International Journal of Advanced Biochemistry Research

**ISSN Print:** 2617-4693
**ISSN Online:** 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; 9(10): 701-703
www.biochemjournal.com
Received: 01-07-2025
Accepted: 05-08-2025

**YG Deshmukh**
Department of Animal Nutrition, Nagpur Veterinary College, Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra, India

**AP Dhok**
Department of Animal Nutrition, Nagpur Veterinary College, Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra, India

**Corresponding Author:**
**AP Dhok**
Department of Animal Nutrition, Nagpur Veterinary College, Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra, India

# Performance of broiler chicken on low protein diet supplemented with protease enzyme

**YG Deshmukh and AP Dhok**

**DOI:** https://www.doi.org/10.33545/26174693.2025.v9.i10j.6149

**Abstract**
One hundred and eighty day old broilers chicks were randomly divided into six groups of three replications each. The ($T_1$) was fed as per BIS (2007); $T_2$, 5 percent reduced protein than $T_1$; $T_3$ 10 percent reduced protein than $T_1$; $T_4$ standard diet with protease @ 100 g/ton of feed; $T_5$ 5 percent reduced protein with protease @ 100 g/ton of feed and $T_6$ 10 percent reduced protein with protease @ 100 g/ton of feed.

**Keywords:** Broiler chicken, protease enzyme, low protein diet

## Introduction
Endogenous proteases is synthesized and released in the GI tract and these proteases are accounted to be sufficient to optimize feed protein utilization (Nir *et al.*, 1993) [20]. Despite of that, exogenous protease is effective in low protein diets. Exogenous serine protease enzymes enhancing protein and energy digestibility and thus improve the performance parameters. The increase nutrient availability with enzyme supplementation is associated with improved digestibility or retention of energy, protein or other nutrients. Chick consuming soybean meal diet supplemented with protease had higher body weight gain, apparent nitrogen retention and apparent metabolizable energy without affecting FCR (Ghazi *et al.*, 1997) [13]. Hence experiment was carried to study the performance of broilers on low protein diet with and without protease.

## Materials and Methods
One hundred and eighty commercial broilers, divided into six groups were fed for 6 weeks. The $T_1$ group was fed as per BIS (2007) [2]. The $T_2$ was fed on diet with 5 percent reduction in protein than $T_1$, $T_3$ with 10 percent reduction in protein than $T_1$, $T_4$ standard diet with protease, $T_5$ with 5 percent reduced protein than $T_1$ with protease and $T_6$ with 10 percent reduced protein than $T_1$ with protease. The body weight of each bird was recorded weekly, and feed consumption daily. A metabolic trial of 5 days collection period was conducted for five consecutive days during 6$^{th}$ week of experiment. The feed ingredients, mash feed and samples collected during the metabolic trial were analyzed as per AOAC (2005) [1]. The blood samples collected during 6$^{th}$ week of experiment were analyzed for total protein, albumin and globulin (Doumas, 1978) [3]. The carcass studies were conducted at the end of experiment. The data was analyzed statistically as per Snedecor and Cochran (1994) [4]. (The 1 gm of protease equals 6,00,000 IU and protease was supplemented @ 100 g/ton of feed).

**Table 1:** Formulation of experimental feed

| Ingredients | Pre-starter | | | Starter | | | Finisher | | |
|---|---|---|---|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_1$ | $T_2$ | $T_3$ | $T_1$ | $T_2$ | $T_3$ |
| Maize grain | 54.5 | 58.0 | 61.4 | 55.6 | 59.1 | 69.3 | 60.5 | 63.3 | 66.4 |
| Soya DoC | 39.8 | 36.7 | 33.5 | 37.35 | 34.35 | 31.35 | 31.8 | 29.1 | 26.5 |
| Veg. Oil | 2.5 | 2.1 | 1.75 | 3.95 | 3.45 | 3.1 | 4.5 | 4.25 | 3.7 |
| DCP | 1.3 | 1.3 | 1.4 | 1.3 | 1.3 | 1.4 | 1.35 | 1.35 | 1.4 |
| LSP | 1.4 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 |
| Salt | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Lysine | 0.1 | 0.1 | 0.11 | 0.1 | 0.1 | 0.1 | 0.13 | 0.16 | 0.15 |
| Methionine | 0.1 | 0.1 | 0.11 | 0.1 | 0.1 | 0.13 | 0.12 | 0.14 | 0.15 |

(To the above, trace mineral mixture, vitamin mixture, Coccidiostats and toxin binders were added over and above to fortify diets.)

## Results and Discussion

**Table 2:** Performance of broilers on low protein diet with protease

| Parameters | $T_1$ | $T_2$ | $T_3$ | $T_1$ | $T_2$ | $T_3$ | SEM |
|---|---|---|---|---|---|---|---|
| Initial BW, g | 42.42 | 43.80 | 43,74 | 43.68 | 43.65 | 43.65 | 0.28 |
| Final BW**, g | $1736.67^{b}$ | $1889.33^{d}$ | $1785.67^{c}$ | $1879.67^{d}$ | $1767.33^{c}$ | $1589.33^{a}$ | 42.82 |
| Weekly wt gain**,g | $282.37^{b}$ | $307.59^{d}$ | $290.32^{bc}$ | $305.10^{d}$ | $287.28^{bc}$ | $257.61^{a}$ | 36.72 |
| Feed consumption**, g | $2817.72^{a}$ | $3195.06^{c}$ | $3202.32^{c}$ | $3169.08^{bc}$ | $3048.66^{bc}$ | $2816.46^{a}$ | 114.1 |
| FCE** | $1.71^{b}$ | $1.68^{a}$ | $1.79^{e}$ | $1.68^{a}$ | $1.73^{c}$ | $1.77^{d}$ | 0.04 |
| DM metabolizability**,% | $79.67^{cd}$ | $79.53^{cd}$ | $78.70^{a}$ | $78.90^{ab}$ | $79.02^{abc}$ | $80.15^{d}$ | 0.23 |
| CP metabolizability**,% | $62.61^{a}$ | $67.42^{b}$ | $73.15^{c}$ | $64.32^{a}$ | $74.22^{c}$ | $78.27^{d}$ | 0.70 |
| CF metabolizability**,% | $30.37^{a}$ | $37.16^{c}$ | $38.86^{d}$ | $33.37^{b}$ | $39.22^{d}$ | $43.68^{e}$ | 0.51 |
| EE metabolizability,% | 81.62 | 80.69 | 81.17 | 81.16 | 82.07 | 81.04 | 0.43 |
| Serum protein**, g/dl | $3.75^{d}$ | $3.24^{b}$ | $3.08^{a}$ | $3.94^{e}$ | $3.44^{c}$ | $3.22^{b}$ | 0.03 |
| Serum albumin**, g/dl | $2.02^{c}$ | $1.76^{ab}$ | $1.69^{a}$ | $2.19^{d}$ | $1.84^{b}$ | $1.73^{a}$ | 0.02 |
| Serum globulin**, g/dl | $1.74^{d}$ | $1.48^{ab}$ | $1.40^{a}$ | $1.75^{d}$ | $1.61^{c}$ | $1.49^{b}$ | 0.02 |
| Dressing**, % | $73.54^{a}$ | $75.17^{c}$ | $76.39^{d}$ | $74.00^{b}$ | $75.32^{c}$ | $76.44^{d}$ | 1.04 |
| Edible meat** % | $65.59^{a}$ | $70.24^{c}$ | $71.25^{d}$ | $69.13^{b}$ | $70.19^{c}$ | $71.22^{d}$ | 0.86 |
| Abdominal fat pad**, % | $2.59^{c}$ | $2.14^{a}$ | $2.14^{a}$ | $2.14^{a}$ | $2.90^{d}$ | $2.26^{b}$ | 0.09 |
| Breast meat**, % | $16.21^{b}$ | $16.10^{b}$ | $15.67^{a}$ | $16.20^{b}$ | $16.12^{b}$ | $15.84^{a}$ | 0.11 |
| Net profit, Rs/kg | 8.39 | 10.01 | 4.90 | 8.70 | 8.16 | 5.53 | |

Similar superscripts within the respective row indicates non significant differences ($p$<0.01)

The BW gain (Table 2) were significantly ($p$<0.01) higher in $T_2$ and at par with $T_4$ group. Addition of protease enzyme enhances body weights, however effect of protease could not be seen in 10 percent protein reduced group. The findings corroborates with Rada *et al.,* (2013) [21], reported higher body weights on low protein feed. Ardekani and Chamani (2012) [8] also reported more body weights in broilers when protein level was reduced. Kamran *et al.,* (2004) [16] reported beneficial effects on body weights when protein in diet was reduced. However Angel *et al.,* (2011) [7] and Frietas *et al.,* (2011) [12] reported no significant effect on growth of birds, fed low CP feed with protease. The feed consumption was more in $T_2$ and $T_3$ groups and corroborates with Yadav and Sah (2005) [23] who reported increased feed consumption of broilers on low protein diet. The increase in feed consumption of birds due to reduced protein may be attributed to the tendency of the birds to eat more in order to compensate for lower protein diets. The less feed consumption due to reduced protein may be due to the protease, which also increased CP metabolizability, as evident in the present study. Improvement in feed consumption of control group with protease are in agreement with Khan *et al.,* (2006) [18] who observed increased feed consumption due to enzyme. The better FCR was observed in $T_2$ and $T_4$ group, indicated better conversion of feed into body weight on low protein feed. Addition of protease in low protein diet could not be effective in conversion of feed into meat. The findings are consistent with Kamran *et al.,* (2004) [16] and Freitas *et al.,* (2011) [12] reporting better FCR on protease in control diet. However Rada *et al.,* (2013) [21] observed no significant change due to low protein diet. The DM metabolizability was higher in $T_6$ group and corroborates with Olukosi *et al.,* (2007) [24] reported higher ($p$<0.05) DM digestibility when enzyme alone was added in the feed. Khan *et al.,* (2006) [18] also reported increased ($p$<0.05) DM digestibility due to enzyme addition. Zanella *et al.,* (1999) [25], observed increased starch digestibility due to enzyme supplementation, attributed to solubilization and disruption of grains endosperm cell walls. The effect of protease could not be seen in normal diet in improving CP metabolizability rather it worked better on CP reduced diet and exceptionally well, indicated best utilization of protein when fed at lower level. These results are supported by Angel *et al.,* (2011) [7] and Yadav and Sah (2005) [23]. The CF metabolizability was better in group receiving 10 percent low protein diet and in agreement with Yadav and Sah (2005) [23]. Effects of protease on poultry diet do not appear to be completely limited to protein digestion, but also affect the digestibility of other nutrients. Increased digestion of corn starch with the use of protease, attributed to the disruption of protein matrix in starch granules. The protein hydrolysis catalyzed by the exogenous protease may be responsible for the improvement in apparent CP digestibility. The fibre degradation may be one of the mechanisms by which protease increases the digestion of nutrients in chickens. The serum total protein was significantly higher in $T_1$ and $T_4$ group over the protein deficient diet. The findings are supported by Abudabos (2012) [6] who observed higher serum total protein due to enzyme. However, El-Katcha *et al.,* (2014) [11] reported no significant effect on blood serum total protein. The serum albumin and globulin levels were also higher on control diet with enzyme exhibited positive effect of protease on serum biochemical parameters in normal diet. These findings are in consistent with Hernandez *et al.,* (2012) [8]. The serum protein, albumin and globulin on protein deficient diet either with protease or without protease supplementation were within the normal range as reported by Jerry *et al.* (2008) [26]. The dressing percentage was higher in both the groups i.e. with and without enzyme supplementation than control and consistent with Kamran *et al.,* (2004) [16]. The improvement in carcass yield with the use of low CP diet (supplemented with essential amino acids) could be due to reduced heat increment, which is associated with the metabolism of excess protein (Kamran *et al.,* 2004) [16]. The breast meat was less on 10 percent low protein diet with and without enzyme and it was comparable in either group of control diet. These results are supported by Cafe *et al.,* (2002) [9] reporting no consistent effect on yield of breast. The net profit Rs. per kg BW was highest in $T_1$ (Rs.10.01) and supported by Kamran *et al.,* (2004) [16] and Kamran *et al.,* (2011) [17]. It was concluded that the protein level can be reduced in broiler diet upto five percent than standard without any adverse effect on birds for economical broiler production.

## Concussion

It was concluded that dietary protein levels in broiler feed can be reduced by up to 5% without adverse effects on growth performance or carcass traits. Protease enzyme supplementation enhanced body weight, feed conversion ratio, and nutrient metabolizability, particularly under reduced protein conditions. Improved serum biochemical parameters and digestibility indicated better nutrient utilization. However, a 10% reduction in protein showed negative effects on growth and carcass yield. Overall, inclusion of protease in moderately reduced protein diets improves growth efficiency, nutrient utilization, and profitability, supporting economical and sustainable broiler production without compromising performance.

## References


1. AOAC. Official Methods of Analysis. 18th ed. Washington (DC): Association of Analytical Chemists; 2005.
2. BIS. Indian Standards of Poultry Feed Specifications. 5th ed. IS-1347. New Delhi (IN): Manak Bhavan; 2007.
3. Doumas BT. Determination of serum total protein and albumin. Clin Chim Acta. 1978;31:87-96.
4. Snedecor GW, Cochran WG. Statistical Methods. 8th ed. Ames (IA): Iowa State University Press; 1994.
5. Tietz NV. Clinical Guide to Laboratory Tests. Philadelphia (PA): W.B. Saunders Co; 1976. p. 238.
6. Abudabos AM. Effect of enzyme supplementation to normal and low density broiler diets based on corn-soybean meal. Asian J Anim Vet Adv. 2012;7:139-148.
7. Angel CR, Saylor W, Vieira SL, Ward N. Effects of a monocomponent protease on performance and protein utilization in 7-to 22-day-old broiler chickens. Poult Sci. 2011;90:2281-2286.
8. Ardekani HM, Chamani M. Fortify low protein diet with supplemented essential amino acids on performance, carcass characteristics, and whole-body female broiler chickens. Ann Biol Res. 2012;3(5):2208-2212.
9. Café MB, Borges CA, Fritts CA, Waldroup PW. Avizyme improves performance of broilers fed corn-soybean meal-based diets. J Appl Poult Res. 2002;11:29-33.
10. Cowieson AJ, Adeola O. Carbohydrases, protease, and phytase have an additive beneficial effect in nutritionally marginal diets for broiler chicks. Poult Sci. 2005;84:1860-1867.
11. El-Katcha MI, Soltan MA, El-Kaney HF, El-Sayed R. Growth performance, blood parameters, immune response and carcass traits of broiler chicks fed on graded levels of wheat instead of corn without or with enzyme supplementation. Alex J Vet Sci. 2014;40:95-111.
12. Freitas DM, Vieira SL, Angel CR, Favero A, Maiorka A. Performance and nutrient utilization of broilers fed diets supplemented with a novel monocomponent protease. J Appl Poult Res. 2011;20:322-344.
13. Ghazi S, Rooke JA, Galbraith H, Bedford MR. Effect of adding protease and α-galactosidase enzyme to soybean meal on nitrogen retention and true metabolizable energy in broilers. Br Poult Sci. 1997;38:28-29.
14. Ghazi S, Rooke JA, Galbraith H, Bedford MR. The potential for the improvement of the nutritive value of soybean meal by different proteases in broiler chicks and broiler cockerels. Br Poult Sci. 2002;43(1):70-77.
15. Hajati H, Rezaei M, Sayyahzadeh H. The effects of enzyme supplementation on performance, carcass characteristics and some blood parameters of broilers fed on corn-soybean meal-wheat diets. Int J Poult Sci. 2009;8(12):1199-1205.
16. Kamran Z, Mirza MA, Ahsan-ul-Haq, Mahmood S. Effect of decreasing dietary protein levels with optimal amino acids profile on the performance of broilers. Pak Vet J. 2004;24(4):165-168.
17. Kamran Z, Mahr-Un-Nisa, Nadeem MA, Sarwar M, Amjid SS, Pasha RH, Nazir MS. Effect of low crude protein diets with constant metabolizable energy on performance of broiler chickens from one to thirty-five days of age. Indian J Anim Sci. 2011;81(11):1165-1172.
18. Khan SH, Sardar R, Siddique B. Influence of enzymes on performance of broilers fed sunflower-corn based diets. Pak Vet J. 2006;26(3):109-114.
19. Liu SY, Selle PH, Court SG, Cowieson AJ. Protease supplementation of sorghum-based broiler diets enhances amino acid digestibility coefficients in four small intestinal sites and accelerates their rates of digestion. Anim Feed Sci Technol. 2013;183:175-183.
20. Nir I, Nitsan Z, Mahagna M. Comparative growth and development of the digestive organs and of some enzymes in broiler and egg-type chicks after hatching. Br Poult Sci. 1993;34:523-532.
21. Rada V, Foltyn M, Lichovníková M, Musilová A. Effects of protease supplementation of low protein broiler diets on growth parameters and carcass characteristics. Mendelnet. 2013:268-272.
22. Rosa AP, Scher A, Stefanello C, Diaz E, Duarte V, Oichenaz N, Sorbara JOB. Effect of pure protease enzyme and dietary protein/amino acids levels on broiler performance. Poult Sci. 2009;88(1):1-132.
23. Yadav JL, Sah RA. Supplementation of corn-soybean based broiler's diet with different levels of acid protease. J Inst Agric Sci. 2005;26:65-70.
24. Olukosi OA, Cowieson AJ, Adeola O. Age-related influence of a cocktail of xylanase, amylase, and protease or phytase individually or in combination in broilers. Poultry science. 2007 Jan 1;86(1):77-86.
25. Zanella I, Sakomura NK, Silversides FG, Fiqueirdo A, Pack M. Effect of enzyme supplementation of broiler diets based on corn and soybeans. Poultry science. 1999 Apr 1;78(4):561-568.
26. Jerry DJ, Tao L, Yan H. Regulation of cancer stem cells by p53. Breast Cancer Research. 2008 Aug 29;10(4):304.