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Performance of Broiler on Phytase Supplemented Soybean Meal Based Diet

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Abstract: An investigation was made on the performance of 144 unsexed Van Cobb broiler chicks from 21 days to 42 days of age. The chicks were fed on soybean meal (SM) based iso-nitrogenous and iso-energetic diet incorporating phytase with the levels of 0.0, 0.50, 1.00 and 1.50 g/kg diet for better utilization of the basal diet. The growth rate, feed intake, feed consumption, dressing yield and profitability increased as the level of phytase supplementation increased and the level of phytase had no effect on survivability. The addition of phytase seemed to be effective to overcome the antinutritive effect of phytate phosphorus and non-starch polysaccharides (NSP) on broiler performance. Therefore, it was concluded that 1.50 g/kg phytase may be incorporated in SM based broiler diet for profitable production.

Key words: Phytase, broiler, growth rate, feed intake, feed conversion and dressing yield

Introduction

In poultry ration, the protein ingredients are comparatively higher than those of others and protein costs involve about 45 per cent of the total feed cost (Lester, 1989). Traditionally, protein needs l poultry ration is met up mainly with vegetable proteins plus little amount of animal protein (Alam *et al*., 2003). Recently, most popular animal protein ingredient fish meal (FM) has been claimed to be adulterated with materials like sand, saw dust, fish bone, fish scales, heavy bacterial loads etc (Ali, 1995). Fluctuation in availability and competition of poultry and livestock with human for FM is the another problem regarding use of FM in poultry ration. So, poultry farm owners in Bangladesh are keenly seeking somewhat as substitute of FM. Among vegetables protein sources, soybean meal (SM) is comparatively cheaper and available in Bangladesh throughout the year. It's nutritive value is quite fine when compared with other plant protein sources. But this mostly available and cheaper SM is not suitable for using in higher amounts in poultry diet, because SM contains some antinutritional factors like phytate phosphorus, trypsin inhibitors, non-starch polysaccharides (NSP), oligosaccharides and lectins (Acamovic, 2001; NRC, 1994) which decrease feed consumption, growth rate and feed utilization. It's phytate phosphorus reduces the phosphorus and calcium availability. These adverse effects of soybean meal could possibly be overcome by dietary supplementation of exogenous phytase (Naher, 2002). Addition of exogenous phytase in low protein diet have been reported to improve growth performance of broiler (Lan *et al*., 2002; Ahmad *et al*., 2000) and also improve phosphorus digestibility for certain plant based feedstuffs and overall utilization of broiler diet (Rutherfurd *et al*., 2002; Moshad, 2001). Kies *et al*. (2001) reported that between 80 per cent and 70 per cent of the P in feedstuffs of plant origin is present as phytate and birds are unable to hydrolyze phytate due to lack of necessary enzyme. The addition of phytase to diets permits hydrolysis of phytate reduces in manure and helps to correct possible environmental problem. Moreover, Ren *et al*., 1999 found that phytase supplementation in broiler diet reduces the feed cost and makes broiler production profitable. So, there is a chance to study the performance of broilers fed on SM based diet fortified with phytase.

Materials and Methods

The experiment was conducted at Bangladesh Agricultural University Poultry Farm, Mymensingh with 21 days old broilers (Van Cobb) for a period of 21 days from mid January to mid February, 2003. The research was carried out to investigate the effect of the supplementing phytase in the soybean meal based diet on body weight, feed consumption, feed efficiency, mortality, dressing percentage and cost of broiler production. A total of 144 experimental birds were equally assigned to four dietary treatments (D_1, D_2, D_3 and D_4) and each of 3 replications (R_1, R_2 and R_3) with 12 birds in each. The lay out of the experiment is shown in Table 1.

The experimental birds were randomly distributed according to treatments and replications. The experimental birds of all treatment groups were reared on littered floor with 1000 cm^2 floor space and feed and water were supplied *ad libitum* to the birds throughout the experimental period. Initial body weight and amount of feed supply were recorded at the beginning of the experiment. Feed intake, feed supply and body weights were recorded every week. At 43 days of age, one male and one female broiler from each replicate group weighing average of pen weight were selected for processing ready to cook meat. Final processing performed by removal of the head, shank, elementary

Table 1: Lay out of the experiment

Replications	Dietary treatments and No. of birds				
	D_1	D_2	D_3	D_4	Total
R_1	12	12	12	12	48
R_2	12	12	12	12	48
R_3	12	12	12	12	48
Total No. of birds	36	36	36	36	144

Where, D_1 = Control diet (containing 25% soybean meal+0g phytase/kg feed); D_2 = Control diet+0.50g phytase/kg feed; D_3 = Control diet+1.00g phytase/kg feed; D_4 = Control diet+1.50g phytase/kg feed.

Table 2: Composition of the experimental diets

Feed ingredients	Kg per 100 kg mixed feed			
	D_1	D_2	D_3	D_4
Maize	57.0	57.0	57.0	57.0
Rice polish	9.0	9.0	9.0	9.0
Soybean oil	2.5	2.5	2.5	2.5
Soybean meal	25.0	25.0	25.0	25.0
Meat and bone meal	2.5	2.5	2.5	2.5
Protein concentrate (Provita)	2.0	2.0	2.0	2.0
Oyster shell	1.5	1.5	1.5	1.5
Salt	0.5	0.5	0.5	0.5
Vitamin-mineral premix*	+	+	+	+
Total	100	100	100	100
Phytase (g/kg Diet)	0.0	0.50	1.00	1.50
Calculated composition				
ME kcal/kg	3123.55	3123.55	3123.55	3123.55
CP (%)	20.91	20.91	20.91	20.91
Ca (%)	1.13	1.13	1.13	1.13
Available P (%)	0.58	0.58	0.58	0.58
CF (%)	4.45	4.45	4.45	4.45
Lysine (%)	1.15	1.15	1.15	1.15
Methionine (%)	0.37	0.37	0.37	0.37

* Vitamin-mineral premix is added @ 2.5g/kg.

tract, oil gland, kidneys, lungs, heart, liver and gall bladder. The collected and calculated growth performance and cost-return data were statistically analyzed using analysis of variance (ANOVA) technique with the principles of Completely Randomized Design (CRD). The dressing yield parameters were analyzed by using a 2 (Sex) × 4 (diets) factorial experiment in a CRD. The variances were partitioned into sex (S), Diet (D), S×D and error. Least Significance Differences (LSD) of all data were calculated to compare variation among treatments where ANOVA showed significant differences among means.

Results and Discussion

Performance of broilers: The results of performance of broilers on different dietary treatments was given in Table 4. The results indicated that the body weight were not significant different (P>0.05) between 0g and 0.50g phytase per kg SM based diet when fed up to 35 days of age but significantly lowered from other enzymatic diets during the same period. After 35 days of age all enzymatic diets significantly increased (P<0.01) live weight. Highest live weight (1814.58g) was obtained for the supplementation of 1.50g phytase per kg feed indicating a suitable level of phytase supplementation to SM based diet for growth. Increasing live weight with increasing concentration of dietary phytase in SM based diet fully agreed with many previous findings (Lan *et al.*, 2002; Moshad, 2001; Ahmad *et al.*, 2000; Augelovicova and Michalik, 1997; Salobir *et al.*, 1998). But result of this study contradicts with the report of Pizzolante *et al.* (2002); Mohanna and Nys (1999) and Wilson *et al.* (1999). They found that dietary phytase had no effect on live weight gain of broilers.

Feed consumption were not different (P>0.05) between 0g and 0.50 g/kg dietary enzyme groups. Birds that received 1.00g and 1.50g phytase/kg diet consumed significantly more feed as compared to the control. There was no statistical difference in feed consumption between 1.00g and 1.50g phytase per kg diet

Table 3: Performance of boilers fed on different dietary levels of phytase

Parameters	Age (day)	Diet (D)				LSD and level of significance
		D_1	D_2	D_3	D_4	
initial live weight (g/bird)	21	678.46^{ab}	673.61^{c}	675.27^{bc}	679.02^{a}	3.361*
Live weight (g/bird)	28	957.63^{c}	959.16^{c}	987.49^{b}	994.16^{a}	4.718**
	35	1328.19^{c}	1329.16^{c}	1381.24^{b}	1404.16^{a}	9.55**
	42	1699.99^{d}	1742.12^{c}	1778.19^{b}	1814.58^{a}	4.644**
Feed consumption	28	747.22^{c}	762.49^{b}	798.60^{a}	795.83^{a}	10.86**
(g/bird)	35	1645.83^{b}	1659.72^{b}	1708.33^{a}	1704.16^{a}	21.20**
	42	2527.77^{b}	2542.36^{b}	2592.91^{a}	2612.49^{a}	32.82**
FCR (Feed : weight gain)	28	2.68^{a}	2.67^{a}	2.56^{b}	2.52^{c}	0.01883**
	35	2.51^{a}	2.53^{a}	2.42^{b}	2.35^{c}	0.02598**
	42	2.45^{a}	2.38^{b}	2.35^{c}	2.30^{d}	0.01883**
Survivability %	28	100	100	100	100	NS
	35	100	100	100	100	NS
	42	100	100	100	100	NS

where, D_1 = Control diet (containing 25% soyabean meal+0g enzyme/kg feed); D_2 = Control diet+0.50g enzyme/kg feed; D_3 = Control diet+1.00g enzyme/kg feed; D_4 = Control diet+1.50g enzyme/kg feed; Figures in the same row containing superscript with similar alphabet do not differ significantly. NS- Non significant, ** P<0.01, * P<0.05.

supplemented groups. Increased feed consumption on phytase supplemented SM based diet was observed for broilers as compared to the birds that received control diet up to 28, 35 and 42 days of age. These results were in agreement with Ahmad *et al.* (2000); Naher (2002); Aksakal and Bilal (2002). These authors were in the opinion that increased digestibility of nutrients and partial degrading of cell wall of feed as being reasons for increased feed consumption on enzymatic diet. On the other hand, the result contradicts with the findings of some earlier workers (Wilson *et al.,* 1999). They found that feed consumption was decreased due to addition of enzymes since birds fulfilled their nutrient requirement by taking less amount of feed.

During the whole experimental period, feed conversion (FC) of all dietary levels of phytase supplementation differed significantly (P<0.01). At the end of experimental period feed conversion was found best (2.30) in 1.50 g/kg phytase group. On the other hand, the poorest feed conversion (2.45) was found on enzyme free SM based diet. No significance difference (P>0.05) in survivability was found in broilers indicated that phytase supplementation had no effect on mortality.

A depressing feed conversion of SM based control diet and also diet fortified with 0.50g phytase/kg feed was observed up to 35 days of age. It is due to higher phytin P concentration and non-starch polysaccharide (NSP) that declined nutrient utilization with a consequent reduced poorer feed conversion (FC) on SM based diet. This result agreed with the investigation of Kanaya *et al.* (1976). On the other hand, the result show that, increasing FC with increasing concentration of dietary phytase in SM based diet coincides with the findings of some earlier workers (Lan *et al.,* 2002; Moshad, 2001; Aksakal and Bilal, 2002; Scott *et al.,* 1997). They reported that feed conversion was increased due to better feed utilization by birds.

The survivability of birds during the experimental period did not differ significantly. The survivability of all dietary treatment groups was 100%, and therefore did not differ significantly among dietary groups. It indicates that dietary supplementation had no detrimental effect on survivability. Survivability results of birds during entire experimental period on all diets indicated that enzyme supplementation had no effect on mortality. This result coincides with the finding of Alam *et al.* (2003); Lan *et al.* (2002); Moshad (2001) and Pillai *et al.* (1995). They also reported no effect of phytase supplementation on survivability results.

Meat yield characteristics: The obtained data on meat production of broilers on different dietary treatments were given in Table 4. There were significant differences (P<0.01) in dressing yield among different levels of phytase. Total meat, thigh meat, breast meat and liver weight also significantly differed (P<0.01) among different levels of dietary phytase and noted highest on 1.50 g/kg phytase supplemented diet followed by other levels of phytase. However, 1.50 g/kg phytase gave the best response in terms of meat yield on SM based diet. Dietary enzyme had no effect on blood and gizzard weight. The addition of 1.50g phytase per kg SM based diet gave highest response in breast meat, thigh meat, dressing percentage and total meat. Naher (2002); Moshed (2001); Preston *et al.* (2000) and Ferguson *et al.* (1998) reported increased carcass yield for addition of phytase enzyme. Dressed weight was a function of live weight. A positive correlation of dressed weight with live weight or age obtained coincides with the findings of some earlier workers (McNally and Spicknall, 1949; Jaap *et al.,* 1950; Howlider and Rose, 1989).

Table 4: Meat yield characteristics of broiler fed on different levels of dietary phytase

Parameters	Sex	Diet (D)					LSD and level of significance		
		D_1	D_2	D_3	D_4	Mean	Diet	Sex	Diet × Sex
Live weight	M	1713.33	1751.67	1795.00	1853.33	1778.33	**	**	NS
of bird's	F	1660.00	1736.67	1778.33	1810.00	1746.25	45.57	32.22	
sample	Mean	1686.67^{d}	1744.17^{c}	1786.67^{b}	1831.67^{a}	1762.29			
Blood	M	4.29	4.14	4.07	4.50	4.25	NS	*	NS
weight (%)	F	4.16	4.03	3.92	3.84	3.98		0.22	
	Mean	4.22	4.08	3.99	4.17	4.12			
Feather	M	5.10	4.78	3.72	3.88	4.37	**	NS	NS
weight (%)	F	4.74	4.42	3.43	3.40	3.99	0.80		
	Mean	4.92^{a}	4.59^{a}	3.57^{b}	3.64^{b}	4.18			
Liver	M	2.13	2.32	2.37	2.63	2.36	**	NS	NS
weight (%)	F	2.20	1.98	2.48	2.44	2.27	0.27		
	Mean	2.16^{b}	2.15^{b}	2.42^{a}	2.53^{a}	2.32			
Gizzard	M	2.45	2.56	2.54	2.57	2.53	NS	NS	NS
weight (%)	F	2.53	2.48	2.53	2.52	2.51			
	Mean	2.49	2.52	2.53	2.55	2.52			
Heart	M	0.61	0.60	0.65	0.61	0.62	*	NS	NS
weight (%)	F	0.59	0.60	0.62	0.63	0.61	0.01		
	Mean	0.60^{c}	0.60^{c}	0.63^{a}	0.62^{b}	0.615			
Abdominal fat	M	2.42	2.40	1.90	1.81	2.13	**	NS	NS
weight(%)	F	2.18	2.25	1.84	1.70	2.99	0.39		
	Mean	2.30^{a}	2.32^{a}	1.87^{b}	1.75^{b}	2.063			
Breast meat	M	8.20	8.38	8.95	9.20	8.68	**	NS	NS
weight (%)	F	8.03	8.51	8.87	9.10	8.63	0.29		
	Mean	8.11^{d}	8.44^{c}	8.91^{b}	9.15^{a}	8.65			
Drumstic meat	M	6.12	5.25	5.05	5.09	5.37	**	*	NS
weight (%)	F	5.72	4.92	5.01	4.96	5.15	0.41	0.21	
	Mean	5.92^{a}	5.08^{b}	5.03^{b}	5.03^{b}	5.26			
Thigh meat	M	9.09	10.12	10.46	11.41	10.27	**	NS	NS
weight (%)	F	9.13	10.25	10.57	11.61	10.39	0.53		
	Mean	9.11^{c}	10.18^{b}	10.52^{b}	11.51^{a}	10.33			
Dressing yield (%)	M	61.82	62.24	68.49	68.25	65.20	**	NS	NS
	F	61.28	61.80	67.43	69.06	64.89	1.12		
	Mean	61.55^{b}	62.02^{b}	67.96^{a}	68.65^{a}	65.04			
Total meat (%)	M	30.55	30.97	34.78	35.70	33.00	**	NS	NS
	F	31.13	31.61	34.17	35.19	33.02	1.37		
	Mean	30.84^{b}	31.29^{b}	34.47^{a}	35.44^{a}	33.01			

Where, D_1 = Control diet (containing 25% soybean meal+0g enzyme/kg feed); D_2 = Control diet+0.50g enzyme/kg feed; D_3 = Control diet+1.00g enzyme/kg feed; D_4 = Control diet+1.50g enzyme/kg feed; Figures in the same row containing superscript with similar alphabet do not differ significantly. NS- Non significant, ** P<0.01, * P<0.05.

Table 5: Cost return analysis of broilers fed on different levels of dietary phytase

Variable	Dietary Enzyme				LSD value	Level of significance
	D_1	D_2	D_3	D_4		
initial live weight (g/broiler)	678.46^{ab}	673.61^{c}	675.27^{bc}	679.02^{a}	3.361	*
Final live weight (g/broiler)	1699.99	1742.12	1778.19	1814.58	4.694	**
Chick cost (Tk./bird)	37.31	37.04	37.14	37.35	-	-
Feed cost (Tk./broiler)[1]	28.99^{b}	29.28^{b}	30.02^{a}	30.38^{a}	0.3812	**
Feed cost (Tk./kg broiler)	17.05	16.81	16.88	16.74	-	NS
Other cost (Tk./broiler)	5.99	5.99	5.99	5.99	-	-
Total cost (Tk./broiler)	72.29^{c}	73.32^{c}	73.15^{b}	73.72^{a}	0.3368	**
Total cost (Tk./kg broiler)	42.52^{a}	41.51^{b}	41.14^{c}	40.62^{d}	0.2228	**
Market price (Tk./kg broiler)	55.00	55.00	55.00	55.00	-	-
Sale (Tk./broiler)	93.50	95.82	97.80	99.80	-	-
Profit (Tk./broiler)	21.21^{d}	23.49^{c}	24.65^{b}	26.08^{a}	0.4125	**
Profit (Tk./kg broiler)	12.48^{d}	13.49^{c}	13.86^{b}	14.38^{a}	0.2228	**

where, D_1 = Control diet (containing 25% soybean meal+0g enzyme/kg feed); D_2 = Control diet+0.50g enzyme/kg feed; D_3 = Control diet+1.00g enzyme/kg feed; D_4 = Control diet+1.50g enzyme/kg feed; Figures in the same row containing superscript with similar alphabet do not differ significantly; NS- Non significant, ** P<0.01, * P<0.05.; = Chick cost was calculated by considering initial live weight at 21 days and market price of broilers.;[2]

Profitability: Results given in Table 5. showed that total cost of production 40.62 Tk. per kg broiler decreased as the dietary supplementation of phytase increased (1.50 g/kg) comparison with that of control SM based diet that showed cost of production as 42.52 Tk./kg broiler. A highest live weight (1814.58g) and therefore, a highest feed cost (30.38 Tk./broiler) was found for the supplementation of 1.50g phytase per kg SM based diet. The profits per kg broiler were Tk. 12.48, 13.49, 13.86 and 14.38 for the supplementation levels of 0, 0.50, 1.00 and 1.50g phytase per kg SM based diet. So, profit (Tk./kg broiler) was increased as the dietary concentration of enzyme was increased in SM based diet during 21-42 days of age. Profit (14.38 Tk./kg broiler) was significantly highest ($p<0.01$) on supplementation of 1.50g phytase per kg SM based diet. Feed cost was reduced due to supplementation of phytase, which increased profitability of broiler rearing. However, profit was increased when dietary enzyme concentration was increased at the level of 1.50 g/kg SM based diet. This study coincides with the findings of Ahmad *et al.* (2000); Kies *et al.* (2001); Ren *et al.* (1999); Augelovicova and Michalik (1997) and Morkunas *et al.* (1993). They reported that reduced feed cost was for the improved feed utilization and faster growth rate of broilers. But, the profitability may differ among different enzymatic diets signifying the importance of proper selection of dose for enzyme to get the best result, in terms of profitability.

Conclusions: Considering the above facts and findings, it may be concluded that addition of phytase enzyme improved live weight, feed utilization, and dressing yield. Supplementation of 1.50g phytase per kg SM based diet gave the best result indicating a suitable level of phytase supplementation to SM based diet to obtain beneficial effect on overall performance of broiler.

a Phytin phosphorus, which is the major anti-nutritional factor, can be inactivated efficiently by supplementation of phytase. This influenced efficient feed utilization and rapid growth of broilers.

b Supplementation of 1.50g phytase per kg SM based diet (25% SM in ration) is most effective on profitable broiler rearing.

c Based on the findings of the present study, it may be worthwhile to investigate further whether or not a higher level of SM above 25% fortified with phytase enzyme may be useful to obtain beneficial effect.

However, as the increased use of 25% soybean meal in diet fortified with 1.50 g/kg phytase gave best performance of broiler meat production, it may be worthwhile to investigate further whether a higher level above 25% might produce improved or similar growth leading to a further increase in profitability.

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