

Research Article**SUPPLEMENTATION OF CORN-SOYBEAN BASED BROILER'S DIETS WITH DIFFERENT LEVELS OF ACID PROTEASE****J. L. Yadav and R. A. Sah**

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ABSTRACT

A study was conducted at the Animal Science Farm, Tuntungin, Putho of the Institute of Animal Science, University of the Philippines, Los Baños, College, Laguna, Philippines, during 2001-2002 to find out the supplementation effects of corn-soybean based broiler's diet with acid protease on its performance. The parameters studied were: growth, feed consumption, nutrient digestibility and economic analysis. Three hundred day-old, male broiler chicks were group brooded and fed with commercial pre-starter diets for seven days. Thereafter the chicks were randomly distributed to 30 cages with 10 chicks each. Five treatments randomly assigned to the 30 cages using a Completely Randomized Design. The treatments were: basal diet, diet with reduced crude protein, diet with reduced crude protein + 0.05 % protease, diet with reduced crude protein + 0.075 % protease, and diet with reduced crude protein + 0.1 % protease. The body weight gain, feed consumption, feed efficiency, and carcass quality were recorded. The results showed that one per cent reduction in CP of the diet significantly decreased the crude protein digestibility of broiler starter and finisher diets. Although the protease supplementation of reduced CP diet consistently and significantly improved the digestibility of CP in broiler starter and finisher diets. Dietary protease inclusion at 0.075 percent significantly improved mean body weight gain in broiler at 28 days of age. Average cumulative feed consumption was significantly lower at 0.05 percent protease supplementation in broiler finisher diet. The highest income was derived from broilers fed diet supplemented with 0.075 percent protease. Further research should be carried out to confirm the results.

Key words: Broiler, corn-based, and acid protease**INTRODUCTION**

The addition of enzymes to poultry diets have stimulated recent interest to the feed manufacturer and livestock producer as a means of improving animals and birds performance. Feed enzyme is proving an extremely powerful tool in making poultry production more efficient. Now, it has been well established that supplementing feeds with enzymes improves the efficiency of production, enhances the use of lower quality foodstuffs and reduces the excretion and waste of nutrients (Coelho, 1996). The nutritional problems associated with cereal grains have been overcome by addition of feed enzymes. Enzyme supplementation can break down anti-nutritional substances found in feed raw materials, thus augmenting the digestive capacity of the animal, improving availability of the feed nutrients, and increasing release of nutrients in the upper part of the gastrointestinal tract.

Use of enzymes has changed way the nutritionist select ingredients for a nutritionally balanced, least-cost diet. Enzymes will play an indispensable role in 21st century. A study was conducted to find out the effects of supplementation of corn-soy based broiler's diet with acid protease on its performance mainly on growth, feed consumption, nutrients digestibility and economics of production.

MATERIALS AND METHODS

Three hundred day-old, male broiler chicks were group brooded and fed with commercial pre-starter diets for seven days. Thereafter, the chicks were randomly distributed to 30 cages with 10 chicks each. Five treatments were randomly assigned to the 30 cages following a Completely Randomized Design. The study was conducted at the Animal Science Farm, Tuntungin, Putho of the Institute of Animal Science, University of the Philippines, Los Baños, College, Laguna, Philippines, during 2001-2002.

Basal starter, and finisher diets were formulated to contain 20% and 18.5% CP, respectively. Both diets

contained 3000 Kcal/kg, Metabolisable energy (ME) and adequately supplemented with required vitamins, minerals, and amino acids. The starter and finisher diets with reduced crude protein (CP) were formulated to contain 19% and 17.5% CP, respectively. Both diets contained 3000 Kcal/kg, ME, and adequately supplemented with required vitamins, minerals, and amino acids. The diets with reduced CP were supplemented with protease at different levels (0, 0.05, 0.075, and 0.1%), specified in the treatments. The ingredient composition and calculated nutrient contents of the diets are presented in Table 1. The chicks were fed starter diets for 8 to 28 days, and finisher diets from 29 to 42 days of age ad libitum.

Table 1. Ingredient composition and calculated nutrient contents of basal diets and diets with reduced crude protein

Ingredient	Starter diet		Finisher diet	
	Basal	Reduced CP	Basal	Reduced CP
Corn yellow	56.89	58.43	58.93	57.61
Soybean, U.S. 46 %	30.25	27.11	25.26	22.61
Copra meal	6.43	7.98	9.70	7.36
Crude coco oil	2.50	2.50	2.50	2.50
Limestone, Fine	1.73	1.74	1.71	1.23
Biofos/TG21	1.52	1.54	1.30	1.23
Salt	0.25	0.25	0.25	0.25
Vit. Premix	0.12	0.12	0.10	0.10
Min. premix	0.10	0.10	0.10	0.10
Chlorine chloride 25	0.10	0.10	0.10	0.10
DL- Methionine	0.05	0.08	0.05	0.09
Cycostat	0.06	0.05	—	—
Rice bran DI	—	—	—	6.29
Total	100.00	100.00	100.00	100.00
CALCULATED ANALYSIS				
Crude Protein	20.00	19.00	18.50	17.50
M.E. kcal/kg	3000	3000	3000	30.00
Crude Fat %	5.23	5.33	5.41	6.05
Crude Fiber %	2.84	2.96	3.13	3.24
Calcium %	0.95	0.95	0.90	0.90
Total Phosphorus %	0.71	0.70	0.65	0.69
Avail Phosphorus %	0.45	0.45	0.40	0.40
Lysine %	1.04	1.02	0.96	0.90
Meth+Cystine	0.75	0.75	0.70	0.70

Digestion trials were conducted to determine the digestibility of the feed nutrients at 4 and 6 weeks of age of broilers. Four birds from each treatment were randomly selected and placed in individual cages. They were fed respective diets with 0.2 % chromic oxide as indicator for 7 days. On the 3rd to 6th day of feeding, feces were collected. Samples of experimental diets and feces collected were subjected to proximate analysis following the method as described by AOAC (1990). Apparent digestibility (COD) of each nutrient was calculated as follows:

$$\text{COD} = 100 - 100 \left[\frac{\% \text{ Indicator in feed}}{\% \text{ Indicator in feces}} \times \frac{\% \text{ nutrient in feces}}{\% \text{ nutrient in feed}} \right]$$

During the experimental periods the body weight gain, feed consumption, feed efficiency, and carcass quality were recorded. Finally the income over feed and chicks cost were calculated to find out the effectiveness of the enzymes.

RESULTS AND DISCUSSION

Digestibility study

Results showed that one percent reduction of crude protein of the diet in broiler starter (8-28 days) significantly ($p < 0.05$) decreased digestibility of CP, but not EE, CF, and NFE relative to the basal diet. Supplementation of reduced crude protein diets with different levels of protease consistently and significantly

($p < 0.05$) increased the digestibility of crude protein but not EE and NFE. Crude fiber digestibility was slightly decreased at 0.05 percent protease but consistently increased at 0.075 and 0.1 percent protease. There was a significant ($P < 0.05$) improvement in CF digestibility only at 0.1 percent protease in diet. Increasing the levels of protease of the reduced crude protein diets increased the digestibility of all nutrients almost to the levels of basal diet (Table 2).

Table 2. Digestion coefficients (%) of nutrients of broiler starter and finisher diet supplemented with different levels of acid protease

Treatments	Digestion coefficients (%) of broiler starter diet				Digestion coefficients (%) of broiler finisher diet			
	Crude Protein	Ether Crude	Crude Extract	Nitrogen-Free-Extract	Crude Protein	Ether Extract	Crude Fiber	Nitrogen-Free-Extract
Basal Diet	84.27 ^a	82.30	5.19 ^{abc}	82.61	83.90 ^a	81.58 ^{ab}	58.27 ^b	86.36
Diet with reduced crude protein	76.31 ^c	81.09	52.21 ^{bc}	81.67	77.25 ^b	81.00 ^{ab}	58.25 ^b	85.40
Diet with reduced crude protein + 0.05 % protease	80.19 ^b	76.29	50.78 ^c	82.66	82.13 ^a	78.46 ^b	58.71 ^b	86.21
Diet with reduced crude protein + 0.075 % protease	81.53 ^{ab}	78.01	61.29 ^{ab}	83.39	82.67 ^a	81.41 ^{ab}	62.16 ^a	85.83
Diet with reduced crude protein + 0.1 % protease	83.12 ^{ab}	80.26	63.60 ^a	83.42	83.96 ^a	84.73 ^a	62.91 ^a	86.10

Means within column having different superscripts are significant at $p < 0.05$

Supplementation of diets with exogenous enzymes has been reported to enhance the nutrient digestibility of pigs and poultry (Ghazi *et al.*, 1997). Marsman *et al.* (1997) observed improved protein digestibility by feeding multi-activity enzyme preparation. Naveed *et al.* (1998) reported improvement in nutrients digestibilities of broiler diet with enzyme supplementation. A marked improvement in the apparent coefficient of digestibility of nutrients and an increase in metabolizable energy content of the different feed grains were observed when they were supplemented with commercial enzymes (Adam, 2000). Zanella *et al.* (1999) observed 2.9 percent improvement in the crude protein digestibility with addition of enzymes. A 3% improvement in the real digestibility of crude protein was observed in corn-soybean meal based diets of broiler supplemented with enzymes containing protease, cellulase and amylase (Rostagno *et al.*, 2000). Rodrigues (2000) reported 1.9% improvement in the coefficients of digestibility of protein, starch and energy in the corn-soybean based broiler diet supplemented with combination of enzymes (protease, xylanase and amylase).

Average body weight gain

The results revealed that the body weight gain of broilers decreased at 28 days of age with the reduction of crude protein in the diet. 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. The results showed that enzyme was effective in increasing the body weight gain only at 0.075% level and beyond that level it was ineffective.

The decrease in body weight gain with the reduction of crude protein in diet of broilers could be due to the decreased nutrient digestibility as shown in Table 3. On the other hand, the improvements in body weight gain of broilers with protease supplementation of diets could be ascribed to the increased nutrient digestibility as shown in Table 3. The results are supported by the findings of Silva and Smithhard (1997) who reported a significant increase in body weight gain in the broilers fed diets supplemented with xylanase and protease. Similarly, Ravindran *et al.* (2001) reported a significant linear effect on weight gain by feeding broilers with microbial phytase enzyme in broilers. An improvement in body weight gain of the broilers was also observed when they were fed enzyme supplemented diets (Reddy *et al.*, 1997, Zanella *et al.*, 1999; Osei and Oduro, 2000).

Feed consumption

The results indicated that the reduction of crude protein in diet increased the feed consumption of broilers at 28 and 42 days of age. Protease supplementation of the reduced crude protein diets generally decreased the feed consumption of the broilers in both periods of trial. The increase in feed consumption of birds with reduction of crude protein in diet could be due to the tendency of the birds to eat more in order to compensate for lower protein diets. In contrast, the decrease in feed consumption of birds with protease supplementation of reduced CP diets could be due to the exogenous protease, which significantly increased the digestibility of crude protein as presented in Table 3. The results confirmed with the findings of Ranade and Rajmane (1992) who reported a lower feed intake of broilers fed supplemented diets with enzyme preparation containing cellulose, protease, xylanase, beta-glucanase and alpha amylase activities. Hubilla (1994) also reported a significant decrease in feed consumption of broilers fed diets supplemented with commercial enzymes. Espino *et al.* (2000) observed that broilers fed diets supplemented with amylase, lipase and protease generally consumed lesser amount of feed compared to that fed control diet.

The results demonstrate that the feed efficiency of the broilers was depressed with reduction of crude protein and was slightly improved with protease supplementation in diet. The depression in feed efficiency of broilers with reduction in crude protein content of diet could be due to the decreased body weight gain and increased feed intake. The slight improvements in feed efficiency with protease supplementation of the reduced crude protein diets could be attributed to the increased in weight gain and decreased feed intake of the broilers as shown in Table 3. The results are in agreement with the work of Espino *et al.* (2000) who reported a significant improvement on the feed efficiency of broilers with microbial protease, lipase and amylase fed diets after 40 days of feeding. Feed efficiency of broilers fed wheat-based, wheat-barley-soy and wheat-soy based diets improved with enzyme supplementation (Wyatt and Graham, 1996). Ranade and Rajmane (1992) also noted improvement in feed conversion efficiency of broilers fed with diets supplemented with enzyme preparation containing cellulose, protease, xylanase, beta-glucanase, and alpha-amylase activities. Cowan (1990) reported a 2-3 % increase in efficiency of feed utilization by birds fed diets containing enzymes compared to those fed control diet. An improvement in feed efficiency of broilers was observed with enzyme supplementation of the diets (Zanella *et al.*, 1999; Viveros *et al.*, 1994; Osei and Oduro, 2000).

Average dressing percent

Results showed that dietary reduction of crude protein increased the average dressing percent of broilers over those fed basal diet which was statistically not significant ($p > 0.05$). Increased protease supplementation of the reduced crude protein diets had no significant effect on the dressing percent of the broiler (table 3). The results are in agreement with the finding of Espino *et al.* (2000) who observed a slight increase in the dressing percent of broilers fed diets containing protease, amylase and lipase. An improvement in dressing percent of broilers fed diets supplemented with enzymes has been reported (Richter *et al.*, 1991, Osei and Oduro, 2000). The results contradict the findings of Hartman (1996) who observed significant increase in dressed yield of broilers fed wheat-based diets supplemented with commercial enzymes. This difference in dressed yield of broilers could be due to different diet and kind and level of enzyme used.

Table 3. The mean body weight gain, average cumulative feed consumption, and cumulative feed efficiency of broilers fed basal diet and diets with reduced crude protein supplemented with different levels of acid proteases from 8 to 42 days of age

Treatments	Body weight gain			Feed consumption		Feed efficiency		Dressing %
	8 days	28 days	42 days	28 days	42 days	28 days	42 days	
Basal Diet	126.70	752.83 ^{ab}	1661.67	1240.00	2983.33 ^{ab}	1.64	1.80	70.44
Diet with reduced crude protein	125.83	733.50 ^b	1662.66	1281.66	3136.66 ^a	1.75	1.88	73.10
Diet with reduced crude protein + 0.05 % protease	125.00	726.00 ^b	1658.00	1201.66	2946.66 ^b	1.65	1.80	73.51
Diet with reduced crude protein + 0.075 % protease	123.70	781.00 ^a	1693.18	1255.00	2955.00 ^{ab}	1.61	1.77	74.13
Diet with reduced crude protein + 0.1 % protease	125.10	765.00 ^{ab}	1668.26	1230.00	2996.66 ^a	1.60	1.79	72.76
CV %	1.65		2.10	5.70	4.61	7.41	4.87	4.19

Means within column with different superscript are significantly different ($p \leq 0.05$)

Income over feed and chick cost

The highest increase in income over feed cost was observed in the case of broilers fed diet supplemented with 0.075 percent protease. The results indicated that the reduction of crude protein decreased the income over feed cost. Protease supplementation of reduced crude protein diets increased the income over feed and chicks cost to the level of the basal diet. The decrease in income over feed and chicks cost with reduction of crude protein of the diet could be attributed to the increased mean cumulative feed consumption over basal diet fed.

Table 4. Income over feed and chick cost of broilers fed basal diets and diets with reduced crude protein supplemented with different levels of acid protease from 8 to 42 days of age

Treatments	Total feed intake (kg)	Total feed and chick cost (PhP)	Average body weight (kg)	Income from sale of the birds (PhP)	Income over feed and chick cost)
Basal Diet	2.98	44.60	1.79	71.60	27.00
Diet with reduced crude protein	3.14	45.50	1.81	72.40	26.90
Diet with reduced crude protein + 0.05 % protease	2.95	43.60	1.79	71.60	28.40
Diet with reduced crude protein + 0.075 % protease	2.99	44.02	1.83	73.20	29.18
Diet with reduced crude protein + 0.1 % protease	2.99	44.02	1.82	72.80	28.78

Note: PhP means Pilipino peso

The improvement in income over feed cost with protease supplementation of the reduced crude protein diets could be attributed to the decreased feed intake and feed cost. The results are in agreement with the findings of Osei and Oduro (2000) who reported increased income over feed and chicks cost of broilers fed diets supplemented with enzymes.

CONCLUSIONS

The finding of the study indicated that the reduction in CP by one percent significantly decreased the crude protein digestibility of broiler starter and finisher diets, Whereas, protease supplementation of reduced CP diet could consistently and significantly improve the digestibility of CP in broiler starter and finisher diets. Crude fiber digestibility was significantly improved at 0.1% in broiler starter diet, and 0.075, and 0.1% protease supplementation in broiler finisher diet. Dietary protease inclusion at 0.075% significantly improved average body weight gain in broiler at 28 days of age. The mean cumulative feed consumption was significantly lower at 0.05% protease supplementation in broiler finisher diet. The highest income was derived from broilers fed diet supplemented with 0.075% protease further research should be carried out to confirm the results.

ACKNOWLEDGMENTS

The authors wish deep sense of gratitude to the Director of Research and Publications, the Dean of Institute of Agriculture and Animal Sciences, and all other staffs who directly or indirectly helped in finalizing and publishing this paper.

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