RESEARCH ARTICLE

Effect of Dietary Supplementation of Protease Enzyme on Performance of Commercial Broiler Chicken

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Abstract

An experiment was conducted to investigate the effect of dietary supplementation of different levels of protease enzyme with reduced crude protein (CP) levels of diet on the performance of commercial broiler chicken. Total 160 straight run day-old commercial broiler chicks were randomly distributed to five treatments, with four replicates consisting of eight birds in each. The treatments were: T_1 (Basal diet as per BIS 2007), T_2 (1% CP reduction than basal diet with addition of protease enzyme @ 175 g/ton of feed), T_3 (2% CP reduction than basal diet with addition of protease enzyme @ 175 g/ton of feed), T_4 (1% CP reduction than basal diet with addition of protease enzyme @ 350 g/ton of feed), T_5 (2% CP reduction than basal diet with addition of protease enzyme @ 350 g/ton of feed). The data of body weight, body weight gain, feed consumption, feed conversion ratio, carcass characteristics and economics of rearing of broiler birds were recorded during the experimental period of 6 weeks. Results indicated that the dietary supplementation of protease enzyme @ 175 g/ton of feed and @ 350 g/ton of feed with 1% or 2% reduction in CP level of diet showed numerically higher body weight and weight gain as compared to control. Feed conversion ratio was at par with the control. Carcass characteristics were not affected by protease enzyme supplementation. However, protease enzyme supplementation @ 350 g/ton of feed with 2% reduction in CP level as well as 175 g/ton of feed with 1% reduction in CP level in broiler diet resulted in higher economic return (Rs./bird) in terms of return over feed cost (ROFC). Further study is required with higher levels of protease enzyme supplementation with reduced CP levels of broiler diets to achieve optimum growth performance of broiler birds.

Keywords: Broiler, Carcass traits, Crude Protein (CP), Growth performance, Protease enzyme.

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Introduction

Feed is a major input item for broiler rearing. It accounts for more than 75% of the total cost of production (Kamal and Raga, 2014). The rising cost of broiler feed ingredients especially protein sources has resulted in the rise of cost of poultry feed in recent years and has reduced the margin of profit in broiler farming (Purushothaman *et al.,* 2015). Addition of enzymes to corn-soy diets help to improve digestibility of energy and protein and this part of energy and protein will be accessible for birds, which is economically very important .A wide range of endogenous proteases synthesized and released in the gastrointestinal tract of birds and are generally considered to be sufficient to optimize feed protein utilization (Mohammadigheisar and Kim, 2018). However, crude protein (CP) and amino acid (AA) digestibility reported for poultry indicate that large amounts of protein pass through the gastrointestinal tract without being completely digested (Lemme *et al.,* 2004). This undigested protein represents an opportunity for the use of supplemental exogenous proteases in broiler feeds to improve protein digestibility (Angel *et al*., 2011). The objective of present study was to evaluate the effect of dietary supplementation of protease enzyme on production performance and economics of rearing of commercial broiler chicken.

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Materials and Methods

Experimental Design

A total of 160 straight-run commercial day-old broiler chicks of Vencobb strain were randomly distributed to five treatments (T_1 to T_5). Each treatment comprised of four replicates consisting eight chicks per replicate. The five dietary treatments were: T_1 (Basal diet as per BIS 2007), T_2 (1% CP reduction than basal diet with addition of protease enzyme @ 175 g/ton of feed), T_3 (2% CP reduction than basal diet with addition of protease enzyme @ 175 g/ton of feed), T_4 (1% CP reduction than basal diet with addition of protease enzyme @ 350 g/ton of feed), T_5 (2% CP

reduction than basal diet with addition of protease enzyme @ 350 g/ton of feed). Birds were reared in deep litter system using standard management and health care practices. The experiment was carried out for a period of six weeks.

Parameters Studied

The body weight (BW) was recorded at day-old age (BW_0) and then at weekly interval. The body weight (BW) was recorded at day-old age (BW_0) and then at weekly interval. The body weight gain (BWG) and average feed consumption (FC) was recorded at weekly interval as well as during pre-starter phase , starter phase , finisher phase and overall experimental period. Feed conversion ratio (FCR) was recorded at weekly interval. At the end of experiment, various carcass traits were studied from total twenty birds (two males and two females from each treatment). Economics (Rs./bird) of rearing of broiler birds was calculated at the end of the experiment in terms of return over feed cost (ROFC). The ROFC was derived by subtracting the feed cost from income of selling of birds on live weight basis.

Statistical Analysis

The data were analysed by using completely randomized design and means of replicates under each treatment were considered for statistical analysis (Snedecor and Cochran, 1994).

Results and Discussion

Body Weight and Body Weight Gain

The data on mean body weight (BW) of broilers at day-old age and then at weekly interval is presented in Table 1. The body weight of broilers at the end of sixth week (BW_6) from groups T_2, T_3, T_4 and T_5 was numerically higher as compared to control (T_1). This indicated that supplementation of protease enzyme in a broiler diet containing low CP (1 or 2%) help to improve body weight. Odetallah *et al*. (2005) and Sonu *et al*. (2018) also observed numerically improved body weight of broiler birds supplemented with protease enzyme.

The body weight gain (BWG) during pre-starter phase, starter phase, finisher phase and overall experimental period is given in Table 2. Weekly mean BWG did not differ significantly ($p < 0.05$) from each other, except at 3rd week of age (BWG_3). Similarly, BWG during pre-starter, starter and finisher phase as well as for overall period (0-6 weeks) did not differ significantly ($p < 0.05$) from each other, but BWG was improved numerically in all the treatments as compared to control indicating beneficial effect of protease

Table 1: Mean of weekly body weight (g) of broilers

	Treatments							
Traits	T_1	T_2	T_3	T_4	T_5	*SEm*	*CD at 5%*	*CV%*
BW_0	46.35 ± 0.09	47.15 ± 0.36	46.97 ± 0.30	46.51 ± 0.34	45.97 ± 0.19	0.28	NS	1.19
BW_1	174.69 ± 4.88	182.41 ± 0.65	182.25 ± 4.05	187.32 ± 4.16	176.70 ± 5.60	4.23	NS	4.68
BW_2	431.91 ± 7.67	448.06 ± 4.75	433.82 ± 11.72	447.82 ± 4.19	422.69 ± 1.00	6.89	NS	3.15
BW_3	851.90 ± 16.82	881.35 ± 20.05	911.22 ± 20.54	910.95 ± 13.98	859.16 ± 8.50	16.58	NS	3.76
BW_4	1405.92 ± 29.90	1481.25 ± 14.22	1449.38 ± 45.22	1482.08 ± 15.83	1406.53 ± 35.25	30.44	NS	4.21
BW_5	2025.17 ± 34.72	2083.82 ± 36.87	2103.91 ± 50.13	2101.00 ± 24.93	2066.15 ± 35.22	37.26	NS	3.60
BW_6	2567.26 ± 21.94	2693.35 ± 28.87	2571.38 ± 39.55	2606.34 ± 79.15	2591.95 ± 66.24	52.02	NS	3.99

NS= non-significant.

Table 2: Mean of weekly body weight gain (g) of broiler

	Treatments							
Traits	T_1	T_2	T_3	T_4	T_5	*SEm*	*CD at 5%*	*CV%*
BWG_1	128.34 ± 4.96	135.26 ± 0.84	135.28 ± 4.25	140.81 ± 4.07	130.72 ± 5.47	4.24	NS	6.32
BWG_2	257.22 ± 3.41	265.65 ± 4.52	251.56 ± 7.93	260.50 ± 3.57	246.00 ± 4.61	5.08	NS	3.96
BWG_3	419.99^{c} ± 9.82	433.29^{bc} ± 15.40	477.41^{a} ± 10.74	463.13^{ab} ± 11.17	436.47^{bc} ± 8.89	11.42	34.75	5.12
BWG_4	554.02 ± 20.45	599.91 ± 25.05	538.16 ± 38.19	571.14 ± 13.81	547.37 ± 28.00	26.38	NS	9.39
BWG_5	619.25 ± 11.32	602.57 ± 38.56	654.53 ± 11.33	618.92 ± 12.71	659.62 ± 20.10	21.49	NS	6.81
BWG_6	542.09 ± 54.53	609.53 ± 41.88	467.47 ± 42.03	505.34 ± 60.26	525.80 ± 39.77	48.39	NS	18.26
BWG_{0-2}	385.56 ± 7.76	400.92 ± 5.09	386.85 ± 11.96	401.31 ± 4.34	376.72 ± 0.89	7.05	NS	3.61
BWG_{3-4}	974.01 ± 24.94	1033.19 ± 15.08	1015.56 ± 43.55	1034.27 ± 12.85	983.84 ± 35.37	28.85	NS	5.72
BWG_{5-6}	1161.34 ± 50.43	1212.10 ± 32.49	1122.00 ± 30.90	1124.26 ± 66.54	1185.42 ± 31.33	44.64	NS	7.69
BWG_{0-6}	2520.92 ± 21.85	2646.20 ± 28.77	2524.41 ± 39.49	2559.83 ± 79.08	2545.98 ± 66.12	51.94	NS	4.06

The means bearing different superscript within same row differ significantly from each other ($p < 0.05$)

enzyme supplementation in spite of reduction in CP levels in broiler diets. These findings are in agreement with the results of Yu *et al.* (2007), Cowieson and Ravindran (2008), Mohammadigheisar and Kim (2018) and Saleh *et al.* (2020). Significant improvement in BWG was observed by Yadav and Sah (2005), Hajati *et al.* (2009), Ajayi (2015), Kamel *et al.* (2015) and Sonu *et al.* (2018). Supplementation of protease enzyme in broiler diet containing low CP (1 or 2% less) help to improve BWG. However, the levels of protease enzyme supplementation used in present study might not be sufficient to achieve optimum broiler performance with reduced CP levels in broiler diets.

Feed Consumption

The feed consumed by the bird is one of the major economic traits which determine largely the profitability in poultry production. So, efforts are put to reduce feed consumption without affecting production performances. The data of feed intake (g/bird) recorded at weekly interval as well as during pre-starter, starter, finisher phase and overall experimental period is shown in Table 3. The feed consumption for overall period of six weeks (TFC_{0-6}) of birds fed with different treatment rations did not differ significantly ($p < 0.05$) from each other. The highest feed consumption (TFC_{0-6}) was observed in T_2 group followed by T_4, T_3, T_5 and T_1 groups. Total feed consumption of birds fed with treatment rations was at par with the control ration. The findings of present study were in agreement with Odetallah *et al.* (2005), Yu *et al.* (2007), Cowieson and Ravindran (2008), Angel *et al.* (2011), Ndazigaruye *et al.* (2019) and Saleh *et al.* (2020), who also did not observe significant influence of protease enzyme supplementation on the average daily feed consumption. Hajati *et al.* (2009), Freitas *et al.* (2011) and Ajayi (2015) observed decrease in feed consumption of birds fed with protease supplemented diet. Contrast to the present findings, Sonu *et al.* (2018) found significant ($p < 0.05$) difference in feed consumption of birds fed with protease supplemented diet.

Feed Conversion Ratio

Feed conversion ratio (FCR) is an important tool to measure the feed efficiency of birds. It indicates magnitude of profitability in broiler production and reflect feeding management practices followed in broiler farm. The data on average weekly FCR is showed in Table 4. The FCR of birds fed with treatment rations was at par with the control ration. These findings were in accordance with the results of Odetallah *et al.* (2005), Yu *et al.* (2007), Yamazaki *et al.* (2011), Rada *et al.* (2013), Ajayi (2015) and Dongare *et al.* (2017), who also did not find significant difference in FCR of birds on the inferior diets (with low CP levels) with protease enzyme supplementation from control diet. The present findings are in contrast with Abudabos (2010), Fru-Nji *et al.* (2011), Kamel

Table 3: Mean of feed consumption (g/bird) of broiler
The means bearing different superscript within same row differ significantly from each other ($p < 0.05$)

	Treatments							
Trait	T_1	T_2	T_3	T_4	T_5	*SEm*	*CD at 5%*	*CV%*
FC_1	132.60 ± 2.59^{b}	153.04 ± 1.39^{a}	154.22 ± 3.27^{a}	153.29 ± 3.48^{a}	156.25 ± 2.02^{a}	2.67	8.11	3.56
FC_2	359.00 ± 5.03	366.60 ± 8.08	378.60 ± 2.14	370.66 ± 5.58	362.78 ± 6.72	5.86	NS	3.19
FC_3	598.91 ± 16.06^{c}	682.64 ± 15.55^{ab}	700.41 ± 9.87^{a}	689.39 ± 26.24^{a}	636.85 ± 14.07^{bc}	17.23	52.40	5.21
FC_4	779.27 ± 37.60	881.76 ± 7.37	839.16 ± 40.02	859.72 ± 24.05	804.01 ± 35.30	31.28	NS	7.51
FC_5	1264.77 ± 80.32	1309.83 ± 113.79	1298.50 ± 32.28	1309.74 ± 24.77	1254.63 ± 38.05	67.08	NS	10.42
FC_6	1172.63 ± 56.34	1173.59 ± 58.40	1146.02 ± 43.88	1167.12 ± 69.93	1115.31 ± 43.65	55.33	NS	9.58
TFC_{0-2}	491.60 ± 6.19^{b}	519.63 ± 7.58^{a}	532.82 ± 1.90^{a}	523.94 ± 6.89^{a}	519.04 ± 7.58^{a}	6.39	19.44	2.47
TFC_{3-4}	1378.18 ± 24.12^{c}	1564.40 ± 18.84^{a}	1539.57 ± 44.75^{ab}	1549.10 ± 35.17^{a}	1440.86 ± 44.54^{bc}	35.10	106.77	4.70
TFC_{5-6}	2437.39 ± 31.57	2483.48 ± 133.34	2444.52 ± 44.38	2476.85 ± 81.95	2369.94 ± 61.39	79.03	NS	6.47
TFC_{0-6}	4307.17 ± 55.83	4567.17 ± 141.44	4516.90 ± 86.24	4549.90 ± 104.26	4329.83 ± 101.96	101.81	NS	4.57

Table 4: Mean of feed conversion ratio of broilers

	Treatments							
Traits	*T1*	*T2*	*T3.*	*T4*	*T5*	*SEm*	*CD at 5%*	*CV%*
FCR_1	0.76 ± 0.01^{c}	0.84 ± 0.01^{ab}	0.85 ± 0.03^{ab}	0.82 ± 0.01^{b}	0.89 ± 0.03^{a}	0.02	0.05	4.20
FCR_2	1.14 ± 0.02^{b}	1.16 ± 0.01^{b}	1.23 ± 0.03^{a}	1.17 ± 0.01^{b}	1.23 ± 0.02^{a}	0.02	0.06	3.21
FCR_3	1.28 ± 0.02^{b}	1.36 ± 0.01^{a}	1.36 ± 0.02^{a}	1.33 ± 0.02^{a}	1.35 ± 0.01^{a}	0.02	0.05	2.51
FCR_4	1.33 ± 0.01^{b}	1.41 ± 0.02^{a}	1.43 ± 0.01^{a}	1.40 ± 0.03^{a}	1.40 ± 0.01^{a}	0.02	0.06	2.74
FCR_5	1.55 ± 0.04	1.63 ± 0.06	1.60 ± 0.03	1.61 ± 0.03	1.56 ± 0.02	0.04	NS	4.80
FCR_6	1.68 ± 0.03	1.70 ± 0.05	1.76 ± 0.02	1.75 ± 0.03	1.67 ± 0.03	0.03	NS	3.99

The means bearing different superscript within same row differ significantly from each other ($p < 0.05$)

Table 5: Mean of carcass characteristics of broilers

Sr. No.	Traits	Treatments T1	T2	T3	T4	T5	SEm	C.D at 5%	CV%
1.	Pre-slaughter live wt.(g)	2652.75 ± 125.72	2600.50 ± 115.26	2558.75 ± 87.97	2547.25 ± 135.49	2542.75 ± 70.36	109.67	NS	8.50
2.	Dressed wt. (g)	1983.50 ± 80.53	1971.50 ± 92.06	1882.00 ± 77.01	1910.50 ± 113.20	1899.25 ± 37.50	83.80	NS	8.69
3.	Dressing (%)	74.85 ± 0.68	75.79 ± 0.43	73.57 ± 1.81	74.94 ± 0.67	74.74 ± 0.59	0.97	NS	2.60
4.	Liver wt. (g)	59.50 ± 1.26	52.25 ± 2.59	52.25 ± 3.45	53.75 ± 1.65	57.50 ± 3.97	2.78	NS	10.11
5.	Heart wt. (g)	17.25 ± 0.63	17.25 ± 1.11	15.75 ± 1.49	16.75 ± 2.53	15.75 ± 0.25	1.44	NS	17.36
6.	Gizzard wt. (g)	86.75 ± 3.09	87.50 ± 2.84	81.25 ± 4.92	82.00 ± 3.34	85.50 ± 2.72	3.48	NS	8.22
7.	Giblet wt. (g)	163.50 ± 3.52	157.00 ± 3.89	149.25 ± 4.17	152.50 ± 5.81	158.75 ± 5.31	4.63	NS	5.92
8.	Giblet (%)	6.19 ± 0.18	6.08 ± 0.35	5.85 ± 0.25	6.01 ± 0.23	6.25 ± 0.19	0.24	NS	8.05

Table 6: Return Over Feed Cost (Rs. / bird) of broilers

	Price of feed (Rs./kg)			Feed consumption (g/bird)			Cost of feed consumed (Rs/bird)				Final body wt. (g/bird)	Selling price (Rs/ kg live body wt.)	Income from selling of bird (Rs./bird)	ROFC (Rs./bird)
	0-2 wk	3-4 wk	5-6 wk	0-2 wk	3-4 wk	5-6 wk	0-2 wk	3-4 wk	5-6 wk	Total				
Treat.	A	B	C	D	E	F	G	H	I	J	K	L	M	M-J
T_1	37.71	39.17	39.59	491.60	1378.18	2437.39	18.54	53.98	96.50	169.02	2567.26	70.00	179.71	10.69
T_2	36.95	38.39	38.81	519.63	1564.40	2483.48	19.20	60.06	96.38	175.64	2693.35	70.00	188.53	12.89
T_3	36.01	37.55	38.02	532.82	1539.57	2444.52	19.19	57.81	92.94	169.94	2571.38	70.00	180.00	10.06
T_4	37.03	38.48	38.80	523.94	1549.10	2476.85	19.40	59.61	96.10	175.11	2606.34	70.00	182.44	7.33
T_5	36.10	37.54	37.99	519.04	1440.86	2369.94	18.74	54.09	90.03	162.86	2591.95	70.00	181.44	18.58

et al. (2015) and Saleh *et al.* (2020), who reported that broilers fed with protease enzyme supplementation significantly improved FCR.

Carcass Characteristics

The statistical analysis of data on various carcass characteristics (Table 5), *viz.,* pre-slaughter weight, dressed weight (with giblet), dressing percentage and giblet percentage were non-significant. Results indicated that carcass characteristics were not affected by protease enzyme supplementation and reduction in CP level of broiler diet. These findings were in accordance with the results of Hassan *et al.* (2011), Rada *et al.* (2013), Ajayi (2015), Dongare *et al.* (2017), Sonu *et al.* (2018) and Ndazigaruye *et al.* (2019), who also failed to see significant effect of supplementing protease enzyme on the carcass traits of broiler birds. Present findings differed from Cafe *et al.* (2002), Hajati *et al.* (2009) and Saleh *et al.* (2020), who found significantly increased weight of hot carcass, cuts (breast and thigh muscles) and liver with protease enzyme supplementation.

Economics

Feed is a major input item for broiler rearing. It accounts for more than 75 % of the total cost of production (Kamal and Raga, 2014). The economics of broiler production in terms of return over feed cost (ROFC) clearly expresses the profitability of broiler production. ROFC (Rs./bird) for birds fed with T_1, T_2, T_3, T_4 and T_5 rations was found to be 10.69, 12.89, 10.06, 7.33 and 18.58, respectively (Table 6). The protease enzyme supplementation @ 350 g/ton of feed with 2% reduction in CP level (T_5) as well as 175 g/ton of feed with 1% reduction in CP level (T_2) in broiler diet resulted in higher economic return in terms of ROFC as compared to other treatment rations and control ration.

Addition of protease enzyme resulted in reduction of cost of treatment rations as compared to control ration during pre-starter, starter and finisher phases. After addition of protease enzyme in the diet, cost (Rs.) of T_1, T_2, T_3, T_4 and T_5 rations was found to be 37.71, 36.95, 36.01, 37.03 and 36.10, respectively, during pre-starter phase. After addition of protease enzyme in the diet, cost (Rs.) of T_1, T_2, T_3, T_4 and T_5 rations was found to be 39.17, 38.39, 37.55, 38.48 and 37.54, respectively, during starter phase, and 39.59, 38.81, 38.02, 38.80 and 37.99, respectively, during finisher phase. These findings were in accordance with Purushothaman *et al.* (2015), who also observed reduced cost of broiler diet during pre-starter, starter and finisher phases with addition of protease enzyme.

Conclusions

Supplementation of protease enzyme @ 175 g/ton or 350 g/ton of feed with low CP (1% or 2%) broiler diet showed numerically higher body weight and weight gain as compared to control diet. The feed consumption and FCR of broilers fed with low CP diets supplemented with protease

enzyme were at par with the control. Carcass characteristics were not affected by protease enzyme supplementation and reduction in CP level of broiler diet. The protease enzyme supplementation @ 350 g/ton of feed with 2% reduction in CP level (T_5) as well as 175 g/ton of feed with 1% reduction in CP level (T_2) in broiler diet resulted in higher ROFC (Rs./ bird) as compared to other treatment rations and control ration. Further study is required with higher levels of protease enzyme supplementation with reduced CP levels in broiler diets to achieve optimum growth performance of broiler birds.

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