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Effect of replacing different level of Crude Protein with Synthetic Amino acids on Growth Performance, Carcass Traits and Nutrient Digestibility in Broilers

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Abstract

Present study was conducted with the aim of replacing dietary crude protein (CP) in poultry diet with synthetic essential amino acids and to determine its effect on growth performance, slaughter data and nutrient digestibility in broilers. Five (A, B, C, D and E) iso-caloric & iso-nitrogenous (ME 2850/2950 Kcal/kg; CP 20%/18%) starter and finisher diets were formulated respectively. In both phase diet A was standard diet, in remaining starter/finisher diets (B, C, D and E) CP level was reduced (19/17, 18/16, 17/15 and 16/14) and make them iso-nitrogenous by supplementation of synthetic amino acids. Result showed no significant (P>0.05) effect of replacing CP with synthetic amino acids on all parameters of growth performance of broilers except on feed intake during starter phase. Best FCR during starter (1.33) and finisher (1.67) phase was found in broilers fed on diet B. Similarly, highest (P>0.05) dressing percentage with lowest (P>0.05) abdominal fat was observed in birds fed on diet B while highest (P>0.05) breast meat yield was found in control group. No significant (P>0.05) effect of replacing CP with amino acids was found on nutrient digestibility in both phase, highest digestibility was found in group C (75.50%) and E (79.84%) during starter and finisher phase, respectively. It is concluded that CP of boiler diet can be replaced by synthetic amino acids up to 17 and 15% in start and finisher diet, respectively without compromising the growth performance of broilers.

Keywords: Lysine; Methionine; Threonine; Growth performance; Slaughter data; Nutrient digestibility and Broilers.

Introduction

Protein is essential constituent of broiler's diet like carbohydrates, fats, vitamins and minerals. During the process of digestion proteins are converted into amino acids and absorb in small intestine and perform different structural and physiological functions [1]. Protein is the major and most costly component in poultry ration [2]. It is much difficult to meet the crude protein (CP) requirement in poultry ration compared with other essentials nutrient [3]. In modern poultry production system high weight gain with low FCR is require which mainly depends upon the provision of dietary protein, so dietary protein level is a major factor which controls weight gain, carcass characteristics [2]. The cost of protein feedstuffs are increasing consistently, thus increasing the feeding cost of broilers. Reducing protein and amino acid level of feed can reduce diet cost but it will result in poor performance [4].

Synthetic amino acids like lysine and methionine are supplemented in low protein diets to optimize the performance of broilers [5,6]. In broiler's diet methionine is one of the most limiting amino acids. Methionine is required for the growth performance i.e. maximum body weight gain of birds. For maximum mass production, amino acids i.e. L-lysine and DL-methionine are commonly replaced with natural protein [5]. During formulating a poultry diet, CP level in mainly emphasised because the protein level in the broiler's diet significantly affects performance, feed cost, and profitability of a broiler production enterprise [2,7]. Maximum growth performance and carcass quality of birds depend upon the proportion of lysine among all essential amino acids [5]. Synthetic amino acids especially lysine has positive effect on breast meat yield in broilers [8]. Synthetic essential amino acids have protein sparing effect and used to balance low CP diet [9]. Synthetic amino acids can be used in low protein diet for better growth performance and to improve feed conversion ratio [10].

The objective of present study was to examine the effect of replacing different levels of CP with synthetic amino acids on growth performance, slaughter data and nutrient digestibility in broiler.

Materials and Methods

Birds and experimental diets

Three hundred day-old boiler chicks (as hatched) of Hubbard strain were distributed in to five experimental groups with six replicate (10 chicks/replicate) in each group, under completely randomized design. Chicks were put in to floor pens. Fresh and clean water and feed was available *ad libitum* around the clock to them. There was two phases of experiment i.e. starter (1-21 days) and finisher (22-35 days) phase. Ten experimental diets, five for starter phase (Table 1) and five for finisher phase (Table 2) were formulated. During both phases diet A was served as control. Chemical composition of starter and finisher diets is given in tables 1 and 2, respectively.

Table 1. Ingredients and nutrient composition of starter rations.

Ingredients	Diets[1]				
	A	B	C	D	E
Corn	28.70	32.40	33.00	37.10	39.40
Rice Polishing	7.00	7.00	7.00	7.00	7.00
Soybean meal	9.32	7.02	3.13	1.50	0.00
Sunflower meal	1.94	0.83	3.50	0.96	0.52
Rice broken	20.00	20.00	20.00	20.00	20.00
Canola meal	14.50	14.50	14.50	14.50	14.50
Guar meal	4.00	4.00	1.50	4.00	4.00
Rape seed meal	1.50	1.50	4.00	2.00	3.00
Molasses	1.00	1.00	1.14	1.34	1.20
Fish meal	6.50	6.50	6.50	6.19	6.45
Corn gluten	2.50	2.50	2.50	2.50	0.88
Vegetable oil	0.95	0.38	0.67	0.00	0.00
Limestone	0.81	0.83	0.79	0.84	0.83
Di-calcium phosphate	0.49	0.53	0.53	0.62	0.60
Salt	0.15	0.15	0.15	0.15	0.15
Sodium bicarbonate	0.04	0.04	0.03	0.03	0.03
Premix[2]	0.10	0.10	0.10	0.10	0.10
L-lysine HCl	0.26	0.38	0.51	0.62	0.70
DL-Methionine	0.16	0.20	0.25	0.30	0.35
L-Threonine	0.03	0.09	0.14	0.19	0.34
Betafin	0.04	0.04	0.04	0.04	0.04
Lincomycine 4.4%	0.01	0.01	0.01	0.01	0.01
M-Tox+(Toxin binder)	0.05	0.05	0.05	0.05	0.05
Nutrient composition					
Dry matter	88.86	89.78	88.89	88.73	88.85
Crude Protein	20.00	20.00	20.00	20.00	20.00
Metabolizable energy (kcal/kg)	2850.00	2850.00	2850.00	2850.00	2850.00
Ash	6.55	6.38	6.27	6.11	6.06
Lysine	1.263	1.274	1.287	1.161	1.186
Methionine	0.418	0.422	0.429	0.393	0.384
Methionine+Cysteine	0.785	0.813	0.818	0.754	0.748
Threonine	0.822	0.864	0.866	0.776	0.826

[1]Diet A: control diet with CP 20/18% in starter/finisher phase; Diet B: CP reduced by 1%; Diet C: CP reduced by 2%; Diet D: CP reduced by 3%; Diet E: CP reduced by 4%.

[2]Minral-Mix 0.250 g, (Packing of 25 kg with: Iron 95,940 mg, Copper 20,250 mg, Zinc 123 mg, Manganese 153 mg, Selenium 401 mg, Iodine 2,032 mg, Sepiolite (binder) 100,000 mg, Calcium 6.3% and Magnesium 1.5%), Vitamix 0.250 g (Packing of 25 kg with: Vit. A 20,000,000 U.I, Vit D3 4,000,000 U.I, Vit E 60,000 mg, Vit K3 8,640 mg, Vit B1 4,000 mg, Vit B2 12,000 mg, Niacine 80,290 mg, Vit B5 20,000 mg, Vit B6 6,000 mg, Vit B8 200 mg, Vit B9 2,000 mg, Vit B12 20 mg, Calcium 27.8%, and Antioxidants (BHA 60 mg and Ethoxyquine 60 mg) and M. Tox 0.500 g per 100 kg of feed.

Table 2. Ingredients and nutrient composition of finisher rations.

Ingredients	Diets[1]				
	A	B	C	D	E
Corn	28.33	34.53	35.00	35.00	35.00
Rice polishing	6.00	7.50	7.50	7.50	7.50
Rice broken	30.00	25.00	25.00	25.00	25.00
Soybean meal	6.00	3.00	2.00	1.50	0.00
Sunflower meal	0.00	0.00	0.00	0.03	0.00
Canola meal	14.50	14.50	14.50	14.50	15.00
Corn gluten	2.50	2.50	1.89	1.07	2.50
Guar meal	1.74	2.11	2.66	4.00	3.43
Rape seed meal	2.50	2.50	2.50	2.50	2.50
Fish meal	5.47	5.22	4.31	5.20	4.40
Molasses	0.28	0.20	1.00	0.20	0.87
Vegetable oil	0.76	0.68	1.00	1.00	1.00
Limestone	0.91	0.98	0.98	1.00	0.99
Di-calcium phosphate	0.00	0.04	0.21	0.00	0.17
Salt	0.15	0.15	0.15	0.15	0.15
Sodium bicarbonate	0.06	0.06	0.06	0.06	0.06
Premix[2]	0.10	0.10	0.10	0.10	0.10
DL-Methionine	0.16	0.20	0.26	0.28	0.30
L-Threonine	0.07	0.13	0.18	0.20	0.23
L-lysine HCL	0.36	0.49	0.59	0.60	0.70
Betafin	0.04	0.04	0.04	0.04	0.04
Lincomycin	0.01	0.01	0.01	0.01	0.01
Vemozyme	0.01	0.01	0.01	0.01	0.01
M-Tox+(Toxin binder)	0.05	0.05	0.05	0.05	0.05
Nutrient composition					
Dry matter	89.38	88.31	88.34	88.13	88.91
Crude Protein	18.00	18.00	18.00	18.00	18.00
Metabolizable energy (kcal/kg)	2950.00	2950.00	2950.00	2950.00	2950.00
Ash	5.39	5.41	5.20	5.33	5.27
Lysine	1.029	1.095	1.142	1.158	1.251
Methionine	0.367	0.384	0.378	0.356	0.388
Methionine+Cysteine	0.736	0.757	0.733	0.686	0.753
Threonine	0.679	0.729	0.741	0.74	0.81

[1]Diet A: control diet with CP 20/18% in starter/finisher phase; Diet B: CP reduced by 1%; Diet C: CP reduced by 2%; Diet D: CP reduced by 3%; Diet E: CP reduced by 4%.

[2]Minral-Mix 0.250 g, (Packing of 25 kg with: Iron 95,940 mg, Copper 20,250 mg, Zinc 123 mg, Manganese 153 mg, Selenium 401 mg, Iodine 2,032 mg, Sepiolite (binder) 100,000 mg, Calcium 6.3% and Magnesium 1.5%), Vitamix 0.250 g (Packing of 25 kg with: Vit. A 20,000,000 U.I, Vit D3 4,000,000 U.I, Vit E 60,000 mg, Vit K3 8,640 mg, Vit B1 4,000 mg, Vit B2 12,000 mg, Niacine 80,290 mg, Vit B5 20,000 mg, Vit B6 6,000 mg, Vit B8 200 mg, Vit B9 2,000 mg, Vit B12 20 mg, Calcium 27.8%, and Antioxydants (BHA 60 mg and Ethoxyquine 60 mg) and M.Tox 0.500 g per 100 kg of feed.

Procedure

Growth performance was studied on the bases of weight gain, feed consumption and feed conversion ratio (FCR). Daily feed intake and fort night weight gain was recorded to find FCR. The body weight of chicks was recorded on arrival at farm and at the end of every week, from each replicate. Data on feed intake of each replicate was recorded separately. Its value was calculated by subtracting the amount of feed refused from the total quantity of feed offered during the week. Feed conversion ratio is used to measure the bird's efficiency in converting feed weight into increased body weight. FCR was also corrected for dead birds. Data on mortality was recorded from each replicate throughout the experiment. Mortality was observed two times in 24 hours and weight of dead bird (if any) was also recorded.

Carcass characteristics

At the end of the trial, two birds from each treatment were selected on random basis. Weighed individually and slaughtered to obtain data on carcass characteristics. In order to get data on carcass characteristics, live body weight of birds was recorded. After slaughtering, the feathers were removed followed by evisceration in order to get dressed weight, breast meat weight, thigh meat weight and giblet organs weight (heart weight, liver weight and abdominal fat). Dressing percentage was calculated by dividing carcass weight including internal organs (heart, liver and gizzard) of the birds slaughtered.

Crude protein digestibility trial

Indirect marker method was used for determining nutrient digestibility. For this purpose, acid insoluble ash (Celite®) was added in the experimental diet @ 1%. Faeces samples were collected on day 20th and 33rd of trial. The polythene sheets were placed under each pen and droppings were collected twice a day. Faeces samples were stored at -10°C. Nutrient digestibility was determined by following relationship:

Chemical analysis

Proximate analysis of feed samples was done to find average value of dry matter (DM), crude protein (CP), ash percentage and crude fibre (CF). Feed samples were oven dried at 105°C for 4 h to find DM content. CP was calculated as N × 6.25 and nitrogen (N) was determined by Kjeldhal method [11].

Statistical analysis

Data collected for each parameter was analysed using PROC GLM procedure of Statistical Analysis System [12] under completely randomized design. The means were compared using Tukey's test and the differences were checked for statistical significance (P<0.05).

Results

Growth performance

No significant (P>0.05) effect of dietary treatments was found on all parameters of growth performance, except on feed intake during starter phase. Highest weight gain was found in group D (789 g) and B (1114 g) during starter and finisher phase, respectively. Best FCR was observed in broilers fed diet B throughout experiment with 1.33 during starter phase and 1.67 during finisher phase (Table 3).

Table 3. Growth performance of broilers fed experimental diets.

Variables	Diets[1]					SEM[2]	Significance[3]
	A	B	C	D	E		
Starter phase (1-21 days)							
Feed intake	1014^{ab}	1011^{ab}	1036^{a}	1040^{a}	917^{b}	22.4	*
Weight gain	753	762	768	789	689	16.87	NS
FCR	1.35	1.33	1.35	1.33	1.34	0.01	NS
Finisher phase (22-35 days)							
Feed intake	1911	1861	1864	1872	1759	25.24	NS
Weight gain	1089	1114	1112	1106	1058	10.42	NS
FCR	1.76	1.67	1.68	1.69	1.69	0.02	NS

[1]Diet A: control diet with CP 20/18% in starter/finisher phase; Diet B: CP reduced by 1%; Diet C: CP reduced by 2%; Diet D: CP reduced by 3%; Diet E: CP reduced by 4%.

[2]SEM: Standard error of mean.

[3]NS: Non-significant; *: 0.01<P<0.05.

Slaughter data

Data of carcass characteristics showed no significant (P>0.05) effect of replacing crude protein with amino acids on all treatments except thigh and heart weight (Table 4). Highest dressing percentage (59.73%) with lowest abdominal fat pad (1.72%) was found in birds fed diet B. Highest breast meat yield (18.72%) was found in control group while best thigh (4.96%), heart (0.70%) and liver weight (2.86%) was found in broilers fed on diet E.

Table 4. Carcass characteristics of broilers fed experimental diets.

Parameter (g)	Diets[1]					SEM[2]	Significance[3]
	A	B	C	D	E		
Dressing %	55.49	59.73	56.92	57.12	58.35	0.71	NS
Breast	18.72	18.32	18.17	18.42	17.83	0.15	NS
Thigh	4.48^{c}	4.46^{c}	4.95^{a}	4.74^{b}	4.96^{a}	0.11	*
Abdominal Fat	1.73	1.72	1.96	1.99	1.97	0.06	NS
Heart	0.52^{b}	0.52^{ab}	0.61^{ab}	0.68^{ab}	0.70^{a}	0.04	*
Liver	2.56	2.63	2.54	2.75	2.86	0.06	NS

[1]Diet A: control diet with CP 20/18% in starter/finisher phase; Diet B: CP reduced by 1%; Diet C: CP reduced by 2%; Diet D: CP reduced by 3%; Diet E: CP reduced by 4%.

[2]SEM: Standard error of mean.

[3]NS: Non-significant; *: 0.01<P<0.05.

Crude protein digestibility

Crude protein digestibility was not affected (P>0.05) by feeding experimental diets to broilers during both phase (Table 5). Highest crude protein digestibility (%) was found in group C (75.50) and E (79.84) during starter and finisher phase, respectively.

Table 5. Crude protein digestibility % affected by experimental diets.

Variables	Diets[1]					SEM[2]	Significance
	A	B	C	D	E		
Starter phase	73.88	75.09	75.50	74.43	74.48	0.26	NS
Finisher phase	74.81	79.12	77.37	79.35	79.84	0.92	NS

[1]Diet A: control diet with CP 20/18% in starter/finisher phase; Diet B: CP reduced by 1%; Diet C: CP reduced by 2%; Diet D: CP reduced by 3%; Diet E: CP reduced by 4%.

[2]SEM: Standard error of mean.

[3]NS: Non-significant; *: 0.01<P<0.05.

Discussion

Replacement of crude protein with synthetic amino acids is not only important for economical but also for nutritional and environmental aspects. Synthetic amino acids can be used in low protein diet for the maximum weight gain with best FCR [10]. Maximum growth performances with better carcass quality of birds depend upon the proportion of lysine among all essential amino acids [5]. Synthetic amino acids, especially lysine has main effect on breast meat yield in broilers [8].

The present study was conducted to find the level of crude protein which could be replaced safely with syntactic amino acids without compromising growth performance of broilers. Growth performance was studied on the bases of feed intake, weight gain and FCR. In present study growth performance was not affected significantly (P>0.05) by dietary treatments and a number of researchers have obtained similar results [9,13-15]. The results of the present trial on feed intake are in accordance with the results of [9,16,17] they found no difference in feed intake of broilers when dietary CP contents were decreased. FCR was slightly improved by decreasing dietary CP level, similar results were found in previous studies [9,16,17].

Results of present study showed that the dressing percentage, breast meat, liver weight, abdominal fat and liver weight were not affected (P>0.05) by feeding low CP content diet. No differences in the breast meat yield of the broiler chicks when the CP level was reduced and formulated to satisfy the essential amino acids needs [18,19]. The replacement of the dietary CP with amino acids supplementation had no effect on breast meat and liver weight yield of broilers [15,20]. Significant difference was observed in heart weight and thigh weight (P<0.05). Overall, the results of the present trial indicated that decreasing dietary CP level associated with optimal essential amino acids did not significantly affect the carcass characteristics. The results corresponded with those of Han et al. [9].

In the present experiment CP digestibility was not affected (P>0.05) by feeding experimental diets to broilers during both phase. Highest crude protein digestibility (%) was found in group C (75.50) and E (79.84) during starter and finisher phase, respectively.

Conclusion

This study concluded that crude protein level of broiler diet can be reduced to 17% in starter phase and 15% in finisher phase with supplementation of synthetic amino acids. Replacement of CP with synthetic amino acids up to above mentioned levels shows positive effect on growth performance, slaughter data and crude protein digestibility.

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