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Effect of different concentration of commercial protease enzyme on broiler production

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Abstract
Premise of the study was to corroborate the growth promoting effect of protease on the performance and to explore its digestion enhancer effect in broiler chicks. A total of 400 DOC of same hatch were procured and randomly distributed into five groups i.e. T_0 (Control), T_1, T_2, T_3 and T_4 treatments with good body weight and 80 chick were randomly distributed into five treatment with four different protease enzymes concentration (T_1 0.01g, T_2 0.02g, T_3 0.03g, T_4 0.35g) and one control without enzyme respectively. In this treatment four replication were carried out with 20 chick each in each replication randomly distributed. All broilers were offered water ad lib at all time. They were housed in deep litter. A bulb of 100 watt was left on in each block. Broilers were given floor space @ 0.75 sq ft. Each was managed under identical management condition. The data on feed intake, body weight was recorded weekly to determine gain in weight and FCR. The data were analysed statistically. The mean body weight DOC in different treatment T_0, T_1, T_2, T_3, and T_4 was 45.65, 45.92, 45.02, 46.72 and 45.95 g respectively. The differences in body weight of DOC were non-significant.

Keywords: Broilers, digestibility, protease, FCR, feed intake

1. Introduction
Animal husbandry has been practiced for thousands of years since the first domestication of different animals like cattle, sheep and goat, poultry and swine for different species different nutrition aspect have to consider to raise successful farming among all poultry farming in animal husbandry account or contribute 60% of agriculture GDP. From an industrial standpoint, only a limited number of enzymes are commercially available and few of them have found applications in large quantities. More than 75% of industrial enzymes are hydrolases. (Rao *et al*. 1998) [11].

Today the enzymes are used in many industrial applications and the demand for, highly active and specific enzymes are growing rapidly. Global market for industrial enzymes is reported to be €1 billion in 1995 whereas, it was increased to $2.3 billion in 2007 and was expected to increase to over $2.7 billion by 2012. Poultry Nutrition deal with all avian species nutrition which is required for advance commercial farming. Multiple feed additive added in the feed for better feed conversation ratio, protease is one of the enzymes which added in poultry nutrition. Feeding enzymes to poultry is one of the major nutritional advances in the last five decade. These enzymes come from microorganisms that are carefully selected for the task and grown under controlled conditions (Wallis, 1996) [15]. Potentially enzymes used in the feed industry are cellulase (β-glucanases), xylanases and associated enzymes, phytases, proteases, lipases, galactosidases etc.

1.1 Proteases are classified in different ways
1. By organism (plant, animal, bacterial, fungal), where animal and plant derived Proteases are produced by extraction while fungal and bacterial derived Proteases are produced by fermentation.
2. By their pH activity range (acid, neutral, alkaline, high alkaline).
3. By their peptide bond specificity (endopeptidases, exopeptidases, or amino acid specific Proteases).
4. By their photolytic mechanism (serine, threonine, cystine, and aspartic acid, glutamic acid, or metallic Proteases).

a) The use of protease enzyme on feed has been the most of widely used strategies to improve nutrient utilization efficacy and reduce the feed cost in the poultry industry. Protease have routinely included to poultry diet for many year as a part of cocktail enzyme containing xylanas, celluase, amylase, and glucanase.

Therefore, the present study to determine weekly gain in weight and feed conversion ratio (FCR) of broilers fed on ration supplemented with different commercial protease enzyme.

1.2 Feed Conversion Ratio (FCR)

Study revealed that addition of 0.1% of Avizyme to a nutritionally complete broiler diet based on corn and soybean meal, and resulted in the significant (P =0.05) improvements in body weight of male broilers at 16, 35 and 49 days of age (Cafe *et al*. 2002) [3]. Multiple trial on keratinase (broad spectrum Protease enzyme, 3,00,00U/g) and revealed that feed conversion ratio (FCR) was also improved when chicks were fed with LP+ E diet both at 21d and 26 d of age (Odetallah 2003) [8]. Acid Protease at 0.05%, 0.075% and 0.1% in broiler diet with reduction of protein content by 1 unit in starter (20 Vs. 19) and in finisher diet (18.5 Vs. 17.5). The results revealed that Protease supplementation of the reduced CP diets with 0.075% and 0.1% actually increased the body weight gain of broilers at both 28 and 42 days of age (Yadav and Sah, 2005) [13]. Protease containing feed additive Versazyme (6,60,000 U/g) at 0.1% to corn-soyabean meal containing 95% and 105% amino acids. Significant (P 0.05) body weight gain at 21, 35 and 42 days of age. Supplementation of both the diets with Versazyme improved BW at 21d. Although Versazyme supplementation was discontinued at 21 d, the effect was carried over to the end of the trial (Odetallah *et al*. 2005) [9]. Supplementation of Protease to coccidiosis infected broiler birds and concluded that dietary Protease supplementation stimulates BWG, which seems more prominent in coccidiosis-infected broilers. There was no significant (P 0.05) interaction on BWG between the Protease supplementation and single species coccidiosis infections (Peek *et al*. 2009) [10]. Dose-response experiment with Ross broiler chickens from one day old to 42 d of age to determine the effect of exogenous composite enzyme (TXAP) fed on maize –soybean diet at 0.5 to 2.5 g/kg in fact inclusion of TXAP did not significantly (P=0.05) affect any of performance variable as demonstrated by variance and regression analysis (Ngxumeshe and Gous 2009) [7].

Ven Cobb broiler chicks fed with maize-soya bean meal diet by addition of XAP (Xylanase, Amylase, Protease) and Phytase alone or in combination, results revealed that the addition of XAP alone did not affect body weight, but when phytase alone or in combination with XAP were added, there was an increase (P=0.01) in body weight above the negative control diet (Tiwari *et al*. 2010) [12].

Experiment on broiler by supplementing multi enzyme containing acid Protease (10,000 U/g), alpha-amylase (40 U/g), pectinase (30 U/g), phytase (10 U/g), glucoamylase (5 U/g), and cellulose (4 U/g) revealed that body weight gain was significantly (P 0.05) higher for birds fed control diet at 42 days (Hana *et al*. 2010) [5]. Study on male Ross 308 broiler chicks to determine the effect of exogenous Protease (75,000 Protease/g) at 0, 100, 200, 400, 800, and 1600 ppm of feed to corn-soya bean-based meal and reported that the body weight gain improved in broilers fed the positive control diets as compared with those fed the negative control diets, irrespective of the addition of Protease. Protease supplementation of the negative control diet had no effect on BWG, regardless of Protease concentration (Freitas *et al*. 2011) [4].

Effect of monocomponent Protease (75,000 PROT units/g) added to corn-soybean meal diets (PC; 22.5% CP, LP;20.5% CP) fed to Ross 708 broilers from 7 to 42 days of age and reported that broiler fed the PC diet gained 7.5% more weight than those fed the negative control diet (Angel *et al*. 2011) [1]. Experiment on Ross 708 broiler chicks by supplementation of Protease (75,000 PROT units) to low protein diets at level of 0mg, 100mg, 200mg, 400mg, and 800mg/kg of diet and concluded that body weight gain and feed gain ration of broilers supported by the PC diet were significantly (P 0.05) better than the same values observed for the LP diet without Protease (Bill Dudley 2012) [2].

The impairment of feed consumption ratio (FCR) in birds fed the LPO diets compared with those fed the PC diet. Yet when the Protease was added at inclusion levels of 200 to 800 mg/kg, FCR was ameliorated such that no difference existed between the FCR of birds fed the PC diet and those fed the LP diet (Angel *et al*. 2011) [1].

1.3 Digestibility of Nutrients

Addition of 0.1% Avizyme to cornbased diets with soybean meal, extruded soybeans, or roasted soybeans resulted in significant (P 0.05) improvements in digestibility of crude protein (+2.9%), starch (+1.8%), and fat (1.6%). The metabolizable energy of the test diet was also significantly (P=0.05) improved (+2.5%) by enzyme addition (Zanella *et al*. 1999) [16]. Amino acid digestibility of a maize and soy-based diet for broilers could be improved by around 3% when supplemented with xylanase, amylase and Protease allowing performance to be maintained on a diet with a lower nutritional plane (Zanella *et al*. 1999) [16]. Effect of commercial enzyme Homecozyme and Rovabio on broilers on corn-sunflower diet and revealed that apparent digestibility's of DM, OM, CP, EE, starch and energy were increased ($P< 0.05$) with supplementation of enzymes (Khan *et al*. 2006) [6].

The thermo tolerance and efficacy of a commercial multi-enzyme product containing amylase, Protease and xylanase in broilers and reported that, Apparent digestibility of CP, AD of GE ($P< 0.001$), and AME ($P< 0.001$) values were all improved linearly as the level of addition of enzyme increased within the whole range tested in mash diets (Yang *et al*. 2010) [14]. The mono component Protease improved the digestibility values for CP and fat when determined at 42 days of age, and this effect was more pronounced in the high-protein diets (Freitas *et al*. 2011) [4]. Digestibility of crude protein was increased ($P< 0.05$) in broilers fed the LP- supplemented diets compared with those fed with PC, but it was similar between those fed LP diets with any Protease concentration (Angel *et al*. 2011) [1].

2. Materials and methods

2.1 Experimental materials

To conducted and evaluate the growth performance of present study the following materials are needed. 1. Commercial broiler feed (with different 4 commercial protease enzymes) 2. Drinker 3. Feeder 4. Pollsters (liquid vitamin & electrolyte, liquid amino acid, tannic acid) 5. Cobb 400 Y DOC 6. Brooder 7. Thermometer.

2.2 Methods: Total 400 Cobb 400 Y Chicks Were procured from renowned hatchery With good body weight, with 80 Chicks were randomly distributed into 5 treatments with four different protease enzymes concentration and one control respectively in this treatment four replication were carried out with 20 chick each in each replication randomly distributed.

Table 1: Ingredient and nutrient composition of experimental diets (%DM)

Ingredients (%)	Broiler Pre-Starter (1-14day)	Broiler Starter (15-28day)	Broiler Finisher (29-42day)
Maize	60	62	63
Hypro Soy	29.1	25.4	22.5
Meat Bone Meal	30	40	47
Lysin	3	3.5	4
Oil	10	12	15
Methionin	3	3.5	4
Threonin	0.5	0.6	0.7
Di Calcim Phosphate	10	13	15
Salt	2.50	3.0	4
Sodium by Carbonate	1	1.5	2
Protease(g)	350	350	350
Vitmix	0.6	0.7	0.9
Toxin Binder	1	1.5	1.9
Livoliv	1	1.2	1.5
Antidiarrhoea	0.5	1	1.5
Antioxidant	0.1	0.7	0.9
Antibiotic	0.02	0.05	0.9
Moisture (%)	6.29	6.79	6.98
Crude protein (%)	21	22	23
Total ash (%)	4	5	7

2.2 Experimental design
Four-hundred-day old commercial broiler chicks (Cobb-400) comprising of both male and female are procured from hatchery and reared for 42 days under standard managemental regimes. The chicks with uniform comparable body weight were wing banded, weighed and randomly allotted to five dietary treatment groups (Table 2) in a randomized design. Each treatment groups were having four replicates with twenty birds in each replicate (80 birds/treatment).

2.3 Experimental diet
The yellow maize and meat bone meal-based broiler diets (pre-starter, starter and finisher) were formulated. The control diet was formulated as per cob 400 manual to meet the nutrient requirement of Cobb broilers. Ground corn was offered to the flock within 12 hours of hatching and subsequently on a pre starter (days 1-14), a starter (days 15-28), and a finisher feed (days 29-42) was offered to each treatment group. Sample of Protease was analysed for assay at laboratory before mixing with the experimental diet.

Table 2: Description of dietary treatment

Sl. N0.	Treatment	Description
1.	T0	Control diet as per cobb-400 requirements of nutrients
2.	T1	Control diet + protease enzyme @ 0.01% of feed
3.	T2	Control diet + protease enzyme @ 0.02%of feed
4.	T3	Control diet + protease enzyme @ 0.03% of feed
5.	T4	Control diet + protease enzyme @ 0.35% of feed

2.4 Parameters studied
Following parameters were studied to observe the effect of growth on broiler diets with and without enzyme supplementation are described hereunder.

2.5 Body weight gain
Following the initial body weight on day one the chicks were weighted individually at weekly intervals to observe the body weight gain. Accordingly, the body weight gain in different dietary groups was compared among treatment groups. Comparison was also made between treatment groups. All the chicks were weighed in early hours of the day to avoid stress. The digital electronic top pan balance having the accuracy of one gram was used for this purpose.

2.6 Feed consumption
Average weekly feed consumption was recorded for each replicate and was added to proceeding weeks feed consumption to calculate cumulative feed consumption.

2.7 Feed Conversion Ratio
The feed conversion ratio (FCR) expressed as the amount of feed consumed to the body weight gained under each group of birds arrived at each week and also cumulatively.

$$FCR = \frac{\text{Feed consumption in Kg}}{\text{Body weight gain (in Kg)}}$$

3. Results and discussion
3.1 Body weight of day-old chicks (g)
The body weight of day-old chicks randomly distributed into control (T_0) and four different treatments (T_1, T_2, T_3 and T_4) are presented in Table 1. The body weight of day-old chicks randomly distributed in different treatments contained in Table 3.1, it was noted irrespective of treatments. The body weight of chicks in general ranged from 45.02-46.72 g. The highest mean body weight of chicks was recorded in T_4 (48.72 g) followed by T_3 (45.95g), T_2 (45.92 g), T_1 (45.65 g) and T_0 (45.02 g). The differences in these values between the treatments were found non-significant which indicated that the random distribution of the chicks among the different groups of treatments of the experiments was proper and unbiased. These finding also justify the reported date of (Cafe *et al*. 2002) [3].

Table 3.1: Average Body weight (g) of day old broilers in five different treatments

Treatments						
Replication	**T0**	**T1**	**T2**	**T3**	**T4**	**Replication Mean (g)**
R1	45.5	47.8	45.5	45.6	45.3	45.94
R2	46.7	43.8	44.6	48.8	46.5	46.08
R3	45	46.1	46.5	47	46.7	46.26
R4	45.4	46	43.5	45.5	45.3	45.14
Totals	182.6	183.7	180.1	186.9	183.8	45.855
Treatment Mean (g)	**45.65**	**45.925**	**45.025**	**46.725**	**45.95**	

3.2 Body weight of broiler chicks at one week of age

The body weight of one-week old chicks contained in Table 3, it was noted that irrespective of treatments, the body weight of chicks at one week of age ranged 149.66-160.12 g. The highest mean body weight of chicks at first week of age was recorded in T_3 (160.12) followed by T_2 (154.33 g), T_0 (152.29 g) T_1 (150.51 g) and T_4(149.66 g). The differences in these values were found to be non significant; indicating there by a non significant effect of Protease enzyme supplementation in water on body weight of chicks at first week of age. The broilers in registered non-significantly body weight compared to other treatments. The differences in body weight of broilers in T_1, T_2, T_3 and T_4 were Non-significant. The broilers in T_4 registered non significantly lowest body weight at one week of age. The results revealed that there is a beneficial effect of supplementation of Protease enzyme in water of broilers on body weight (Yadav and shah 2005) [13].

Table 3.2: Average Body weight (g) of day old broilers at first week of age in five different treatments

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	171.75	147.5	162	164.5	156.25	160.4
R2	144	136.05	148.68	151	165.75	149.096
R3	156.5	175	173.5	149	127	156.2
R4	136.94	143.5	133.15	176	149.66	147.85
Totals	609.19	602.05	617.33	640.5	598.66	153.3865
Treatment Mean	152.2975	150.5125	154.3325	160.125	149.665	

3.3 Body weight of chicks at two weeks of age

The body weight of two weeks old chicks in Table 3. 3, it was noted that irrespective of treatments the body weight of chicks ranged from 352.59-370.16 g. The highest mean body weight of broiler chicks at two week of age was recorded in T_2 (370.16g) followed by T_4 (369.56g), T_3 (366.75g), T_1 (358.73g) and T_0 (352.59g), and the differences in these values were found to be non-significant, indicating there by a non-significant effect of treatments on body weight of chicks at two weeks of age. The broilers in T_2 registered non-significantly highest body weight (Hana *et al*. 2010) [5].

Table 3.3: Average Body weight (g) of broilers at two weeks of age in five different treatments.

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	417.5	337.5	382.1	367	363.68	373.556
R2	333.5	342.94	370	345.5	380.5	354.488
R3	312	372	393	363.5	364.5	361
R4	347.36	382.5	335.55	391	369.56	365.194
Totals	1410.36	1434.94	1480.65	1467	1478.24	363.5595
Treatment Mean	352.59	358.735	370.1625	366.75	369.56	

3.4 Body weight of broiler chicks at three weeks of age

The body weight of three weeks old chicks contained in Table 3.4, it was noted that irrespective of treatments the body weight of chicks ranged from 736.59-763.91 g. The highest mean body weight of broiler chicks at three weeks of age was recorded in T_4 (763.91 g) followed by T_2(755.25g), T_1(751.29 g), T_0 (736.59g) and T_3 (728.90 g). The differences in these values were found to be non-significant, indicating thereby a non-significant effect of treatments on body weight of chicks at three weeks of age. The broiler in T_2 registered non-significantly highest body weight compared to other treatments. The results of the study indicate a beneficial effect of supplementation of different commercial protease enzyme in water of broilers on body weight (Angel *et al.* 2011) [1].

Table 3.4: Average Body weight (g) of broilers at three weeks of age in five different treatments.

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	857.5	693	778.42	772.5	764.73	773.23
R2	708.94	731.17	755	611.11	772.5	715.744
R3	648.82	804.5	786.5	746	754.5	748.064
R4	731.11	776.5	701.11	786	763.91	751.726
Totals	2946.37	3005.17	3021.03	2915.61	3055.64	747.191
Treatment Mean	736.5925	751.2925	755.2575	728.9025	763.91	

3.5 The body weight of chicks at four weeks of age

The body weight of four weeks old chicks contained in Table 3.5 it was noted that irrespective of treatments, the body weight of chicks ranged from 1241.63-1295.48 g. The highest mean body weight of broiler chicks at four weeks of age was recorded in T_1 (1295.48) followed by T_3 (1293.83g), T_4

(1282.70g), T_2 (1254.37g) and T0 (1241.63g). The differences in these values were found to be non-significant, indicating thereby a non-significant effect of treatments on body weight of chicks at four weeks of age. The body weight of broilers in T_1 registered non-significantly highest body weight compared to all other treatments. The results indicate a beneficial effect of different commercial protease enzyme in water supplementation on body weight of broilers (Tiwari *et al.* 2010) [12].

Table 3.5: Average Body weight (g) of broiler at four weeks of age in five different treatments

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	1448.5	1173.5	1257.36	1341.57	1282.1	1300.606
R2	1175.26	1276.87	1218.82	1246.25	1273	1238.04
R3	1113.33	1392.63	1322.5	1258.5	1293	1275.992
R4	1229.44	1338.94	1218.82	1329	1282.7	1279.78
Totals	4966.53	5181.94	5017.5	5175.32	5130.8	1273.6045
Treatment Mean	1241.6325	1295.485	1254.375	1293.83	1282.7	

3.6 The body weight of chicks at five weeks of age

It was noted that irrespective of treatments, the body weight of chicks ranged from 1246.25-1690.25g (Table 3.6). The highest mean body weight of broiler chicks at five weeks of age was recorded in T_4 (1504g) followed by T_1 (1500.19g), T_2 (1492.50 g), T_0 (1453.19g) and T_3 (1862.33g). The differences in these values were found to be non-significant, indicating there by a non-significant effect of treatments of on body weight of chicks at five weeks of age. Non-significantly highest body weight of broilers was recorded in T_1compared to all other treatments. Results revealed that inclusion of Different commercial protease enzyme in water of broiler enhanced body weight of broilers (Peek *et al.* 2009) [10].

Table 3.6: Average Body weight (g) of broiler at five weeks of age in five different treatments

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	2056	1758.33	1798.23	1965.55	1878.42	1891.306
R2	1764.44	1827.55	1870	1813.12	1816.31	1818.284
R3	1585.71	2011.05	1886.31	1855.5	1892	1846.114
R4	1825.6	1911.6	1772.9	1849.5	1862.62	1844.444
Total	7231.75	7508.53	7327.44	7483.67	7449.35	1850.037
Treatment Mean	1807.9375	1877.1325	1831.86	1870.9175	1862.3375	

3.7 The body weight of broilers of different treatments

The body weight of broilers, contained in Table 3.7, it is noted that mean body weight of broilers, irrespective of treatments at one, two three four and five weeks of age was 153.38, 363.55, 747.18, 1273.60 and 1850 g respectively; and the differences in these were significant, indicating thereby a significant effect of age on the body weight of broilers in all treatments. These results were as expected, because under normal conditions the increase in body weight with the intake of feed is what one would expect with the increase in age of birds. When treatment-wise body weight of broilers was observed, it was noted that highest weekly mean body weight of broilers was recorded in T_1 (886.63 g) followed by T_4, (885.63 g), T_3 (884.10 g) T_2 (873.19 g) and T_0 (858.21 g). The differences in these values of treatments were also found significant, on body weight of broilers.

Table 3.7: Average weekly mean body weight of broiler chicks (g) of different treatments.

Weeks	T0	T1	T2	T3	T4	Replication mean
1	152.3	150.51	154.33	160.12	149.67	153.386
2	352.59	358.73	370.16	366.75	369.56	363.558
3	736.59	751.29	755.26	728.9	763.91	747.19
4	1241.63	1295.49	1254.38	1293.83	1282.7	1273.606
5	1807.94	1877.13	1831.86	1870.92	1862.34	1850.038
Totals	4291.05	4433.15	4365.99	4420.52	4428.18	877.5556
Treat Mean	858.21	886.63	873.198	884.104	885.636	

3.8 Feed intake in broilers during first week of age (g.)

The feed intake in broilers during first week, shown in Table 3.8, it was noted that irrespective of treatments, feed intake per broiler during first week of age in general ranged from 115.06-123.80 g. The highest mean feed intake per broiler during the first week was recorded in T_4(123.80 g) followed by T_2 (123.73 g), T_0 (121.46 g), T_3 (120.95 g) and T_1 (115.06 g). The differences in these values were found to be non-significant, indicating thereby a non-significant effect of treatments on feed intake of broilers. This indicates that all treatments irrespective of level of different commercial protease enzyme in water were more or less equally beneficial (Yadav and shah 2005) [13].

Table 3.8: Average feed intake per broiler during first week of age.

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	141.1	133.5	137.5	118	112.8	128.58
R2	115.26	111.3	132.5	117.5	128.9	121.092
R3	107.9	110.5	109.89	137	129.7	118.998
R4	121.6	104.95	115.05	111.3	123.8	115.34
Totals	485.86	460.25	494.94	483.8	495.2	121.0025
Treatment Mean	121.465	115.0625	123.735	120.95	123.8	

3.9 Feed intake in broilers during second week of age (g).
The differences in these values were found to be non-significant, indicating thereby a non-significant effect of treatments on feed intake of broilers Table 3.9. The broilers in T_4 registered non-significantly highest feed intake compared to other treatments. The results of study indicate a beneficial effect of supplementation of different commercial protease enzyme in diet of broilers in water intake (Hana *et al.* 2005) [5].

Table 3.9: Average feed intake per broiler during second week of age.

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	476	393.7	431	383	434.5	423.64
R2	496.84	402.3	421.45	398.5	413.74	426.566
R3	394.5	431.4	389.39	418.5	409.5	408.658
R4	353.5	387.95	413.05	369.5	419.24	388.648
Totals	1720.84	1615.35	1654.89	1569.5	1676.98	411.878
Treatment Mean	430.21	403.8375	413.7225	392.375	419.245	

3.10 Feed intake in broilers during third week of age (g).
The feed intake in broilers during third week, contained in Table 3.10 indicated that irrespective of treatments, feed intake per broiler during third week of age ranged from 898-943.01 g. The highest mean feed intake per broiler during the three weeks of age was recorded in T_0 (943.01 g) followed by T_4 (932.33 g), T_2 (914.98 g), T_1 (901.15 g) and T_3 (898 g). The differences in these values were found to be non-significant, indicating thereby a non-significant effect of different commercial protease enzyme supplementation in the diet on feed intake of chicks at three weeks of age. The broilers in T_0 registered significantly highest feed intake. The results of study indicate a beneficial effect of supplementation of different commercial protease enzyme in the diet of broilers in feed intake.

Table 3.10: Average feed intake per broiler during third week of age

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	1037.5	911.2	954	859	939	940.14
R2	914.64	865.3	944.08	908	929	912.204
R3	942.29	971.94	849.94	998.5	929	938.334
R4	877.61	856.18	911.93	826.5	932.33	880.91
Totals	3772.04	3604.62	3659.95	3592	3729.33	917.897
Treatment Mean	943.01	901.155	914.9875	898	932.3325	

3.11 Feed intake in broilers during fourth week of age (g)
The feed intake in broilers during fourth week, contained in Table 3.11 indicated that irrespective of treatments, feed intake per broiler during fourth week of age in general ranged from 1664.7-1715.83 g. The highest mean feed intake per broilers at four weeks was recorded in T_3 (1715.83 g) followed by T_0 (1705.23 g), T_4 (1702.75 g), T_1 (1671.24 g) and T_2 (1664.7 g). The broilers in T_4 registered non-significantly highest feed intake. However, it was found at par with T_3 and T_2. The feed intake of broilers in T_1, T_2 and T_4 were non-significant. The differences in these were found to be non-significant, indicating thereby a non-significant effect of treatments on intake of broilers. The results of study indicate a beneficial effect of supplementation of different commercial protease enzyme in the diet of broilers in feed intake.

Table 3.11: Average feed intake per broiler during fourth week of age

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	1948.5	1759.57	1735.5	1601.5	1727.5	1754.514
R2	1669.08	1545.3	1665.66	1992.21	1694.26	1713.302
R3	1667.08	1741.41	1592.18	1677.5	1686.5	1672.934
R4	1536.28	1638.68	1665.46	1592.12	1702.75	1627.058
Totals	6820.94	6684.96	6658.8	6863.33	6811.01	1691.952
Treatment Mean	1705.235	1671.24	1664.7	1715.8325	1702.7525	

3.12 Feed intake in broilers during fifth week of age (g).
From the perusal of data on feed intake in broilers during fifth week, contained in Table 3.12 indicated that irrespective of treatments, feed intake per broiler during fifth week of age in general ranged from 2667.95-2736.28. The highest mean feed intake per broiler during the fifth week was recorded in T_0 (2736.28 g) followed by T_4 (2726.19), T_2(2677.67), T_1(2672.56) and T_3(2667.95). The differences in these values were found to be non-significant, indicating thereby a non-significant effect of treatments on feed intake of broilers at five weeks of age. The broilers in T_0 registered significantly highest feed intake. The results of study indicate a beneficial effect of supplementation of different level of commercial protease enzyme in the diet of broilers in feed intake.

Table 3.12: Average feed intake per broiler during fifth week of age

Varieties	T0	T1	T2	T3	T4	Mean
R1	3047.5	2680.79	2669.03	2706.5	2770.66	2774.896
R2	2691.86	2548.42	2746.91	2682.21	2657.42	2665.364
R3	2646.7	2808.78	2628.7	2706	2750.5	2708.136
R4	2559.06	2640.26	2666.05	2577.12	2726.19	2633.736
Totals	10945.12	10678.25	10710.69	10671.83	10904.77	2695.533
Treat Mean	2736.28	2669.5625	2677.6725	2667.9575	2726.1925	

3.13 Average weekly mean feed intake (g.) per Broiler of different treatments

From the perusal of data on weekly feed intake of broilers, contained in Table 3.13, it may be noted that mean feed intake of broilers, irrespective of treatments at one, two, three and four weeks of age was age was 121, 411.87, 917.89, 1692 and 2695.53 g respectively. The broilers in T_0 registered significantly highest feed intake. These results were as expected because under normal conditions an increase in feed intake with the increase in age is a normal phenomenon.

Table 3.13: Average weekly mean feed intake (g.) per Broiler of different treatments

Weeks	T0	T1	T2	T3	T4	Mean
1	121.47	115.06	123.74	120.95	123.8	121.004
2	430.21	403.84	413.72	392.38	419.25	411.88
3	943.01	901.16	914.99	898	932.33	917.898
4	1705.26	1671.24	1664.7	1715.83	1702.75	1691.956
5	2736.28	2669.56	2677.67	2667.95	2726.19	2695.53
Totals	5936.23	5760.86	5794.82	5795.11	5904.32	1167.654
Mean	1187.246	1152.172	1158.964	1159.022	1180.864	

3.14 Average gain in weight of broilers during one week of age (g)

The average gain in weight per broiler during one week of age, contained in Table 3.14, indicate that irrespective of treatments the average gain in weight per broilers during one week of age ranged from 103.71-113.4 g. The highest mean average gain in weight per broiler during first week was recorded in T_3 (113.4) followed by T_2 (1109.30), T_0 (106.67), T_1 (104.58) and T_4 (103.71). The differences in these values were found to be non-significant, indicating there by a non-significant effect of treatments of different commercial protease enzyme gain in weight of broilers at one week of age. The broilers in T_3 registered non-significantly highest gain in weight. The broilers in T_0 (control) registered non-significantly lowest gain in weight at one week of age (Peek *et al.* 2009) [10].

Table 3.14: Average gain in weight of broilers (g.) during one week of age

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	126.35	99.7	116.5	118.9	110.95	114.48
R2	97.3	92.25	104.08	102.2	119.25	103.016
R3	111.5	128.9	127	102	80.3	109.94
R4	91.54	97.5	89.65	130.5	104.36	102.71
Totals	426.69	418.35	437.23	453.6	414.86	107.5365
Treatment Mean	106.6725	104.5875	109.3075	113.4	103.715	

3.15 Average gain in weight of broilers (g) at two weeks of age

The perusal of data on average gain in weight per broiler during second week of age, contained in Table 3.15, indicate that irrespective of treatments the average gain in weight per broilers during second week of age ranged from 200.16-219.89 g. The highest mean average gain in weight per broiler during second week was recorded in T_4 (219.89) followed by T_2 (215.83), T_1(208.22), T_3(206.62) and T_0(200.16). The differences in these values were found to indicating thereby a non-significant effect of treatments in gain in weight of broilers at two weeks of age.

Table 3.15: Average gain in weight of broilers (g) at two weeks of age

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	245.75	190	220.1	202.5	207.43	213.156
R2	189	206.89	221.32	194.5	214.75	205.292
R3	155.5	197	219.5	214.5	237.5	204.8
R4	210.42	239	202.4	215	219.9	217.344
Totals	800.67	832.89	863.32	826.5	879.58	210.148
Treatment Mean	200.1675	208.2225	215.83	206.625	219.895	

3.16 Average gain in weight of broilers during third weeks of age (g)

The perusal of data on average gain in weight per broiler during third week of age contained in Table 3.16 indicate that irrespective of treatments the average gain in weight per broiler at three weeks of age ranged from 368.90-395.61 g. The highest mean average gain in weight per broiler during third week was recorded in T4 (395.61g) followed by T_1 (392.55g), T_2 (385.09g), T_0 (384.00g) and T_3 (368.90g). The differences in these were found to be non-significant indicating thereby a non-significant effect of treatments in gain in weight at three weeks of age. The broilers in T_4 registered non-significantly highest gain in weight. The gain in weight of broilers in T_0 registered non-significantly lowest body weight at third week of age. The results of study indicate a beneficial effect of supplementation of different commercial protease enzyme in water of broilers in gain weight.

Table 3.16: Average gain in weight of broilers (g.) at third week of age

Replication	T0	T1	T2	T3	T4	Replication mean
R1	440	355.5	396.32	405	401.05	399.574
R2	375.44	388.23	385	265.61	392	361.256
R3	336.82	432.5	393.5	382.5	390	387.064
R4	383.75	394	365.56	422.5	399.41	393.044
Totals	1536.01	1570.23	1540.38	1475.61	1582.46	385.2345
Treatment Mean	384.0025	392.5575	385.095	368.9025	395.615	

3.17 Average gain in weight of broilers during fourth week of age (g)

The perusal of data on average gain in weight per broiler during fourth week of age contained in Table 3.17 indicate that irrespective of treatments the average gain in weight per broiler at four weeks of age ranged from 499.11-564.92 g. The highest mean average gain in weight per broiler during fourth week was recorded in T_3 (564.92 g) followed by T_1 (544.06 g), T_4 (518.79 g), T_0 (518.55 g) and T_2 (499.11 g). The differences in these were found to be non-significant indicating thereby a non-significant effect of treatments of different commercial protease supplementation in water on average gain in weight of broilers during fourth week of age.

Table 3.17: Average gain in weight of broilers (g.) during fourth week of age

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	591	480	478.94	569.07	517.37	527.276
R2	466.32	545.7	463.82	635.14	500.5	522.296
R3	464,51	588.13	536	512.5	538.5	543.7825
R4	498.33	562.44	517.71	543	518.79	528.054
Totals	1555.65	2176.27	1996.47	2259.71	2075.16	530.35213
Treatment Mean	518.55	544.0675	499.1175	564.9275	518.79	

3.18 Average gain in weight of broilers during fifth week of age (g).

The average gain in weight per broiler during fifth week of age contained in Table 3.18 indicate that irrespective of treatments the average gain in weight per broiler at five weeks of age ranged from 562.13-581.64 g. The highest mean average gain in weight per broiler during fifth week was recorded in T_1 (581.64 g) followed by T_2 (577.48 g), T_3 (576.96 g), T_0 (566.30 g) and T_4 (562.13 g). The differences in these were found to be non-significant indicating thereby a non-significant effect of treatments in gain in weight at five weeks of age. The broilers in T_1 registered significantly highest gain in weight, however it was found at par with gain in weight of broilers in T_1 and T_4 and T_3 being non-significant difference between the treatments. The results of study indicate a beneficial effect of supplementation of different commercial protease enzyme in water of broilers in gain weight.

Table 3.18: Average gain in weight per broiler during fifth week of age

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	607.5	584.83	540.87	623.98	596.32	590.7
R2	589.18	550.68	651.18	566.87	543.31	580.244
R3	472.38	618.42	563.81	597	529	556.122
R4	596.16	572.66	554.08	520	579.92	564.564
Totals	2265.22	2326.59	2309.94	2307.85	2248.55	572.9075
Treatment Mean	566.305	581.6475	577.485	576.9625	562.1375	

3.19 Average weekly mean gain in weight (g.) per broiler of different treatments

The average gain in weight per broiler contained in Table 3.19, it may be noted that mean average gain in weight per broiler irrespective of treatments during I, II, III, IV and V week of was 107.32, 210.14, 385.23, 529.08 and 572.90 g respectively. The differences in these were non- significant, indicating a non-significant effect of age on the average gain in weight per broiler in all treatments. The broilers in T_1registered non-significantly highest gain in weight compared to other treatments. These results were as expected because under normal conditions, increase in average gain in weight with the increase in age is as expected of effect of treatments of different commercial protease enzyme in water supplementation in diet on growth of broilers.

Table 3.19: Average weekly mean gain in weight (g.) per broiler of different treatments

Weeks	T0	T1	T2	T3	T4	Replication Mean
1	106.67	104.59	109.31	113.4	103.72	107.538
2	200.17	208.22	215.83	206.63	219.9	210.15
3	384	392.56	385.1	368.9	392.62	384.636
4	518.55	544.07	499.12	564.93	518.8	529.094
5	566.31	581.65	577.49	576.96	562.14	572.91
Totals	1775.7	1831.09	1786.85	1830.82	1797.18	360.8656
Treat Mean	355.14	366.218	357.37	366.164	359.436	

3.20 Feed Conversion Ratio (FCR)

The FCR of chicks during first week of age, shown in Table 3.20, it was noted that irrespective of treatments, FCR per broiler chick during one week of age in general ranged from 0.050-0.054 kg. The highest mean average FCR per chick during the one week was recorded in T_2 (0.054) followed by T_0 (0.052), T_1 (0.050), T_4 (0.052) and T_3 (0.052) kg. The differences in these were found to be non-significant (Cafe *et al.* 2002) [3].

Table 3.20: Average feed conversion ratio (FCR) per broiler during first week of age.

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	0.062	0.048	0.058	0.052	0.057	0.0554
R2	0.046	0.045	0.05	0.046	0.056	0.0486
R3	0.054	0.058	0.059	0.05	0.049	0.054
R4	0.049	0.049	0.049	0.06	0.049	0.0512
Totals	0.211	0.2	0.216	0.208	0.211	0.0523
Treatment Mean	0.05275	0.050	0.054	0.052	0.05275	

3.21 Average FCR of broilers during second weeks of age (kg. feed per kg. of weight gain)

The FCR of chicks at two weeks of age, contained in Table 3.21, it was noted that irrespective of treatments, FCR per chick at two weeks of age in general ranged from 0.79-1.10 kg. The highest mean average FCR per chick at the two weeks was recorded in T_2 (0.81) followed by T_0 (0.80), T_1 (0.77), T_3 (0.76) and T_4 (0.63) kg. The differences in these values were found to be significant, indicating thereby a significant, effect of treatments on FCR of broiler at two weeks of age. The FCR of broilers in T_2 registered non-significantly better feed conversion ratio compared to all other treatments. The results indicate a beneficial effect of supplementation on feed conversion ratio in broilers (Freitas *et al.* 2011) [4].

Table 3.21: Average feed conversion ratio (FCR) per broiler during second week of Age

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	0.82	0.9	0.85	0.72	0.72	0.802
R2	0.8	0.82	0.9	0.78	0.77	0.814
R3	0.69	0.63	0.64	0.92	0.21	0.618
R4	0.89	0.73	0.86	0.63	0.83	0.788
Totals	3.2	3.08	3.25	3.05	2.53	0.7555
Treatment Mean	0.8	0.77	0.8125	0.7625	0.6325	

3.22 Average feed conversion ratio (FCR) per broiler during third week of age

FCR of chicks during third week of age, contained in Table 3.22, it was noted that irrespective of treatments, FCR per chick during third week of age in general ranged from 1.08-1.17 kg. The highest mean average FCR per chick during the third week was recorded in T_0 (1.17) followed by T_1 (1.12), T_4 (1.13), T_2 (1.12) and T_3 (1.01) kg. However, the differences in these were found to be non-significant, indicating thereby a non-significant effect of treatments of feed supplementation in diet on FCR of broilers at third week of age (Hana *et al.* 2010) [5].

Table 3.22: Average feed conversion ratio (FCR) per broiler during third week of age

Varieties	T0	T1	T2	T3	T4	Replication Mean
R1	1.13	1.17	1.13	1.04	1.2	1.134
R2	1.28	1.17	1.14	1.15	1.09	1.166
R3	1.26	1.16	1	1.15	1.12	1.138
R4	1.02	1.01	1.23	1	1.13	1.078
Totals	4.69	4.51	4.5	4.34	4.54	1.129
Treatment Mean	1.1725	1.1275	1.125	1.085	1.135	

3.23 Average FCR of broilers during fourth week of age (kg. feed per kg. of weight gain)

From the perusal of data on FCR of chicks during fourth week of age, contained in Table 3.23, it was noted that irrespective of treatments, FCR per chick during fourth week of age in general ranged from 1.20-1.29 kg. The highest mean average FCR per chick at the four weeks was recorded in T_0 (1.29), followed by T_3 (1.22), T_4 (1.22), T_2 (1.21) and T_1 (1.20) kg. The differences in these were found to be non significant, indicating thereby a non significant, effect of treatments on average FCR per broiler at four weeks of age.

Table 3.23: Average feed conversion ratio (FCR) per broilers during fourth week of age

Replication	T0	T1	T2	T3	T4	Replication Mean
R1	1.21	1.31	1.23	1.11	1.23	1.218
R2	1.3	1.18	1.25	1.49	1.21	1.286
R3	1.45	1.21	1.08	1.24	1.23	1.242
R4	1.2	1.1	1.3	1.05	1.22	1.174
Totals	5.16	4.8	4.86	4.89	4.89	1.23
Treatment Mean	1.29	1.2	1.215	1.2225	1.2225	

3.24 Average FCR of broilers during fifth week of age (kg. feed per kg. of weight gain)

FCR of chicks during fifth week of age, contained in Table 3.24, it was noted that irrespective of treatments, FCR per chick during fifth week of age in general ranged from 1.42-1.52 kg. The highest mean average FCR per chick at the five weeks was recorded in T_0 (1.52) followed by T_4 (1.46), T_2 (1.46), T_3 (1.42) and T_1 (1.42) kg. The differences in these were found to be significant, indicating thereby a significant, effect of treatments on average FCR per broiler chicks (Khan *et al.* 2006) [6].

Table 3.24: Average feed conversion ratio (FCR) per broiler during fifth week of age

Replication	T0	T1	T2	T3	T4	Replication mean
R1	1.48	1.53	1.49	1.38	1.48	1.472
R2	1.53	1.4	1.47	1.48	1.47	1.47
R3	1.67	1.4	1.39	1.46	1.45	1.474
R4	1.4	1.38	1.5	1.39	1.46	1.426
Totals	6.08	5.71	5.85	5.71	5.86	1.4605
Treatment Mean	1.52	1.4275	1.4625	1.4275	1.465	

3.25 Average weekly FCR of broilers of different treatments (kg. feed per kg. of gain in weight)

From the perusal of data on weekly average FCR per broiler, contained in Table 3.25 and fig. 4, it may be noted that the mean average FCR per broiler, irrespective of treatments during I, II,III, IV and V week of age was 0.52, 0.75, 1.11, 1.22 and 1.45 kg respectively. The differences in these were found to be significant which indicated a significant effect of age on the average FCR per broilers in all treatments. Since the differences between values of weekly FCR of broilers between the treatments were not significant this indicates feed supplementation played no significant role on the FCR of broilers, because it was found to be at par with control. Therefore, it can be concluded that protease enzyme essential for improvement of FCR or the performance of broilers. That the feed supplementation had influence on the FCR of broilers.

Table 3.25: Mean average feed conversion ratio (FCR) or feed efficiency per broiler

Week	T0	T1	T2	T3	T4	Replication Mean
1	0.052	0.05	0.054	0.052	0.052	0.052
2	0.8	0.77	0.81	0.76	0.63	0.754
3	1.172	1.13	1.13	1.09	1.14	1.1324
4	1.29	1.2	1.22	1.22	1.22	1.23
5	1.52	1.43	1.46	1.43	1.47	1.462
Totals	4.834	4.58	4.674	4.552	4.512	0.92608
Treat Mean	0.9668	0.916	0.9348	0.9104	0.9024	

4. Conclusion

It is concluded that the beneficial effect of different concentration of protease enzyme supplementation in water of broilers. The body weight, gain in weight and feed conversion ratio of broilers. In economic point of view water supplemented with different concentration of protease enzyme at the rate of 0.01g was found the best compared to all other treatments. The mean body weight of five weeks of age in T_0, T_1, T_2, T_3, and T_4 was 1807.93, 1877.13, 1831.86, 1870.91 and 1862.33 g respectively. Mean feed intake per broilers in T_0, T_1, T_2, T_3, and T_4 during five weeks of age was 2736.08, 2669.56, 2677.67, 2667.95 and 2726.19 g respectively and the differences in feed intake of broilers between treatments were significant. Gain in weight broilers at five weeks of age T_0, T_1, T_2, T_3, and T_4 was 566.30, 581.64, 577.48, 576.96 and 562.13 g respectively and the differences in feed intake of broilers between treatments was non-significant. Mean feed conversion ration of broilers in T_0, T_1, T_2, T_3, and T_4 during fifth week of age was 1.52, 1.42, 1.46, 1.42 and 1.46 kg respectively. Differences in FCR of broilers between treatments were non-significant.

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