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Effect of supplementing limiting amino acids on growth performance and carcass traits of Gramasree male chicks fed with low protein diets#

K. S. Sreyass[1*], Beena C. Joseph[2], P. Anitha[3], Binoj Chacko[4] and S. Maya[5]
Department of Poultry Science,
College of Veterinary and Animal Sciences, Mannuthy, Thrissur-680 651
Kerala Veterinary and Animal Sciences University, Kerala, India

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Abstract

An experiment was conducted to study the effect of reduced dietary crude protein (CP) diet supplemented with limiting amino acids on growth performance and carcass traits of Gramasree male birds up to eight weeks of age. A total of 280 day-old chicks were allotted randomly under five dietary treatments each with four replicates of 14 chicks under completely randomized design. The different dietary treatments viz., control diet (T1) was formulated as per ICAR (2013) nutrient requirements for Indian improved native birds with 21 per cent CP and 2800 kcal/kg Metabolizable energy (ME) using corn, soya bean meal, wheat bran and de-oiled rice bran. Treatment diets T2, T3, T4 and T5 were formulated by reducing CP content to 20, 19, 18, and 17 per cent, respectively with isocaloric value of 2800 kcal/kg ME and supplemented with methionine, lysine, threonine and tryptophan to meet the daily requirements. Weekly body weight and feed consumption were recorded. For the carcass study, two birds from each replicate were randomly selected and slaughtered humanely at eighth week of age. The results showed that the final body weight and cumulative weight gain were comparable among the treatments. The lowest cumulative feed intake and feed conversion ratio (FCR) were observed in 17 per cent CP containing treatment (T5), which was not significantly different from rest of the groups. The mean per cent breast meat yield, giblet yield, dressing yield and ready-to-cook yield were comparable among the five dietary treatments. The mean abdominal fat content in birds fed with 18 and 17 per cent (T4 and T5) were significantly ($p<0.05$) higher than the other treatment groups. The overall results indicated that the dietary CP of Gramasree male chicks can be lowered up to 17 per cent with the supplementation of methionine, lysine, threonine and tryptophan without affecting the growth performance of birds.

Keywords: *Low CP diet, limiting amino acids, Gramasree chicks, carcass trait*

1. MVSc scholar
2 and 4 Assistant Professor
3. Professor and Head
5. Professor and Head, Department of Veterinary Anatomy
**Corresponding author: iamdrsreyas@gmail.com, 9400558282*

Poultry development in India has taken a quantum leap in the last four decades. Broiler meat production is growing in India at a rate of 12 per cent per annum (GOI, Ministry of Food Processing Industries, 2019). The demand for broiler meat is expected to grow stronger due to consumer preference, increasing income levels and changing food habits. But there are certain hurdles in the availability of quality protein source at adequate quantity and affordable prices which can adversely affect the future growth of poultry industry. Among the feed ingredients, soya bean meal and corn are the costlier ingredients which together constitute about 95 per cent of the total feed cost and are the major components in changing production and marketing scenario of poultry and poultry products (Megha *et al*., 2021). Along with feed cost, the increased concern over environmental pollution due to rising ammonia emission from poultry houses as an effect of feeding diets with high protein also pose a high risk to future expansion of the poultry sector. Therefore, to find out a suitable feeding regime that decrease the feed cost as much as possible without affecting the growth performance of birds satisfying the requirements of all major nutrients is the need of the hour.

Several nutritional strategies have been proposed to reduce the feed cost and to reduce the possible effect on environmental concern, one such strategy is reducing the crude protein (CP) content of the diet. If this strategy is to be effective and growth performance are not to be harmed, the level of limiting amino acids in such reduced CP diets must be maintained by supplementation. Practically, poultry ration based on corn-soya bean meal are deficit in methionine, lysine, threonine and tryptophan to meet the requirement of birds (Baker *et al*., 1993). Therefore, it became essential to supplement the synthetic feed grade form of these limiting amino acids in the diet to achieve the desired performance. Replacing the soya bean meal partially with the synthetic limiting amino acids having increased bioavailability and affordable price can reduce the total cost of production and improve the nutrient digestibility in birds without altering their growth performance. However, differences in crude protein level, amino acid fortification, feed ingredients, levels of amino acid requirement imposed and age of birds have reported to contribute to the discrepancies in the impacts (McGill, 2009).

Gramasree, a synthetic coloured dual purpose breed of chicken which was evolved from University Poultry and Duck Farm, Mannuthy in 2005, has become very popular due to its coloured plumage and brown shelled eggs similar to native chicken. Farmers in Kerala are showing interest in rearing Gramasree male chicks due to the low chick price, coloured plumage and high selling price compared to commercial broiler chicken. Considering the importance of rearing Gramasree cockerels for meat purpose and wide acceptability of this breed among farmers, studies have been conducted at Kerala Veterinary and Animal Sciences University to standardise the nutrient requirements of Gramasree cockerels at different phases till marketing. Keeping in view of the importance of profitable rearing of Gramasree birds for meat and reducing the nitrogen excretion, the present experiment was carried out study the effect of reduced dietary crude protein supplemented with methionine, lysine, threonine and tryptophan on growth and carcass characteristics of Gramasree birds.

Materials and methods

For conducting the trial, 280 day-old Gramasree male chicks were procured from University Poultry and Duck Farm, Mannuthy. All the chicks were wing banded and randomly allotted to five dietary treatment groups each with four replicates of 14 chicks in a completely randomized design and housed in deep litter system up to eight weeks. Uniform management practices such as scientific feeding, watering, lighting and vaccination were followed for all the groups throughout the experimental period.

Experimental rations

The experimental birds were fed with a control diet (T1) formulated with 21 per cent CP and 2800 kcal/kg ME according to ICAR (2013) nutrient specifications for Indian improved native birds and their crosses using corn, soya bean meal, wheat bran and de-oiled rice bran (DORB) to meet out the requirements

of first four limiting amino acids *viz*. methionine, lysine, threonine and tryptophan at the levels of 0.46, 1.10, 0.70 and 0.20 per cent, respectively by using synthetic amino acids. The other treatment diets (T2 to T5) were formulated isocaloric as that of control by reducing CP content to 20, 19, 18, and 17 per cent, respectively by balancing the amino acid levels as that of control using synthetic source. The same feed composition was followed throughout the experimental period.

Corn, soya bean meal, DORB and wheat bran were analysed for the first four limiting amino acids *i. e.* methionine, lysine, threonine and tryptophan by liquid chromatography and the results are presented in Table 1. The ingredient composition of the ration fed to experimental birds are presented in Table 2. The feed samples were subjected to proximate analysis as per AOAC (2005) which is presented in Table 3. The body weight and feed consumption of individual birds were recorded at weekly intervals from day-old to eight weeks of age and weekly body weight gain and feed conversion ratio were calculated from the data obtained. The cost of feed per bird and per kilogram of body weight of bird were calculated using the cumulative feed consumption and final body weight of the experimental birds. At the end of the experiment, two birds from each replicate were randomly selected and slaughtered humanely to study the carcass traits. Data on breast meat yield, giblet yield, abdominal fat yield, dressing per cent and ready to cook yield were estimated and expressed as per cent of live body weight.

Result and discussion

Body weight

The final body weight, cumulative body weight gain, feed consumption and FCR at eighth week of age are presented in Table 4. The cumulative body weight and weight gain of birds at eighth weeks were not significantly different between the treatments.

The present finding is in agreement with Shao *et al*. (2018) and Joseph *et al*. (2018), who assessed that reduction in dietary crude protein of birds with supplementation of essential amino acids did not affect the final body weight and weight gain. The results are also in par with the findings by Divya (2014) who experimented on Gramasree cockerels with dietary treatments having 2800 kcal/kg ME and CP ranging from 22 to 18 per cent without limiting amino acids supplementation. Contrary to the findings of the present study, Namroud *et.al.* (2008) observed that reduction below two per cent in protein level even with amino acid supplementation exhibited significant decrease in weight gain of broilers.

From the results of the present study, it is evident that, the limiting amino acid levels in low CP diets were so near to the true requirement of the birds, thus optimum to support their growth as that of control diet. If the level of limiting amino acids in low CP diets was inadequate, then it would have caused a deficiency and therefore growth depression (McGill, 2009). If excess level of limiting amino acids were present in diet, it would have catabolised to uric acid with the expenditure of 2-14 ATP from the stored energy (Costa *et al*., 2001).

Feed consumption

At eighth week, the cumulative feed consumption and mean cumulative FCR of birds were not significantly affected by dietary treatments. This result is in close agreement with the findings of Shao *et al*. (2018), Joseph *et al*. (2018) and Van Harn *et al.* (2019), who had also shown that reducing the dietary CP along with essential amino acid supplementation

Table 1. Amino acid contents in feed ingredients used for the trial (mg/kg)

Amino Acids	Corn	Soya bean meal	De-oiled rice bran	Wheat bran
Lysine	24.99	320.50	45.07	212.01
Methionine	18.62	103.64	26.01	19.06
Threonine	11.69	65.33	127.52	37.99
Tryptophan	96.65	75.95	Nil	21.04

Table 2. Ingredient composition of ration used in the trial

Ingredients	Per cent composition				
	T1	T2	T3	T4	T5
Corn	58.90	59.70	60.60	61.92	62.10
DORB	1.40	3.95	5.00	7.00	10.00
Soya bean meal	34.90	31.65	28.53	25.00	21.30
Wheat bran	1.55	1.40	2.40	2.50	2.80
Dicalcium phosphate	1.80	1.80	1.80	1.80	1.80
Calcite	1.30	1.30	1.30	1.30	1.30
Salt	0.15	0.15	0.15	0.15	0.15
Limiting amino acids (g/100kg feed)					
Methionine	0	10	40	70	100
Lysine	0	0	25	120	225
Threonine	0	40	80	120	170
Tryptophan	0	0	0	20	40
Feed additives (g/100kg feed)					
Vitamin AB_2D_3K mix[1]	25	25	25	25	25
Toxin binder[2]	75	75	75	75	75
Anticoccidial[3]	25	25	25	25	25
Choline chloride 60 %[4]	150	150	150	150	150
Trace mineral mixture[5]	100	100	100	100	100
Liver tonic[6]	30	30	30	30	30
Probiotic[7]	30	30	30	30	30

[1]Provimi (A+B2+D3+K): Vitamin Premix, contents per g- vitamin A -82,500 IU, vitamin D3- 12000 IU, Vitamin B2–50 mg, vitamin K- 10mg, vitamin B1 -4.0 mg, vitamin B6 -8.0 mg, vitamin B12 -40 mcg, Niacin -60 mg, calcium panthothenate -40 mg and Vitamin E -40 mg (Cargill animal nutrition Pvt.Ltd.)

[2]UTPP: Toxin binder a powerful blend of Hydrated Sodium Aliminosilicate, Organic Acids, Activated Charcoal and Natural Herbal Ingredients (NEOSPARK Drugs and Chemicals Pvt. Ltd)

[3]Nimax: Granular. Composition- Premix containing a combination of maduramicin 1.5% and nicarbazin 16 % (HUVEPHARMA)

[4]Choline chloride 60 per cent. Contents: each Kg of choline chloride dry 60 % powder contains a minimum 600 g of choline chloride (ANICHOL-60)

[5]ULTRA-TM: Each 5kg contains-Manganese 270 g, Zinc 260 g, Iron 100 g, Copper 10 g, Iodine 10 g, Selenium 1.5 g (NEOSPARK Drugs and Chemicals Private Ltd.).

[6]Liv.52 protec: Production enhancer, hepatic stimulant, growth promoter, liver tonic powder (The Himalaya Drug Company)

[7]Alvizyme plus: Contain digestive enzymes, probiotics and yeast. (Alembic Ltd.)

Table 3. Analysed per cent chemical composition of experimental ration (On dry matter basis)

Parameter	Experimental Diet (Per cent)				
	T1	T2	T3	T4	T5
Dry matter	90.60	91.18	90.82	90.03	90.55
Crude protein	21.33	20.57	19.29	17.93	17.11
Crude fibre	3.45	4.26	4.09	4.62	5.21
Ether extract	2.78	2.82	2.78	2.80	2.78
Total ash	8.20	7.94	6.95	7.56	7.54
Acid insoluble ash	1.40	1.32	1.30	1.22	1.35
Calcium	1.16	1.11	1.18	1.14	1.10
Phosphorus	0.69	0.74	0.70	0.62	0.71
ME (kcal/kg) *	2811	2824	2818	2837	2845

*Calculated

Table 4. Effect of different dietary treatments on body weight, feed consumption and carcass traits of Gramasree male chicks up to eight weeks of age

Parameters	Treatment Groups (Dietary CP Levels)						
	T1 (21%) (Control)	**T2** (20%)	**T3** (19%)	**T4** (18%)	**T5** (17%)	**F** value	**p** value
Body weight at 8th week (g)	836.14 ±7.35	812.53 ±25.15	802.32 ±27.19	809.79 ±16.98	836.85 ±18.89	0.61^{ns}	0.66
Cumulative body weight gain up to 8th week (g)	801.44 ±12.10	777.68 ±10.33	767.82 ±16.11	775.28 ±8.84	802.42 ±25.15	0.31^{ns}	0.87
Cumulative feed consumption up to 8th week (g)	2567.8 ±4.87	2520.77 ±51.89	2558.89 ±36.67	2555.66 ±10.94	2437.79 ±34.73	2.67^{ns}	0.07
Cumulative FCR up to 8th week	3.08 ±0.02	3.16 ±0.08	3.19 ±0.08	3.15 ±0.08	2.91 ±0.07	2.86^{ns}	0.06
Pre slaughter body weight (g)	914.50 ±28.32	888.75 ±22.80	896.25 ±22.33	850.00 ±17.89	878.00 ±25.53	0.61^{ns}	0.56
Breast meat (%)	8.31 ±0.31	8.31 ±0.35	8.11 ±0.17	7.50 ±0.24	7.62 ±0.32	1.95^{ns}	0.12
Abdominal fat (%)	0.09^{a} ±0.02	0.16^{a} ±0.04	0.11^{a} ±0.03	0.29^{b} ±0.15	0.63^{b} ±0.05	1.18*	0.04
Giblet weight (%)	4.87 ±0.06	4.90 ±0.10	4.96 ±0.18	5.05 ±0.21	5.06 ±0.32	0.15^{ns}	0.96
Dressing yield (%)	63.51 ±5.05	68.50 ±2.18	68.32 ±1.11	69.73 ±1.01	65.09 ±3.69	1.13^{ns}	0.36
Ready to cook yield (%)	68.38 ±0.52	73.40 ±0.32	73.34 ±0.71	74.78 ±0.86	70.15 ±1.95	0.69^{ns}	0.60

Mean values bearing same superscript within a row do not differ significantly
ns-non significant
*significant ($p<0.05$)

had no effect on feed consumption. But in contrast to these references, Bregendahl *et al*. (2002) after experimenting on broilers with diet having CP reduced from 23 to 18.5 per cent, with amino acid supplementation reported that feed consumption was lower in low CP diet groups. Shao *et al*. (2018) reduced the CP level of broiler diet up to 17 per cent by balancing with amino acid supply whereas Joseph *et al*. (2018) experimented on Swarnadhara chicks by reducing CP up to 19 per cent with limiting amino acid supplementation. Similar to the present study, both of them observed no significant difference among the cumulative FCR among the treatments. On the contrary, the eighth week mean cumulative feed consumption of Gramasree cockerels obtained by Divya (2014) by feeding the experimental birds with diets containing 22, 20 and 18 per cent CP levels (2800 kcal/kg ME) without balancing the limiting amino acids levels was lower when compared to the present study. From the present study, it is evident that, reducing the dietary crude protein level with limiting amino acid supplementation up to 17 per cent in the diet of Gramasree male chicks did not affect the feed consumption and feed efficiency of birds.

Carcass traits

Statistical analysis of the data pertaining to the carcass characteristics studied did not show any significant difference between groups except for the abdominal fat content (Table 4). The mean abdominal fat content in 18 and 17 per cent CP fed groups (T4 and T5) were significantly ($p<0.05$) higher than that of other treatment groups.

Raju *et al*. (1999), Kamran *et al.* (2004) and Namroud *et al*. (2008) also agrees

with the insignificant variation of mean dressed weight, giblet yield, breast meat yield and dressing per cent among low CP diets after balancing with amino acid supplementation. Divya (2014) who reduced the dietary CP level of Gramasree cockerels from 22 to 18 per cent without limiting amino acid supplementation also observed a non-significant variation in carcass characteristics. The increased abdominal fat yield of birds fed with low CP diets observed in this study was experienced by many researchers previously. Raju *et al*. (1999), Joseph *et al*. (2018) and Karthika *et al*. (2019) have also reported that low protein diets with amino acid supply in the diets increased the abdominal fat of the broilers.

A reduction in CP level causes an increase in ME:CP ratio. In the present study, the ratio was 133:1 in control diet which increased to 165:1 in 17 per cent CP containing diet. A greater ME:CP ratio of low CP diets increases the fat deposition in the carcass. An increased CP content in diets increases the heat increment by deamination and transamination of surplus amino acids to other metabolites in the body. Meanwhile in low CP diets balanced with amino acid supply, energy expenditure in the form of heat of digestion is saved and is added to the body fat reserve (Bartov *et al*., 1974).

Conclusion

Based on the overall results of this study, it could be concluded that, the dietary crude protein level of Gramasree male chicks can be reduced up to 17 per cent with limiting amino acids supplementation to reduce the feed cost without affecting the growth performance of birds for rearing up to eight weeks of age.

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Conflict of interest

The authors declare that they have no conflict of interest.

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