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Utilization of parboiled rice polish based diet with supplementation of phytase and carbohydrase in growing ducklings

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Abstract

A total of 60 day old straight run pekin ducklings were fed *ad libitum* on 6 diets viz, D_1- 15% parboiled rice polish (PRP) based diet, D_2- D_1 + Mixed enzyme (Carbohydrase 120 ppm/kg + phytase 1000FYT/kg), D_3- 25% parboiled rice polish (PRP) based diet, D_4 - D_3 + Mixed enzyme (Carbohydrase 120 ppm/kg + phytase 1000FYT/kg), D_5-35% parboiled rice polish (PRP) based diet, D_6 - D_5+ Mixed enzyme (Carbohydrase 120 ppm/kg + phytase 1000FYT/kg) for 84 days. Diets were supplied two stages containing 22.5, 22.5, 22.8% CP for starter and 16.4, 16.9, 17% CP for finisher. Increasing PRP levels without enzyme decreased live weight, feed intake and feed conversion but increase profitability without affecting livability. Addition of mixed enzyme promoted growth, feed conversion significantly ($P<0.01$), but did not alter livability. The rate of improvement in performance for enzyme supplementation increased with increasing level of dietary PRP. Therefore, it was concluded that it is possible to reduce costly grain by using PRP in duck ration and supplementation of phytase and carbohydrase in PRP diet may be beneficial to improve performance of ducks.

Keywords: Carbohydrase, Duckling, Phytase, Rice polish

Introduction

Bangladesh is a riverine country and 16488 Km^2 of its total land area are Haors, Baors, Canals, Ponds and low lying water reservoirs (Asian Livestock, 1978), 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.

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.

Poultry compete directly with human and other livestock for grains such as wheat, maize etc. The grain usually constitutes about 50% of total diet formulated for poultry. Maize and wheat are also less available as compared to their demand. Therefore, use of expensive grains hardly permits economic diet formulation for profitable poultry production.

Among grain by-products, rice polish is the most abundant in Bangladesh and is reasonably cheaper. It might be used alternative to grains. Polish constitutes about 10% of paddy and is available in large quantities in major rice growing areas of the world (Houston and Kohler, 1970).

Polish obtained from parboiled rice is called parboiled rice polish (PRP). PRP contains more nutrients and little amount of antinutrinational factors like free fatty acids, saponin, hemaglutinin and tannin than raw rice polish, except its phytin-phosphorus content (Padua and Juliano, 1974, Barber and Barber, 1980). PRP is Eshawaraiah *et al*. 1988 almost comparable with wheat in nutrient concentration. Eshawaraiah *et al*. 1988 reported that it contain 13% crude protein and 3250 kcal/kg. Beside some merits of PRP, it has some demerits such as it decreases feed intake, growth rate and feed utilization; its phytase-phosphorus reduces the phosphorus and calcium availability. Its non-strach polysaccharides (NSP) such as cellulose xylose, arabinose and galactonicacid are not easily digested by poultry. These adverse effects of PRP could possibly be overcome by dietary supplementation of exogenous phytase and carbohydrase. Addition of exogenous phytase and carbohydrase have been reported to improve feed utilization in broiler on PRP diet (Moshad 2001).

The present work was therefore, undertaken with the following objectives:

i) To investigate the performance of ducks fed on PRP diet fortified with phytase and carbohydrases at different levels.
ii) To determine the economic feasibility of using phytase and carbohydrase enzyme on PRP based diet in meat type duck.

Materials and Methods

The experiment was conducted with 60 day-old Pekin duckling for a period of 12 weeks. The ducklings were randomly distributed to six dietary treatments having two replications of 5 birds in each. The lay out of the experiment is shown in Table 1. The experimental room was divided into 12 equal littered floor pens by using wire-net and wooden materials. There were 6 dietary treatments in the study in which one was rice polish based control diet and the other five were carbohydrase and phytase based diets. The birds were fed a duck starter diet from 1 day to 14 days of age and finisher diet from 22 to 84 days of age. The feed was supplied *ad libitum* as dry mash. Fresh, cool and clean drinking water was supplied all the times during the whole experimental period. The ingredients were selected on the basis of availability in the local market. Maize, rice polish, soybean meal based control diet was prepared (Table 1).

Table 1. Per cent of ingredient used in duck starter diets (0-2 weeks) and finish starter diets (3-12 weeks)

Ingredients	Dietary parboiled rice polish (PRP*) %					
	Starter			Finisher		
	15	25	35	15	25	35
PRP	15	25	35	15	25	35
Maize (kg)	49	40	29	63	52	45
Soy. Meal (kg)	25	24	25	12	10	10
Soy. oil (kg)	-	-	1	-	-	1
Till Oil Cake(kg)	10	10	9	9	12	8
Meat & bone meal	0.5	0.5	0.5	0.5	0.5	0.5
Salt (kg)	0.5	0.5	0.5	0.5	0.5	0.5
Vit. Mineral **	+	+	+	+	+	+
Calculated composition						
M E (Kcal/ kg)	2925	2908	2951	3059	3012	3102
CP%	22.5	22.5	22.8	16.9	17	16.4
Ca%	0.66	0.59	0.63	0.59	0.61	0.63
P%	0.46	0.4	0.41	0.37	0.42	0.4
Lysine %	1.07	1.0	1.0	0.72	0.73	0.6
Methionine %	0.4	0.4	0.4	0.3	0.3	0.35

*PRP at levels of 15,25 and 35% constituted PRP based diets D_1, D_3, D_5 respectively, while D_2, D_4, D_{6c} –constituted treatment diets containing mixed enzyme (Carbohydrase 120 ppm/kg + phytase 1000FYT/kg)

** Added vitamin-mineral premix @2.5g/kg

The birds were immunized against Duck Plague and Duck Cholera. During the experimental period, initial and weekly body weight, feed consumption, temperature and relative humidity, mortality etc were recorded. To evaluate different treatments weight gain, feed conversion ratio, survivability, production number, performance index, production cost, dressing yield records etc parameters were considered. Data collected and calculated for different parameters were subjected to analysis of variance (ANOVA) using a MSTAT statistical computer package programme according to the principles of Completely Randomized Design (CRD). Least significant differences (LSD) were performed to compare the mean values having significant difference between treatments.

Results and Discussion

The results of feeding different levels of parboiled rice polish (PRP) with and without mixed enzyme on live weight, weight gain, feed conversion ratio, survivability, production number, performance index, production cost of ducks are shown in the Table 2. .Live weight differed significantly among diets and increasing dietary PRP (15-35%) decreased live weight linearly (Table 2).Ducks on 15% PRP diet had 4.13-6.15% increased live weight for supplementation of mixed enzyme depending on age. Respective increased live weight on 25% PRP diet was 5.04 – 20.01% for enzyme addition depending on age. Corresponding figures for 35% PRP diet was 14.36-35.5%.

Table 2. Growth performance of ducklings on different parboiled rice polish (PRP) diets at different ages

Parameters	Age (days)	Diet (D)						LSD (SED) and level of significance +
		D_1	D_2	D_3	D_4	D_5	D_6	
Live weight (g/duckling)	Initial	45.4	45.8	45.9	45.65	45.25	45.7	0.27^{NS}
	7	166.89^{b}	173.5^{a}	165.5^{b}	173.85^{a}	152.85^{c}	174.8^{a}	5.672**
	14	360.3^{bc}	377.5^{b}	345.8^{c}	415.0^{a}	320.0^{d}	704.8^{a}	21.02**
	21	615.5^{c}	653.35^{bc}	1616.8^{c}	724.5^{a}	531.1^{d}	684.5^{b}	36.67**
	28	931.75^{c}	977.55^{b}	921.35^{c}	1070.9^{a}	782.1^{b}	1059.45^{a}	25.27**
	35	1259^{d}	1342^{c}	1259^{d}	1475^{a}	1079^{c}	1444^{b}	19.23**
	42	1642^{b}	1737^{c}	1627^{d}	1865^{a}	1456^{c}	1778^{b}	24.52**
	49	1895^{d}	1981^{c}	1882^{d}	2159^{a}	1736^{c}	2086^{b}	17.78**
	56	2121^{d}	2231^{c}	2110^{d}	2443^{a}	19782^{c}	2355^{b}	20.74**
	63	2317.75^{d}	2429.5^{c}	2303.5^{d}	2677^{a}	2186.2^{c}	2572.3^{b}	27.29**
	70	2480.25^{d}	2588^{c}	2459.65^{d}	2878.85^{a}	2359^{c}	2761.05^{b}	24.21**
	77	2618^{d}	2726^{c}	2603^{d}	3055^{a}	2505^{c}	2917^{b}	16.62**
	84	2751^{d}	2883^{c}	2711^{c}	3188^{a}	2580^{f}	3050^{b}	35.38**
Fed intake (g/duckling)	7	273.7^{bc}	275.8^{abc}	270.9^{c}	282^{ab}	249.6^{d}	286^{a}	10.35**
	14	762.3^{ab}	749.4^{ab}	688.3^{b}	822.1^{a}	727.5^{b}	827^{a}	86.52*
	21	1394^{b}	1434^{b}	1384^{b}	1692^{a}	1126.5^{c}	1559^{a}	185.70**
	28	2473^{b}	2200^{c}	2150^{c}	2332^{bc}	2100^{c}	2747^{a}	229.70**
	35	3482^{bc}	3551^{ab}	3396^{bc}	3965^{a}	3163^{c}	3701^{ab}	426.10**
	42	5100^{b}	5210^{ab}	5003^{b}	5513^{a}	4382^{c}	5490^{a}	299.60**
	49	5965	5960	5785	6528	5776	6457	146.20^{NS}
	56	6505.57^{b}	6817.78^{b}	6707.69^{b}	7442.49^{a}	6407.37^{b}	7333.6^{a}	491.80**
	63	7702.55	7663.75	7786.55	8182.46^{a}	7385.95	8047	133.38^{NS}
	70	7828.25^{b}	8351.38^{ab}	8267.77^{ab}	8853.5^{a}	8420.85^{ab}	8674.65^{a}	580.70*
	77	8617^{b}	8951^{b}	8847^{a}	9781^{a}	9813^{a}	9505^{a}	531.80**
	84	9890.34	9704.28	10111.75	10652.10	10416.75	10105.98	349.800^{NS}

Table 2 (contd.) the growth performance of ducklings on different parboiled rice polish (PRP) diets at different ages

Parameters	Age (days)	Diet (D)						LSD (SED) and level of significance +
		D_1	D_2	D_3	D_4	D_5	D_6	
Feed conversion efficiency	7	2.27ab	2.16c	2.26ab	2.20bc	2.30a	2.22bc	0.081*
	14	2.42	2.26	2.3	2.23	2.65	2.29	0.127^{NS}
	21	2.45	2.36	2.43	2.49	2.32	2.44	0.894^{NS}
	28	2.79a	2.36b	2.46b	2.28b	2.85a	2.71a	0.215**
	35	2.85	2.74	2.80	2.78	3.06a	2.65	0.118^{NS}
	42	3.20	3.08	3.17	3.03	3.11	3.15	0.055^{NS}
	49	3.23	3.08	3.15	3.09	3.42	3.178	0.12^{NS}
	56	3.14	3.12	3.60	3.121	3.33	3.18	0.198^{NS}
	63	3.39ab	3.22abc	3.45a	3.11c	3.45a	3.19bc	0.244^{*}
	70	3.32bc	3.29bc	3.43ab	3.13c	3.64a	3.20bc	0.244*
	77	3.35bc	3.34bc	3.46b	3.25c	3.99a	3.31bc	0.199**
	84	3.66bc	3.42c	3.80ab	3.39c	4.11a	3.37c	0.315**
Performance index	7	7.32c	8.03a	7.31c	7.90ab	6.59d	7.87b	0.49**
	14	14.90c	16.7bc	15.06c	18.66a	12.19d	17.84ab	1.827**
	21	25.18bc	27.68ab	25.43bc	29.14a	22.92c	28.06ab	2.830**
	28	33.39c	41.42b	37.53b	47.23a	27.44d	39.10b	4.072**
	35	44.61c	49.08bc	45.03c	53.14ab	35.26d	54.51a	4.865**
	42	51.38c	56.42b	51.39c	61.55a	46.91d	56.78b	2.145**
	49	58.76c	64.32b	59.75c	69.98a	51.00d	65.90ab	4.529**
	56	67.63cd	71.53bc	64.93d	78.68a	59.34c	74.21b	4.372**
	63	68.44d	75.56c	66.90d	86.07a	63.42d	80.76b	5.156**
	70	77.15c	78.79c	71.84d	92.13a	64.88c	86.41b	4.728**
	77	78.16cd	81.63c	75.25d	94.04a	62.75c	88.16b	4.996**
	84	75.38c	84.33b	71.25	94.04a	62.79d	90.74ab	6.604**
Livability %	84	100	100	80.00	90.00	90.00	100	5.317^{NS}
Cost of production duck								
Feed cost/duck		105.30	107.97	112.18	111.97	111.97	117.71	4.096^{NS}
Feed cost/kg duck		38.18bc	37.46bc	41.38ab	4..36a	43.36a	38.59bc	3.773*
Total cost (Tk. / duck)		126.83	129.74	133.98	133.77	133.77	139.51	2.192^{NS}
Total cost (Tk./ kg duck)		46.10bc	45.02c	49.42ab	51.86a	51.86a	45.74bc	3.840**
Profit (Tk/kg duck)		13.90ab	14.99a	10.58bc	8.15c	8.15c	14.26ab	3.840**

+NS, P>0.05; *, P<0.05; ** P<0.01; All SED are against 5 df

D_1= 15% PRP diet; D_2= D_1 + mixed enzyme; D_3 = 25% PRP diet; D_4 = D_3+ mixed enzyme; D_5 = 35%PRP diet; and D_6 = D_5 + mixed enzyme

Feed intake differed significantly among diets and feed intake almost decreased linearly with increasing PRP levels (Table 2) but increased with supplementation of mixed enzyme. At 15% PRP diet had 0.77-6.70% increased feed intake for addition of mixed enzyme, except at 14, 28, 49, 63 and 84 days where feed intake decreased for enzyme supplementation. At 25% PRP diet increased feed intake, was 4.09–22.25 % for enzyme supplementation. Corresponding increase for 35% PRP diet was 3.02 – 38.39%, except 77 & 84 days where feed intake decrease for enzyme supplementation.

Increasing PRP level in diet decreased feed conversion efficiency (FCE) linearly at all ages (Table 2). Addition of mixed enzyme had a significant (P<0.01) effect on FCE at different dietary PRP levels. A depressing feed conversion on increasing proportion of PRP in diet found. This may imply that due to higher phytin P concentration and NSP decline nutrients utilization with a consequent reduced poorer FC on PRP diets.

Performance index (PI) differed significant (P<0.01) among diets. At 15, 25, and 35% PRP, increased PI were 2.12- 24.04, 8, 07-28.65 and 19.40-54.59% respectively for enzyme supplementation. Livability did not differ significantly among 6 different diets. Total cost of production and profit on different dietary treatments are increasing dietary PRP and with addition of mixed enzyme increased profit. Feed cost/kg duck was decreased significantly on three enzymatic diets than without supplementation of enzyme in PRP diets. At 15, 25, and 35% PRP levels increased profit for enzyme supplementation in diet were 7.84, 57.65 and 74.96% respectively.

Here is significant (P<0.01) effect t for mixed enzyme supplementation on the performance parameter of dressing yield and meat yield characteristics with increasing PRP levels (Table 3). For addition of enzyme gave improve response of total meat, dark meat, breast meat, drumstick meat and dressing percentage.

Table 3. Dressing yield characteristics of ducks on different PRP diet without and with mixed enzyme supplementation

Parameters	Sex	Treatments						Mean	LSD (SED) and level of significance +		
		D_1	D_2	D_3	D_4	D_5	D_6		D	S	D×S
Dressing yield %	M	60.60	61.29	60.40	63.02	58.85	62.47	60.51	0.514**	0.134**	0.637^{NS}
	F	59.56	60.29	59.28	62.02	57.74	61.50	60.66			
	Mean	60.09	60.79	59.84	62.52	58.29	61.98	60.58			
Total meat %	M	30.04	31.93	29.05	73.64	28.54	32.99	30.34	0.403**	0.011**	0.796^{NS}
	F	28.34	30.61	27.69	32.50	27.37	32.08	30.46			
	Mean	29.19	31.27	28.37	33.05	27.95	32.53	30.39			
Dark meat %	M	16.11	16.85	16.09	18.25	15.54	17.54	16.34	0.295**	0.077**	0.418^{NS}
	F	15.49	16.30	15.37	17.85	15.25	17.11	16.62			
	Mean	15.80	16.57	15.73	18.05	15.39	17.32	16.49			
Breast meat %	M	14.50	14.12	13.87	16.01	13.21	15.81	14.43	0.241**	0.063**	0.456^{NS}
	F	14.01	14.32	13.02	15.74	12.88	15.50	14.52			
	Mean	14.26	14.57	13.44	15.87	13.04	15.66	14.57			
Thigh meat %	M	6.19	6.47	6.18	7.04	6.11	6.70	6.31	0.085**	0.022**	0.132^{NS}
	F	6.11	6.31	5.99	6.70	5.99	6.49	6.42			
	Mean	6.15	6.38	6.06	6.87	6.05	6.59	6.36			
Drumstick meat %	M	6.12	6.24	6.18	6.80	6.00	6.71	6.16	0.069**	0.018*	0.098**
	F	5.97	6.09	6.10	6.66	5.83	5.55	6.22			
	Mean	6.04	6.17	6.14	6.73	5.92	6.13	6.19			
Abdominal fat %	M	0.81	1.17	0.92	0.99	0.91	0.94	0.62	0.038^{NS}	0.039**	0.132^{NS}
	F	0.33	0.36	0.34	0.38	0.38	0.36	0.69			
	Mean	0.57	0.77	0.63	0.68	0.64	0.65	0.66			
Blood loss %	M	4.68	5.04	4.79	5.25	4.49	5.21	4.61	0.156**	0.040**	0.158^{NS}
	F	4.21	4.40	4.14	4.77	4.14	4.68	4.69			
	Mean	4.44	4.72	4.47	5.00	4.32	4.94	4.65			
Feather loss %	M	6.76	6.93	6.67	7.76	6.64	7.00	6.67	0.139**	0.037**	0.197**
	F	6.19	6.53	6.35	7.09	6.33	6.83	6.85			
	Mean	6.47	6.73	6.51	7.43	6.45	6.92	6.76			

+NS, P>0.05; *, P<0.05; ** P<0.01; All SED are against 5 df

D_1= 15% PRP diet; D_2= D_1 + mixed enzyme; D_3 = 25% PRP diet; D_4 = D_3+ mixed enzyme; D_5 = 35%PRP diet; and D_6 = D_5 + mixed enzyme

Decreasing live weight with increasing concentration of dietary PRP coincide with some previous findings (Islam *et al* 1996; Azam and Howlider, 1998; Sayre *et al.* 1987; Scholtyseek *et al* 1986). Improved growth of broiler on increasing dietary PRP following addition of mixed enzyme agreed with Moshad (2001).

Decrease feed intake on increasing dietary PRP agreed with the report of Sayre *et al.* (1987), Mahbub (1989), Karim (1983). Feed intake was improved for addition of mixed enzyme and rate of improvement was higher at increasing PRP level. Such result is supported by previous findings (Ravindran *et al* 1995, Zyla *et al* 1999, Gippert *et al* 1999, Moshad. 2001).

Increasing PRP level in diet decreased feed conversion efficiency (FCE) linearly at all ages .This result agreed with the investigation of Warren and Farrell, (1990), Kanaya *et al* (1976). Improved FCE on increasing PRP levels in diet with addition of mixed enzyme agreed with Moshad (2001), Ravindran et al (1995).

At 15, 25, and 35% PRP levels increased profit for enzyme supplementation in diet were 7.84, 57.65 and 74.96% respectively. Such results obtained coincide with the findings of several authors (Farrell *et al* 1993; Kies *et al* 2001; QuMingren *et al*. 1999 and Mikulshi *et al*. 1999).

Moshad (2001), Preston *et al*. (2000), Jamroz *et al.* (1996) and Ferguson *et al*. (1998) have reported increased carcass yield for addition of enzymes. Dressed weight was a function of live weight. A positive correlation of dressed weight with live weight or age obtained coincide with the findings of Mcnally and Spicknall (1949), Jap *et al*. (1950) incase of broiler.

As increasing use of dietary PRP up to 35% in diet with mixed enzyme (Phytase 1000 FYT/kg and carbohydrase 120 ppm/kg) gave best performance of duck meat production, it may be worthwhile to further investigate whether a higher level above 35% might produce improve or similar growth leading to a further increase in profitability.

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