IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 13, Issue 1 Ser. III (January 2020), PP 32-36
www.iosrjournals.org

Effect of Supplementing Protease Enzyme to Pekin Duck Diets on Growth Performance and Carcass Traits

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Abstract: *The effect of protease enzymes supplementation in the diet of meat-type ducks were determined on the production performance and carcass yield from 1-12 weeks of age. In a completely randomized design involving three replicate pens of ten ducklings assigned to each of five treatments. All diets were corn–soybean meal based. T1: Positive control (Standard diet), T2: Negative control 1 (reduction of 4% CP and 4% digestible amino acid: Lysine, M+C, Threonine, Arginine), T3: Negative Control 2 (reduction of 4% CP and 4% digestible amino acid: Lysine, M+C, Threonine but not reduction on Arginine), T4: Negative control 1 (NC1) + 200 g protease/MT and T5: Negative control 2+ 200 g protease/MT diet. The protease inclusion increased body weight (BW) and body weight gain significantly (P<0.05) compared with the negative control group at 12 weeks of age. Moreover, the feed conversion ratio (FCR) of the protease supplementation groups were more efficient (p<0.05) throughout the experimental period. There was an increasing trend in breast meat yield with supplementation of protease in the diet. It may be concluded that it is possible to sustain pekin duck significantly heavier body weight, increase feed efficiency and increase breast meat yield by supplementation of protease in low protein diets.*

Key words*: Protease enzyme, production performance, carcass yields, meat-type ducks*

Date of Submission: 13-01-2020 Date of Acceptance: 29-01-2020

I. Introduction

Bangladesh is a densely populated country of 147 570 km^2 with a population of 160 million people. It is fortunate in having an extensive water resource in the form of ponds, natural depressions (haors and beels), lakes, canals, rivers and estuaries covering an area of 4.56 million ha (DoF, 2005), most of them can be efficiently utilized for duck production. Duck do not compete with chicken for feed because they scavenge in low laying water lodged area that is not suitable for chicken scavenging. Bangladesh produced 195393 MT chicken meat and 53732 tones duck meat (FAO, 2017).

In poultry production, feed alone accounts about 65-70% of the total cost of production (Banergee, 1992). The higher price and non-availability and low quality of feed ingredients are the major constrains of poultry farming in Bangladesh. It may be alleviated through exploration of potential cheaper locally available feedstuffs and by introducing improved methods for better utilization of poor quality feeds. Protein feedstuffs are consistently increasing in cost, a trend that has been exacerbated in recent years. In parallel, increased public concerns regarding the environmental impact of animal agriculture has increased the need to reduce nutrients in the waste generated by food animal production. Research on the use of exogenous enzymes in broiler diets has been ongoing, and many commercial enzyme products are presently available to the poultry industry. Phytase is already well established in most poultry-producing markets around the world.

The wide range of endogenous proteases synthesized and released in the gastrointestinal tract (GIT) is generally considered to be sufficient to optimize feed protein utilization (Le Heurou-Luron et al., 1993; Nir et al., 1993). However, CP and amino acid (AA) digestibility reported for poultry indicate that valuable amounts of protein pass through the GIT without being completely digested (Parsons et al., 1997; Wang and Parsons, 1998; Lemme et al., 2004). This undigested protein represents an opportunity for the use of supplemental exogenous proteases in duck feeds to improve protein digestibility. Among the factors affecting digestibility of vegetable protein ingredients for broilers, genetic variability with-in an ingredient and thermal processing are those that have the most effect (Parsons et al., 1992; Douglas et al., 2000; de Coca-Sinova et al., 2008). Protein digestibility of animal byproduct ingredients used in most poultry-producing countries also varies, in part because of the effects of thermal processing and the type of carcass components used in the process (Parsons et al., 1997; Wang and Parsons, 1998).

Numerous studies of supplemental enzymes in broiler diets have been published in recent years. After phytase, more publications are found for enzyme blends, which many times contain proteases. Unfortunately, these data do not allow for the evaluation of the effects of any of their single-enzyme activities. Fewer studies have been conducted using single proteases in poultry diets. Whereas some data indicate inconsistent results (Simbaya et al., 1996; Marsman et al., 1997; Naveed et al., 1998), other publications show improvements in broiler live performance as well as in energy and nitrogen utilization when proteases were added to diets (Ghazi et al., 2003). Although many factors can affect enzyme activity, the conversion of the enzyme–substratecomplex into measurable amounts of products does not occur without specificity between enzyme and substrate (Bhat and Hazlewood, 2001). Ghazi et al. (2002) compared effects of soybean meal treated before feed mixing with proteases from Aspergillus spp. with one from Bacillus spp. added during feed mixing and observed that the first led to improvements in broiler performance, whereas the second had no effect. Proteases have also been found to affect mucus layer thickness in the GIT, apparently alleviating the effect of a coccidial infection, resulting in higher weights (Peek et al., 2009).

Althoughstudiesofenzymesupplementationshavebeen widely conducted in chickens (broiler chickens and laying hens), such information regarding ducks is rather limited. Therefore, this study investigated the effects of adding protease enzymesonggrowthperformance and carcass yieldresponsesofmeat-typeducksfedacorn-soybean diet.

II. Materials And Methods

The study carried out in the experimental pens of an open-sided shed at Sunamgonj Regional Duck Breeding Centre, Sunamgonj. Before the arrival of ducklings, the experimental house was thoroughly washed, disinfected, dried and fumigated. One hundred fifty day-old pekin ducklings from a Government hatchery were the experimental birds. The ducklings were equally distributed into 5 dietary treatments having 3 replications in each. The replicate groups of ducklings were distributed into 15 littered floor pens (120 cm × 225 cm) randomly. At a depth of about 5 cm fresh and dry rice husk was used as litter. Each replication had 10 ducklings. All diets were corn–soybean meal based. Diets were Positive control (PC), Negative control 1 (NC1), Negative control 2 (NC2), Negative control 1 (NC1) + 200 g protease/MT and Negative control 2 + 200 g protease/MT diet. All mash diets were formulated and mixed and were offered with drinking water ad libitum. All birds were maintained under the same temperature and relative humidity in open sided house and lighting control system during the

Table1 Composition and nutrient contents of the experimental diets.

Ingredient (%)	PC	NC1	NC2	NC1+ protease	NC2+ protease
Maize	51	54	54	54	54
R. Polish	12.6	12.6	12.58	12.58	12.56
Soybean Meal	29	27	27	27	27
Protein Conc.	3	2	2	2	2
Soybean oil	1	1	1	1	1
DCP	2	2	2	2	2
Methonin	0.2	0.2	0.2	0.2	0.2
Lysine	0.1	0.1	0.1	0.12	0.12
Salt	0.25	0.25	0.25	0.25	0.25
Lime stone	0.6	0.6	0.6	0.6	0.6
Vit. Mineral	0.25	0.25	0.25	0.25	0.25
protease	-	-	0.02	-	0.02
Total	100	100	100	100	100
Nutrients specifications					
Crude Protein (%)	22	21.12	21.12	21.12	21.12
(AMEn) Kcal/kg	2900	2900	2900	2900	2900
Calcium (%)	1	1	1	1	1
Available Phosphorus (%)	0.5	0.5	0.5	0.5	0.5
Lysine (%)	1	0.96	.96	0.96	.96
Methionine (%)	0.5	0.48	.48	0.48	.48
Met + Cys (%)	0.85	0.82	0.82	0.82	0.82
Threonine (%)	0.75	0.72	0.72	0.72	0.72
Arginine (%)	1.1	1.056	1.1	1.056	1.1

Positive control (Cherry Valley SM3 ducks Recommendation), Negative control 1: Reduction on 4% CP and 4% amino acid, NC_2: Reduction on 4% CP and 4% amino acid: Lysine, M+C, Threo and not reduction on Argynine, NC_1+ 200 g protease/MT, NC_2 + 200 g protease/MT, #The premix : Vitamin-A, 125000 I.U.; Vitamin-D3 2500, I.U.; Vitamin-E, 20mg; Vitamin-K3, 4mg; Viaamin-B1, 2.5mg; Viaamin-B2, 2mg; Viaamin-B6, 4mg; . acid, 40mg; Pantothenic acid, 12.5mg; Viaamin-BI2, 12mg; Folic ; Biotin, 0.lmg; Cobalt, 0.4mg; Copper, 10mg; Iron, 60mg, mg; Manganese, 60mg; Zinc, 50mg; Selenium, 0.15mg; , l00mg; Choline chloride, 300mg. *Ronozyme ProAct enzyme preparations were obtained from Novozymes A/S (Bagavaerd, Denmark; 75,000 PROT units/g of enzyme).

entireperiod of study. The basal diet (control diet) was formulated based on a corn-soybean meal for the starter (0-42 days) and grower (43-84 days) periods. All diets were analyzed, in duplicate, for DM, CP, AA, calcium, and phosphorus (Evonik analytical Laboratory, Animal Nutrition, Singapore). Formulated and analyzed nutrient contents of the diets are shown in Table 1. Diets were formulated to meet or slightly exceed all nutrient recommendations for ducks. (Table 1; Cherry Valley SM3 ducks Recommendation).

Supplementation of exogenous protease (Ronozyme ProAct CT, obtained from Novozymes A/S, DSM, Bagavaerd, Denmark) was in the treated basal diet. Mean shed temperature during the experiment was around 30^oC with a diurnal variation ranging between $25-33^oC$. The average relative humidity was 83% and it varied between 75–90%. The birds were immunized against Duck Plague and Duck Cholera administering Duck Plague and Duck Cholera vaccine.

Body weight, feed consumption, FCR, survivability were recorded for each individual pen. One bird from each replication was randomly selected and euthanized for processing after termination of the experiment. Data for dressed weight, breast meat, leg meat and wing were taken and recorded using an electronic balance. Data were statistically analysed using SAS (2008) in a completely randomized design followed by determining Ducan multiple range test (DMRT).

III. Results And Discussion

Growth performance:

The average body weight of day-old ducklings were similar in all groups (Table 2). The protease supplemented groups increased body weight (BW) of duck significantly ($P<0.05$) compared with the negative control groups at 8 weeks of age (Table 2). After12 weeks of rearing, the protease inclusion increased body weight (BW) and body weight gain significantly ($P<0.05$) compared with the negative control group.

The average feed intake (FI) per bird during the 12 weeks were similar, indicating the good quality feed and uniformity of birds, as well as proper rearing conditions (Table 3). The inclusion of protease at 8 and 12 weeks of rearing FCR were significantly better ($P<0.05$) compared with the negative control group (Table 2). After 12 weeks of rearing, the most profitable FCR (3.45) were found in the protease supplemented groups. Survivability of ducks were similar in all groups after 12 weeks of rearing.

Table 2 Body weight and body weight gain (BWG), Feed intake, FCR and survivability of ducklings affected by protease supplementation at 12 weeks.

Variables (g/duckling)	Dietary Treatments					SEM	Level of Significance
	PC	NC1	NC2	NC1+ protease	NC2+ protease		
Day old body weight (g/b)	45.17	45.17	45.17	45	45.13	0.12	NS
8th week body weight	2025^a	1895^b	1885^b	2020^a	2015^a	22.15	
Final body weight (g/b)	2555^a	2404^{bc}	2352.33^c	2543.33^{ab}	2560^a	28.93	*
Body weight gain (0-8week) (g/b)	1979.67^a	1849.5^b	1839.66^b	1974.83^a	1969.33^a	22.14	*
BWG(0-12week) (g/b)	2509.67^a	2358.5^{bc}	2307^c	2498.17^{ab}	2514.33^a	28.90	*
BWG (0-12week)(g/b/d)	29.88^a	28.07^{bc}	27.46c	29.74^{ab}	29.93a	0.344	*
Feed intake (g/b)	8833.60	8813.36	8849.26	8768.88	8838.72	21	NS
FCR (0-12 weeks)	3.46^b	3.67^{ab}	3.76a	3.45b	3.45b	0.046	*
Survivability%	99.67	99.33	99.33	99.67	99.67	1.18	NS

^{a,b,c}Means in a column with no common superscript letter differ significantly ($P < 0.05$). PC: Positive control (Cherry Valley SM3 ducks Recommendation), NC1: Negative control 1: Reduction on 4% CP and 4% amino acid, NC2: Reduction on 4% CP and 4% amino acid: Lysine, M+C, Threo and not reduction on Argynine, NC1+ 200 g protease/MT, NC2 + 200 g protease/MT

In earlier studies, Hong et al. (2002) showed an improvement in apparent ileal amino acid digestibility in ducks fed corn-SBM-wheat middling-based diets supplemented with 12000 units of protease activity, 4000 units of amylase activity and 1600 units of xylanase activity per kilogram of diet. In a study with broiler chicks, Douglas et al. (2000) observed that the effectiveness of the same enzyme cocktail as used by Hong et al. (2002) in ducks varied with the SBM sample used. In the study of Ghazi et al. (2002), it was reported that chick response to protease supplementation differed depending on the specificity to soy protein ofthe protease used.

Similarly, Ghazi et al. (2003) observed that only two of the three protease preparations tested improved true N digestibility and only one also improved TME in SBM in broiler cockerels. Although no similar studies with ducks have been reported, it is clear from the present study that the protease used was efficacious in hydrolyzing nutrients in the SBM sample tested. Because the digestive physiology of ducks is different from that of chickens (Muztar et al. 1977). These results are in harmony of those obtained by Awad et al. (2007) who reported that LBW of Pekin ducklings was reached 2.550 kg during growth period (0-12 wks. of age).

Table 3 Effect of Protease on carcass traits of pekins duck at 12 weeks of age.

Variables (g/duck)	Dietary Treatments					SEM	Level of Significance
	PC	NC1	NC2	NC1+ protease	NC2+ protease		
Live weight(g)	2270	2407.33	2383.33	2453.33	2510	40.35	NS
Dressed weight	1699	1735	1711.66	1816.67	1853.33	30.32	NS
Dressing %	74.94	72.05	71.81	74.03	73.88	0.54	NS
Breast meat %	23.47^{bc}	22.77^{c}	22.78^{c}	25.03^{a}	24.41^{ab}	0.29	*
Leg meat %	17.47	17.61	17.82	17.54	17.75	0.12	NS
Wing %	7.13	7.05	7.37	7.46	7.45	0.08	NS
Liver %	2.39	2.54	2.56	2.53	2.48	0.05	NS
Gizzard %	3.92	3.85	3.96	3.92	3.87	.05	NS

^{a,b,c}Means in a column with no common superscript letter differ significantly ($P < 0.05$). PC: Positive control (Cherry Valley SM3 ducks Recommendation), NC_1: Negative control 1: Reduction on 4% CP, NC_2: Reduction on 4% CP and 4% digestible amino acid: Lysine, M+C, Threo, Isol, Val and not reduction on Argynine, NC_1+ 200 g protease/MT, NC_2+ 200 g protease/MT

Carcass traits:

Results of Table (3) show the effect of protease enzyme on duckling growth supplementation to duckling diets during growth period on some carcass traits (expressed as percentages of LBW). Eviscerated carcass, leg, wing, liver and total edible parts percentages were not significantly affected due to protease enzyme supplementation. Breast meat percentage was significantly increased of ducklings fed diets supplemented with protease enzyme, respectively as compared to those fed the control diet. Gizzard percentages were not significantly affected by protease supplementation.

These results were similar to Jamroz et al. (1996) and Wang et al. (2005) who observed that exogenous dietary enzyme supplementation significantly increased meat yield of broilers. Enzyme supplementation had no effect on the relative weight of liver as reported by Hajati et al., (2009). In contrary, Arumbackam et al. (2004) found that eviscerated carcass, giblet and gizzard did not differ significantly due to enzyme supplementation in quails. Saleh et al. (2005), Hang et al. (2008), Hana et al. (2010) and Zahran et al.(2012) reported that whole carcass weight and/or dressing percent, heart, gizzard and abdominal fat were not significantly affected due to enzyme supplementation to diets.

IV. Conclusion

There was numerical effect which shows that supplementation of protease on a negative control diet may elevate performance, both in terms of body weight and FCR closer to the positive control group. Moreover, significant improvement in breast meat yield was obtained when protease was supplemented to the nutrient restricted diet. It may be concluded that it is possible to sustain pekin duck performance and even increase yield of breast meat by supplementation of protease to low protein diets.

Acknowledgments

The authors gratefully acknowledge the Ministry of Education, Govt. of the People's Republic of Bangladesh for financing this project. DSM Nutritional Products, Singapore supplied protease.

Conflicts of Interest

No potential conflict of interest was reported by the authors.

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Mohammad Yousuf Miah,et.al. "Effect of Supplementing Protease Enzyme to Pekin Duck Diets on Growth Performance and Carcass Traits"*IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 13(1), 2020, pp. 32-36.