mn–90000ppm, Zn-80000ppm, Se–300ppm.

**__Additives__: Vit A-10mIU, D_3-2.0 mIU, E-30.0g, C-50 g, B_1-2.0g, B_2-10.0g, B_6-3.0g, B_{12}-0.015, Niacin-30.0g, Calcium-D-Pantothenate 15.0g, Biotin-0.10g, Folic Acid- 2.0g and Vit-K-4.0g; Herbal Liver stimulant-1700g; Semduramicin- 30.0g; Tetracyclin-30.00g; a commercial Toxin binder-200

Table.7 Calculated nutrient and amino acid composition of the finisher diets experimental diets

Nutrient	Treatment						
	T_1	T_2	T_3	T_4	T_5	T_6	T_7
CP %	19.001	18.251	18.253	17.500	17.500	16.752	16.750
ME Kcal/Kg	3153	3154	3154	3156	3157	3159	3160
Calcium %	0.850	0.844	0.844	0.837	0.837	0.831	0.831
T.Phos. %	0.699	0.702	0.701	0.704	0.704	0.706	0.706
A.Phos. %	0.431	0.431	0.431	0.430	0.430	0.429	0.429
Sodium	0.217	0.217	0.217	0.217	0.217	0.218	0.218
Chloride	0.287	0.287	0.287	0.288	0.288	0.289	0.289
Fat	3.135	3.358	3.358	3.581	3.581	3.804	3.805
Linoleic Acid	1.508	1.584	1.584	1.660	1.661	1.737	1.737
Crude Fibre %	3.142	3.261	3.260	3.379	3.378	3.496	3.494
Amino acid composition							
Lysine	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Methionine	0.462	0.472	0.472	0.483	0.482	0.493	0.493
Met+Cys	0.752	0.752	0.752	0.752	0.752	0.752	0.752
Threonine	0.702	0.702	0.702	0.702	0.702	0.702	0.702
Valine	0.859	0.820	0.820	0.802	0.802	0.803	0.802
Isoleucine	0.734	0.692	0.692	0.690	0.690	0.690	0.690
Tryptophan	0.191	0.179	0.191	0.167	0.191	0.154	0.191
Arginine	1.238	1.170	1.170	1.102	1.100	1.032	1.029
Histidine	0.485	0.463	0.463	0.440	0.440	0.417	0.416
Leucine	1.609	1.548	1.548	1.486	1.485	1.423	1.421
P.Alanine	0.893	0.847	0.847	0.801	0.800	0.753	0.752
Tyrosine	0.546	0.518	0.518	0.490	0.490	0.462	0.461

Table.8 Weekly cumulative body weight gain (g/bird) of commercial broilers as influenced by dietary supplementation of L-tryptophan by reducing the dietary levels of crude protein

Treatments	CP Reduction (% units)	Experimental period (Weeks)					
		I	II	III	IV	V	VI
T_1	-	116.2^{ab}	329.5^{a}	666.2^{a}	1044^{ab}	1543^{a}	2096^{a}
T_2	**0.75**	113.0^{b}	319.9^{ab}	645.9^{a}	1007^{ab}	1500^{ab}	2040^{abc}
T_3	**0.75**	118.8^{a}	334.9^{a}	674.8^{a}	1053^{a}	1544^{a}	2089^{ab}
T_4	**1.50**	114.4^{b}	312.6^{ab}	631.4^{ab}	978.7^{bc}	1442^{bc}	1965^{cd}
T_5	**1.50**	116.6^{ab}	323.7^{ab}	655.1^{a}	1027^{ab}	1507^{ab}	2054^{ab}
T_6	**2.25**	113.9^{b}	292.9^{b}	589.5^{b}	930.2^{c}	1396^{c}	1922^{d}
T_7	**2.25**	115.6^{ab}	311.3^{ab}	627.6^{ab}	995.8^{abc}	1466^{abc}	1995^{bcd}
$SE_m\pm$		0.442	3.345	5.980	8.084	10.163	12.060

Values in the same column with unlike superscripts are different.

Table.8 Effect of supplementation of L- tryptophan in reduced crude protein diets on economic feasibility of the birds fed with different treatment diets at the end of the experimental period

Treatments	CP Reduction (% units)	Feed cost (Rs) /ton of feed			Cost of production		Index scores		Net returns	
		Pre-starter	Starter	Finisher	Per bird	Per kg LW	PIS	EIS	Per Bird	Per kg LW
T_1	-	31,341	29,621	28,080	132.7[a]	63.28	286.70[a]	9.932[ab]	16.17[ab]	7.72[ab]
T_2	0.75	30.470	28,930	27,167	127.7[bc]	62.66	276.23[ab]	9.858[ab]	17.05[ab]	8.34[b]
T_3	0.75	30,786	27,240	27,485	130.3[ab]	62.38	285.15[ab]	10.05[a]	18.08[b]	8.62[b]
T_4	1.50	29,431	26,534	26,726	125.0[cd]	63.70	259.59[bc]	9.432[ab]	14.45[ab]	7.30[ab]
T_5	1.50	30,074	29,203	27,362	129.8[ab]	63.22	276.82[ab]	9.822[ab]	15.99[ab]	7.78[ab]
T_6	2.25	28,724	28,230	26,478	121.9[d]	63.45	246.50[c]	9.087[b]	14.54[ab]	7.55[ab]
T_7	2.25	27,688	29,216	27,361	127.6[bc]	63.96	263.34[abc]	9.354[ab]	14.04[a]	7.04[a]
$SE_m\pm$		-	-	-	0.900	0.178	3.236	0.095	0.431	0.178

Values in the same column with unlike superscripts are different

In conclusion, dietary CP diets could be reduced by 1.5 per cent units with supplementation of L- tryptophan without affecting BWG at the end of 42 days in commercial broilers. The 2.25 per cent unit reduced CP group with L-tryptophan supplemented group showed higher cost of production per Kg per live weight. The Performance Index Score indicate that birds in the treatment groups at 1.50 and 2.25 per cent unit reduced CP group without L-tryptophan supplementation group showed significantly inferior Performance Index Score as that of the control group. Supplementation of L-tryptophan significantly improved the PIS at the CP reduction of 1.5 and 2.25 per cent units on par with the control group. Economic index score was higher in 0.75 per cent reduced CP with L-tryptophan supplementation group as compared to 2.25 reduced CP group without L-tryptophan supplementation. Net returns per kg live weight was significantly higher in 0.75 per cent reduced CP group with L-tryptophan supplementation as compared to 2.25 per cent reduced CP diets with L-tryptophan supplementation.

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