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Research Article

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Effect of protease supplementation on the growth performance in broiler chickens fed with normal and reduced crude protein diets

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Abstract

Biological experiment was carried out to study the effect of protease enzyme addition on growth performance economics of production in broiler chicken in Corn-Soybean based normal and low protein broiler diets. Three basal broiler diets (Standard protein, 5% low protein and 10% low protein) were formulated as per Vencobb broiler feeding standards. The influence of protease at three levels (0g, 350g and 700g per ton of feed) was studied at three dose dependent crude protein levels (0, 5 and 10%). The experiment was conducted with two hundred and seventy Vencobb 430 straight run broiler chicks reared for 35 days under standard management regime. The reduction in crude protein content did not influence the body weight gain, average daily gain and economic indices in broiler chicken. From this study, it could be concluded that the supplementation of protease enzyme at the level of either 350 or 700ppm did not affect the production performance and performance indices in broiler chickens.

Keywords: Broiler, protease, body weight gain, performance index

Introduction

Broiler production has achieved tremendous growth over past few decades. There is appreciable improvement in body weight gain and feed conversion ratio. But poultry producers are always under pressure to control cost of production. Feed cost alone accounts for 70% of cost of production. Improving the nutrient utilization will not only improves broiler performance and also economics of production.

Crude protein is one of the important nutrients influence broiler performance and decides feed cost. Improving crude protein digestibility is important for optimum poultry performance. It is general consideration that, endogenous proteases are sufficient for protein digestion and utilization (Le Heurou-Luron et al., 1993; Nir et al., 1993). But due to increase feed intake and accelerated passage rate there were considerable amount of

crude protein pass through gastro intestinal tract without being completely digested (Parsons et al., 1997; Wang and Parsons, 1998; Lemme et al., 2004). These undigested proteins represent a chance for the supplemental exogenous proteases in broiler diets to improve protein digestibility. Supplementation of broiler diets with mono-component protease enzyme has been reported to improve protein ingredients (Adebiyi and Olukosi, 2015; Stefanello et al., 2016) or complete diets (Angel et al., 2011; Cowieson and Roos, 2014, 2016). Protease enzymes addition improves growth performance in broiler by improving nutrients digestibiity. However, the response to protease supplementation is not always beneficial (Yuan et al., 2017). Hence, the present study was carried out to assess the effect of exogenous protease enzyme supplementation to the standard and low protein broiler diets on growth performance and economics of production.

Materials and Methods

Experimental design and diet

A total of 270 newly hatched uniform body weight broiler chicks (VenCobb 430) were obtained from a local hatchery and randomly distributed into nine treatment groups consisting of three replicates per treatment. Each replicate consisted of ten birds. Three basal diets were prepared as Standard broiler ration (SBR), 5% low protein ration (5% LPR) and 10% low protein ration (10% LPR). Each diet was supplemented with protease enzyme at the rate of 0, 350 and 700 g per ton of feed constituting nine groups (Table 1).

Table 1. Experimental design.

Groups	Experimental diets
T1	Standard basal ration (SBR)
T2	5 per cent low protein ration (LPR5%)
T3	10 per cent low protein ration (LPR10%)
T4	SBR + 0.035 per cent protease
T5	SBR + 0.070 per cent protease
T6	LPR5% + 0.035 per cent protease
T7	LPR5% + 0.070 per cent protease
T8	LPR10% + 0.035 per cent protease
T9	LPR10% + 0.070 per cent protease

Source and type of protease

The protease enzyme used in the present study was alkaline protease and added to the diet as top dress having 9 lac units per gram.

Rearing of experimental birds

The birds were reared for period of 35 days under deep litter rearing system. The birds were fed with three phases of diets *viz*., pre-starter (0-10 days), starter (11-24 days) and finisher (25-35 days of age) (Table 2). *Ad libdum* feeding and watering was followed during the study period and standard managemental conditions including lighting, vaccination, etc., were followed.

Parameters studied

The growth performance of the broiler chicken were studied at weekly basis by individually weighing the bird's body weight at the start of each week before feeding in the morning and expressed as cumulative intake and body weight gain. Various economical attributes like cost of production (COP), Economic index score (EIS),

European production efficiency factor (EPEF) and European broiler index (EBI) for the entire growth period while taking into considerations of live weight gain, feed consumption, mortality and efficiency.

Statistical analysis

The data obtained by various parameters were subjected to analysis of variance single factor using the Statistical Package for Social Sciences (SPSS) version 16.0. The means were compared for significance using Tukey's range test and P values less than 0.05 was considered significant.

Results and Discussion

Body weight gain, Average daily gain

Mean weekly body weight gain of broiler chicken fed diets supplemented with three different levels of protease at three different levels of crude protein is presented in Table 3 and represented in Figure 1. The overall weight gain at the end of the fifth week ranged from 2006.53 g (T8) to 2198.53 g (T1). On statistical analysis of the data, it revealed that the mean overall body weight gain of broilers showed no significant difference (P>0.05) among different dietery treatment groups.

The mean average daily gain of broiler chicken fed diets supplemented with three different levels of protease at three different levels of crude protein is presented in Table 4 and graphically represented in Figure 2. The overall average daily gain at the end of the experimental period ranged from 57.33 g (T8) to 62.91 g (T2). On statistical analysis of the data, it revealed that the mean average daily gain of broilers showed no significant difference (P>0.05) among different dietery treatment groups. However there is a numerically declining values were observed in all the enzyme supplemented groups when compared to their respective controls.

The results showed normal growth pattern in broilers of all the dietary treatment groups without any significant difference. From the above data it can be inferred that supplementation of protease in normal and low protein diets did not reveal any significant improvement in the body weight gain and average daily gain when compared with control diets.

This finding is against observation of Odetallah *et al*., (2003). Stark *et al*., (2009) and Cowieson, Adola (2005) and Cowieson and Ravindran (2008) who reported that supplementation of protease or blended enzyme with protease improved body weight gain in broilers.

Table 2: Ingredient and nutrient composition of broiler pre starter diet (%)

Ingredients	Pre-starter			Starter			Finisher		
Ingredients (%)	SBR	LPR5 %	LPR10 %	SBR	LPR5 %	LPR10 %	SBR	LPR5 %	LPR10 %
Maize	59.31	62.62	65.65	61.25	64.26	67.27	62.7	65.4	68.1
Deoiled soybean cake	35.30	325.00	29.80	32.0	29.4	26.8	28.7	26.3	23.9
Ricebran oil	2.00	1.50	1.20	3.6	3.2	2.8	5.3	4.9	4.5
Calcite	0.90	0.90	0.90	0.9	0.9	0.9	0.9	0.9	0.9
Mono-dicalcium phosphate	1.40	1.40	1.40	1.3	1.3	1.3	1.2	1.2	1.2
Salt	0.30	0.30	0.30	0.3	0.3	0.3	0.3	0.3	0.3
DL-Methionine	0.30	0.28	0.26	0.25	0.23	0.21	0.22	0.21	0.20
L-Lysine HCl	0.23	0.23	0.23	0.14	0.15	0.16	0.12	0.13	0.14
Sodium bicarbonate	0.10	0.10	0.10	0.1	0.1	0.1	0.1	0.1	0.1
Additive[†]	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Total	100.0	100.0	100.0	100.00	100.00	100.00	99.54	99.44	99.34

Nutrient Composition (%)									
Crude protein	22.5	21.38	20.25	21.0	19.95	18.9	19.5	18.53	17.55
Calcium	0.80	0.80	0.80	0.80	0.80	0.80	0.72	0.72	0.72
Available phosphorus	0.40	0.40	0.40	0.40	0.40	0.40	0.36	0.36	0.36
Dig. Lysine	1.25	1.19	1.13	1.1	1.04	0.99	1.0	0.95	0.90
Dig. Methionine	0.62	0.58	0.55	0.54	0.51	0.48	0.49	0.47	0.44
Metabolizable energy (kcal/kg)	3,000	3,000	3,000	3,125	3,125	3,125	3250	3250	3250

SBR – Standard broiler ration
LPR5% - 5% crude protein reduction ration
LPR10% - 10% crude protein reduction ration
Additive[†]
Mineral mixture at the added level per kg feed supplied manganese-91 mg, zinc 91 mg, iron-85 mg, iodine-1.82 mg, and copper –30.24 mg and cobalt – 0.365mg.
Vitamin AB2D3K at added per kg feed supplied vitamin A-16500 IU, B2-13 mg, D3-3200 IU and vitamin K-2 mg.
Vitamin B complex at added level per kg feed supplied, thiamine 5 mg, pyridoxine 8mg, Niacin 320 mg, cyanocobalamine 0.05 mg, vitamin E 95 mg, calcium D pantothenate 27.5 mg and folic acid 14 mg, calcium 30.1 mg.
Coccidiostat at the level added per kg feed supplied 125 mg of Di-nitro-ortho-toluamide.
Antibiotic (Oxy tetracycline) 0.5 g was added per kg of feed.

Table 3. Effect protease supplementation at different crude protein reduction diets on body weight gain (g) in broiler chickens.

Treatments	Week 1	Week 2	Week 3	Week 4	Week 5	1-35 Days
T_1	161.77±2.82	329.17±5.53	511.70^{ab}±12.43	588.60±15.91	607.30±18.05	2198.53±48.99
T_2	160.83±2.88	322.70±4.90	516.47^{a}±11.00	585.33±14.33	616.63±16.36	2201.97±43.68
T_3	154.87±2.39	313.50±6.27	492.50^{abc}±11.61	565.20±15.78	601.80±23.80	2127.87±54.10
T_4	160.47±2.14	320.90±5.12	498.53^{abc}±13.67	575.83±16.35	598.90±18.32	2154.63±49.79
T_5	160.47±3.86	320.60±7.43	493.53^{abc}±13.99	573.10±16.75	594.20±19.21	2141.90±56.14
T_6	158.80±2.66	326.80±5.29	477.63^{bc}±10.61	559.80±15.43	567.23±16.65	2090.27±43.65
T_7	158.23±2.31	316.70±4.59	471.70^{c}±9.86	551.37±13.84	605.73±35.42	2070.40±37.64
T_8	157.80±2.83	314.47±5.46	469.80^{c}±11.75	531.67±14.58	532.80±17.32	2006.53±45.88
T_9	161.20±2.56	319.43±4.58	479.43^{bc}±7.95	564.73±14.99	574.47±20.20	2099.27±43.78
P value	0.757	0.514	0.134	0.240	0.154	0.089

Fig 1. Body weight gain (g/bird)

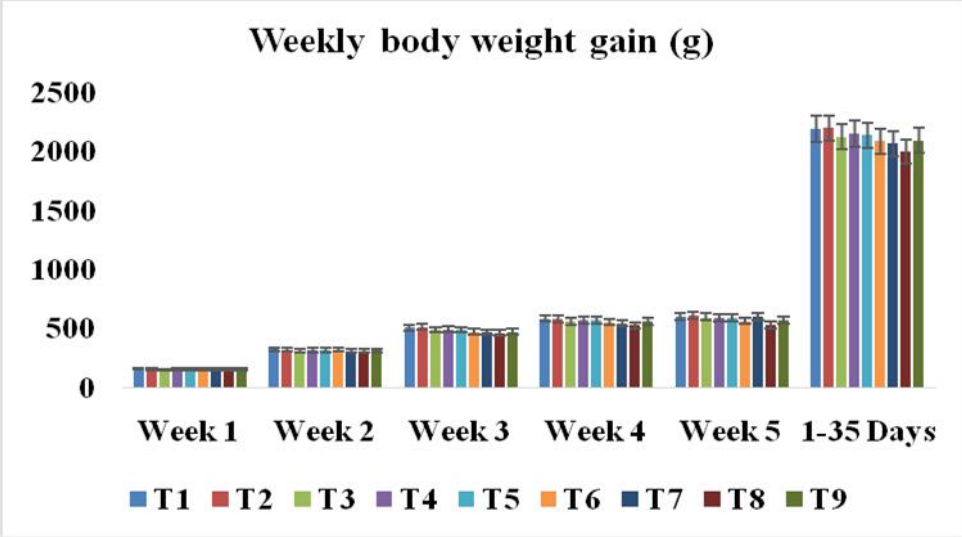
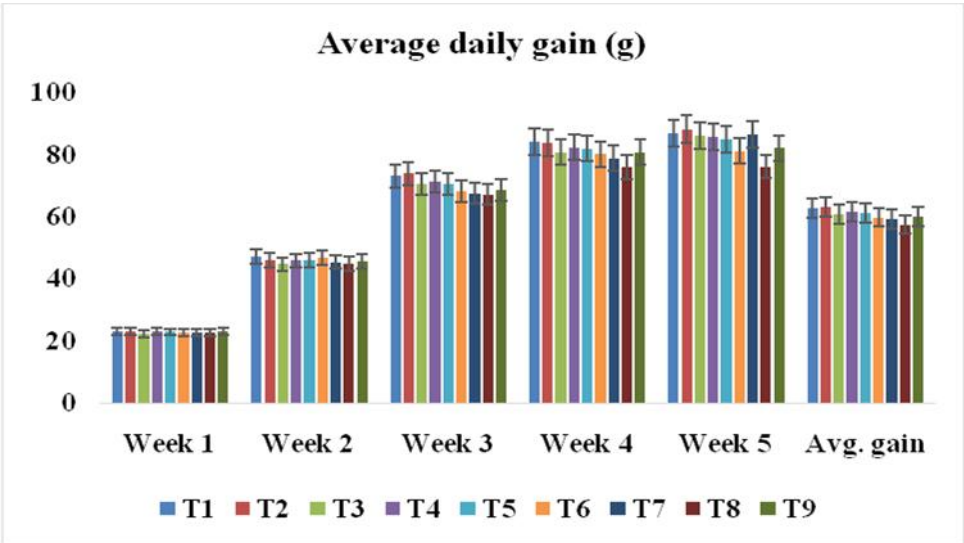


Table 4. Effect protease supplementation at different crude protein reduction diets on average daily gain in broiler chickens.

Treatments	Week 1	Week 2	Week 3	Week 4	Week 5	DAY GAIN
T_1	23.13±0.39	47.10±0.80	73.10±1.77	84.07±2.27	86.80±2.58	62.815±1.400
T_2	23.00±0.42	46.07±0.70	73.80±1.56	83.60±2.04	88.13±2.34	62.914±1.248
T_3	22.13±0.34	44.67±0.91	70.37±1.66	80.70±2.27	86.13±3.40	60.796±1.545
T_4	23.00±0.32	45.77±0.73	71.20±1.95	82.23±2.33	85.60±2.61	61.561±1.422
T_5	22.80±0.56	45.80±1.08	70.43±1.99	81.83±2.38	84.93±2.75	61.198±1.604
T_6	22.70±0.38	46.63±0.76	68.13±1.51	80.03±2.20	81.10±2.39	59.722±1.247
T_7	22.57±0.33	45.33±0.66	67.43±1.40	78.77±1.96	86.50±5.05	59.154±1.075
T_8	22.57±0.41	44.87±0.79	67.07±1.67	75.93±2.09	76.07±2.48	57.329±1.311
T_9	23.07±0.36	45.57±0.66	68.43±1.13	80.63±2.14	82.03±2.91	59.978±1.251
P value	0.734	0.469	0.131	0.242	0.147	0.091

Fig 2. Average daily gain (g/bird/day)



Economics of production

Performance indices and cost economics of broiler chicken fed diets supplemented with three different levels of protease at three different levels of crude protein is presented in Table 5 and depicted in Figure 3. Performance indices like cost of production (COP), Economic index score (EIS), European production efficiency factor (EPEF) and European broiler index (EBI) were found significantly different (P<0.05) between treatment groups. Cost of production per kg live body weight of broiler chicken ranged from Rs 38.05 (T3) to 40.68 (T5). Economic index score ranges from 9.67 to 12.09 in T8 and T1 groups respectively. European production efficiency factor ranges from 391.94 to 475.47 in T8 and T1 groups respectively. European broiler index value ranges from 382.52 (T8) to 464.94 (T1).

From the above data it may be concluded that protease supplementation did not show advantage in all production indices due to lesser body weight gain.

This finding is in agreement with Shimaa A. Amer *et al*., (2021) who concluded that the economic efficiency indicators such as feed cost, total cost, total return, feed cost per kg gain, net profit, performance index and economic efficiency index were not affected by different level of protease enzyme inclusion or their interactions. Toledo G.S.P *et al*., (2007) concluded that cost of production of low protein diet was the lowest with or without inclusion of protease enzyme. However, Yadav and Sah (2005) and Ward and De Beer (2010) found improvement in profitability with protease enzyme addition. Guilherme Aguiar Mateus Pasquali *et al*., (2017) reported that there was higher profitability index when low protein diets were supplemented with enzyme complexes. Toledo G.S.P *et al*., (2007) concluded that that cost of production of low density diet with or without enzymes showed lower cost of production.

Conclusion

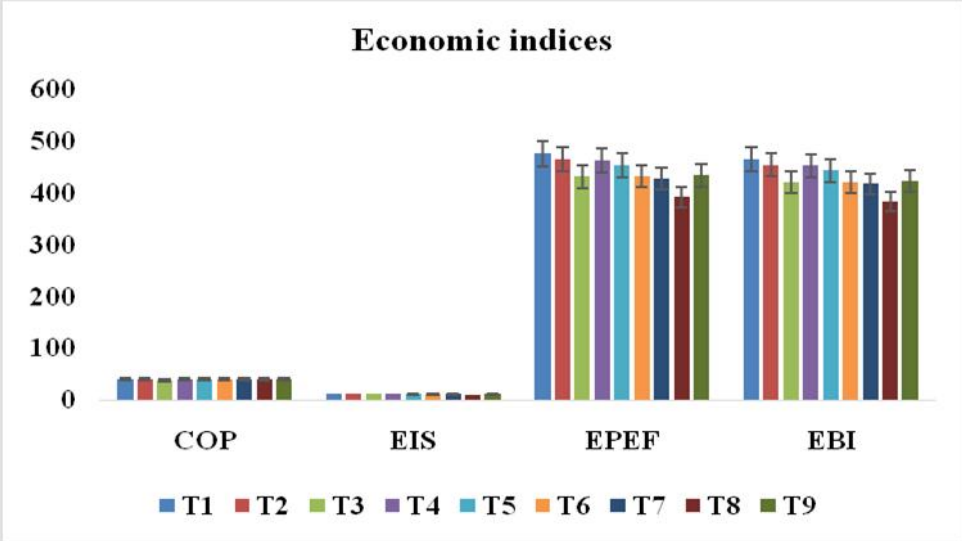
From the above experimental study, it could be concluded that the protease enzyme supplementation to broiler fed with corn-soybean meal based diets (whether normal, 5 or 10 % reduced crude protein diets) did not have any effect on body weight gain, average daily gain and economic indices. Reduced crude protein level in the broiler diets did not affect the production performance of commercial broilers. Since protein is the important nutrients to determine the feed cost, farmers can reduce level of protein in the broiler ration upto 10 percent level to get more profit without affecting broiler performance.

Table 5. Effect protease supplementation at different crude protein reduction diets on economic parameters

Treatments	COP	EIS	EPEF	EBI
T1	39.333^{b}±0.042	12.088^{a}±0.266	475.466^{d}±10.511	464.943^{d}±10.468
T2	39.426^{b}±0.069	11.773^{cd}±0.256	463.930^{d}±9.700	453.513^{d}±9.665
T3	38.050^{a}±0.432	11.376^{bcd}±0.333	430.907^{b}±11.218	420.918^{b}±11.156
T4	39.492^{bc}±0.024	11.709^{cd}±0.271	462.381^{cd}±10.680	451.800^{cd}±10.706
T5	40.677^{e}±0.037	11.137^{bc}±0.305	452.865^{bcd}±12.250	442.638^{bcd}±12.192
T6	39.907^{cd}±0.058	10.815^{b}±0.232	431.435^{b}±9.084	421.322^{b}±9.059
T7	40.248^{de}±0.038	10.609^{b}±0.190	426.965^{b}±7.604	416.831^{b}±7.624
T8	40.527^{e}±0.054	9.672^{a}±0.218	391.940^{a}±8.792	382.519^{a}±8.755
T9	39.411^{b}±0.044	11.003^{bc}±0.234	433.559^{bc}±9.096	423.370^{bc}±9.060
P value	0.000	0.000	0.000	0.000

^{abcd} Mean bearing different superscripts in a column of particular criterion differ significantly (P<0.05)
COP – Cost of production; EIS – Economic index score
EPEF – European production efficiency factor; EBI – European broiler index

Fig 3. Economic indices



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