Effect of exogenous phytase on egg production and egg quality of spent hen

M. K. Bashar[1]*, M. A. R. Howlider[2] and S. M. Bulbul[2]

[1]Bangladesh Livestock Research Institute, Savar, Dhaka-1341, Bangladesh. [2]Department of Poultry Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

Abstract

The present study determined, assessed and quantified the exogenous phytase on egg production and egg quality of spent hens. Ninety laying hens (ISA- Brown) received iso-energetic and iso-nitrogenous diet supplemented with 0, 0.05, 0.1, 0.15 and 0.2 % phytase and reared in cages. Each layer was fed 120g feed/day from 90 to 100 weeks of age. At the inception of the study the spent hen at the age of 90 weeks had an average egg production 65.21 %. Phytase addition in diet increased ($p<0.05$) egg production (7.67, 12.17, 12.04 and 15.87 % higher than control group), egg mass output (5.5, 9.34, 7.65 and 12.72 % higher than that of control) and feed conversion, but it did not alter shell weight, shell thickness. shape index, albumen index, Haugh unit, per cent yolk and yolk color. It was concluded that reduced egg production of spent hen at older ages to some extent might have a relationship to decreased availability of phosphorus. The decreased egg production in hens at older ages could be corrected by adding appropriate phytase level in the diet. Thus, it may be possible to extend and prolonged productive life of spent hens by supplying exogenous phytase in diet. However, the effect of availability of phosphorus on egg production using larger population for a longer period may be performed to confirm the findings of the current study.

(**Key words:** Phytase, egg production, egg quality, prolong the egg laying period)

Introduction

Commercial layer production in Bangladesh has gained a momentum during 1980 and 1990 and it took the industrial shape (Chowdhury, 2011) thus we are producing 6600 million pieces of egg representing 60 to 70% of country's total poultry egg production. In Bangladesh, commercial layer farming is increasing rapidly during the last three decades due to increased demand of eggs. Poultry, specially, leading species; chicken lay eggs in a specified and peculiar fashion; egg production sharply increase to peak from start and then gradually declined. The success of layer farm depends on the level of egg production. The layer performance depends on genetic background, nutrition, physiology, environment and management (Banerjee, 1992). A laying hen produce eggs for a number of years, but profitable rearing is obtained up to the age of 72 – 76 weeks. Akbas *et al.* (1977) reported decline in egg production after peak with the advance of age of the hens. As the age increased, egg production and egg

*Corresponding author: mkbashar@blri.gov.bd

quality sharply increased, but after the period of peak production at about 32 weeks, egg production and egg quality gradually declined. However, the length of laying period is not fixed. It depends on egg production level of the flock. At older ages, both egg production and dietary phosphorus (P) utilization are depressed (Al-Batshan *et al.*, 1994). It is not known whether diminished egg yield and inferior egg quality in older hens could be attributed to decrease availability of P. It is also not clear whether such an age related diminished egg production and egg quality could be corrected by supplying exogenous phytase. Use of vegetation base formulated economic diet for poultry contain a variable concentration (about 50-80 per cent) of P in the form of insoluble complex, phytic acid or phytate, is not available to chicken (Eeckhout and De Paepe, 1994). P is one of the major mineral elements required to hens and plays a major role in several metabolic processes. P and Ca are important for layers (Roland and Gordon, 1996) to ensure adequate egg production and eggshell quality. Phytase is hydrolyzes phytic acid to inositol and phosphoric acid (Liu *et al.*, 1998 and Leske and Coon, 1999). making P availability and many other nutrients to poultry. Some cereals contain endogenous phytase activity (Eeckhout and De Paepe, 1994) and there may be phytase activity in the small intestine of chicken (Maenz and Classen, 1998). Researchers attempted to increase P utilization through supplementation of microbial phytase for incorporation into poultry feed (Cromwell *et al.*, 1995). Hydrolyze phytic acid in plant materials; thereby release inorganic P available for absorption in the digestive tract of fowl. The use of phytase in layer diets also reduces the requirements for inorganic P (Gordon and Roland, 1997; Carlos and Edwards, 1998 and Um and Paik, 1999) thereby reducing costs associated with inorganic P. Boling *et al.*, (2000) rotted the effects of dietary available phosphorus (AP) and exogenous phytase on performance of young and older laying hens. They concluded that maize-soybean meal diets containing 0.15% P (159 mg AP/day) or containing 0.1% AP + 300 units of phytase/kg (108mg AP/day) supported optimal egg production from 20 to 70 weeks of age. A number of researches used different exogenous phytase in egg type chicken at younger age. Researchers are scanty with regard to relations between P availability and egg production of hen at older ages. Present study assessed, quantified and compared the egg production and egg quality of older layers by adding dietary exogenous phase. Ca and P have a significant role in the growth and development of skeleton and other exoskeleton. In general blood is not a good reserve of Ca and P. Therefore, source of Ca and P must be maintained during whole life span without break. Hence current study was assessed and compared the egg production and egg quality of older ages as influenced by exogenous phase.

Materials and Methods

The experiment was conducted for a period of 70 days from 26 September to 06 December, 2011 at Bangladesh Agricultural

University (BAU) Poultry Farm and egg quality determination was performed in the Poultry Science Laboratory in the Department of Poultry Science. Phytase was collected from the dealer of Renata pharmaceuticals. A total of ninety, 90 weeks old healthy ISA- Brown layers were collected from BAU Poultry Farm and reared in cages for a period of 10 weeks. Six hens were accommodated in group cage measuring 13cm x 9cm x 16cm of length, width and height respectively. Six hens kept in each cage were considered as an experimental unit (replication).The phytase was mixed with small amount of feed and then thoroughly mixed with total amount of feed according to phytase level. The basal diet was formulated without supplementation of Rena-Phytase-400. However, in other diets phytase was added at 0.05%, 0.1% 0.15% and 0.2% (Rena-Phytase-400). Five diets were stored (for 7 days) separately in 5 gunny bags according to phytase level for further use. Each hen was allocated 120g feed/day. Fresh clean drinking water was made available at all times. During the whole experimental period, all hens were exposed to a 16 hours continuous photoperiod (natural light + artificial light) in an open sided house. Body weight change, egg production, egg mass production, egg weight and feed conversion ratio were calculated. One egg from each replication of four treatments was considered during the last week of experimental period to determine the egg quality characteristics. Each egg for quality determination was cleaned by wet cloth and then numbered by 4B wooden pencil immediately after collection from pens according to phytase level. All data, either measured or calculated were collected for a Completely Randomized Design (CRD) with three replications for each phytase level. Analysis of variance was performed to compare all the variables among the combinations of phytase levels and replication. Significant differences were isolated by calculating Least Significant Difference (LSD). The data was analyzed by using SPSS-17.0 statistical software program.

Results

Egg Production

Exogenous phytase can be added to diets to hydrolyze phytate in the digestive tract. increasing the availability of phytate P and decreasing dietary need of inorganic P. Phytase also improves the utilization of other minerals that are bound to plant phytate.

Data in Table 1 showed that egg production (%), egg mass production and feed conversion were significantly differed ($p> 0.01$). There were tendency of linear increase of those three variables with the increase of dietary phytase level. Dietary Phytase did not differ among the diets fortified with different levels of dietary phytase.

Table 1 also indicated that there were no differences in final live weight, feed intake and egg weight which could be attributed to the dietary levels of phytase. However, the Fig. 01 impressed that final live weight tented to be increased between 0 to 0.15 % but thereafter diminish at 0.2 % dietary

Table 1. Egg production of spent hens on different levels of dietary exogenous phytase

	Dietary Phytase level (%)					**Significance**	
Parameters	**Control**	**0.05**	**0.1**	**0.15**	**0.2**	**Over all SE**	**Level**
Initial live weight (g/hen)	1903.3 ± 19.2	1925.0 ± 38.2	1953.3 ± 39.4	1958.3 ± 50.7	1925 ± 38.2	15.5	NS
Final live weight (g/hen)	1981.7 ± 4.4	2010.0 ± 42.7	2046.7 ± 39.2	2052.7 ± 52.6	2018 ± 38.2	16.3	NS
Live weight gain(gm.)/day	1.13 ± 0.32	1.23 ± 30.1	1.33 ± 0.06	1.37 ± 0.03	1.36 ± 0.03	0.06	NS
Egg Production (%)	$65.21^{c}\pm1.6$	$72.89^{b}\pm1.2$	$77.38^{ab}\pm2.2$	$77.25^{ab}\pm1.0$	$81.08^{a}\pm3.0$	1.63	**
Egg mass Production (g/Hen/day)	$39.8^{c}\pm1.8$	$45.3^{b}\pm1.5$	$49.1^{ab}\pm1.3$	$47.4^{b}\pm1.5$	$52.5^{a}\pm1.7$	1.3	**
FCR (Feed intake/Egg mass)	$3.03^{a}\pm0.13$	$2.65^{b}\pm0.09$	$2.45^{b}\pm0.06$	$2.53^{bc}\pm0.08$	$2.29^{c}\pm0.08$	0.07	**
Egg weight (g/Egg)	61.0 ± 1.3	62.1 ± 1.1	63.5 ± 0.92	61.5 ± 2.6	64.8 ± 0.4	0.67	NS

Figures with different superscript in the same row differ significantly at **= $P<0.01$ level; NS= Non significant

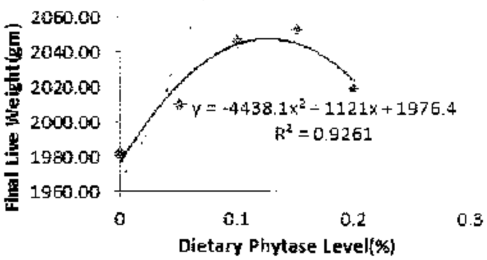

Fig-1 The relationship between final live weight (g/hen) and dietary phytase level (%)

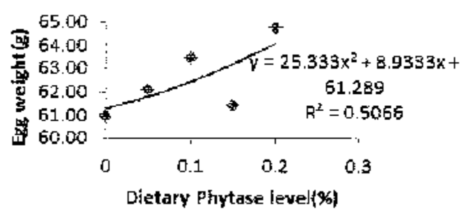

Fig-2 The relationship between Egg weight (g) and dietary phytase level (%)

phytase. Egg weight did not differ among the levels of dietary phytase but the Fig. 02 implies that egg weight tented to be increased with the increase of phytase level up to 0.1 %, depleted at 0.15 % and again repleted at 0.20 % dietary phytase.

Egg Quality

The information catalogued in Table 2 impressed that dietary phytase had insignificance relations with egg quality parameters ($p> 0.05$). However the both signal that those table 02 variables; shell weight and shell percent tented to be increased with the increased of dietary phytase level ($p> 0.05$) and also indicated that there was a positive relation between shell weight and shell per cent. Increasing phytase level tents to be increased ($p> 0.05$) shell thickness. On the other hand dietary phytase level at higher doses detriment the Shape index . It is evident from that increasing phytase level tented to be diminished albumen index between 0 to 0.1 %, which was again, replied with the increase of phytase up to 0.2 % dietary phytase. The yolk indices were almost similar at 0, 0.1 and 0.2 % but it was drastically diminished at 0.05 % level of dietary phytase. The yolk per cent and Haugh unit were similar and highest 0, 0.1 and 0.2, intermediate on 0.1 and lowest at 0.05 % of dietary phytase indicating an irregular trend. All the dietary phytase levels hindred the yolk color index with the increase of phytase level.

Discussion

Almost linear increased in egg production and egg mass production obtained (Table 1) impressed that the poorer availability of phosphorus may be an important determinant of egg production of commercial layer at older ages. Moreover, it implies that, age related declined egg production could be corrected by using exogenous phytase at optimum doses. Such a result is supported by some other investigates (Lucky, 2010; Hughes *et al.*, 2008; Augspurger *et al.*, 2007; Lim *et al.*, 2003 and Boling *et al.*, 2000). Lucky (2010) also noted, increased egg production and egg mass production for supplementation of dietary phytase at 0, 0.05, 0.1 and 0.15 %. The respective increased of egg production were 11.86, 22.2 and 24.58 % against those levels of exogenous phytase coincide with the results of current study. Such a coincidence of the result obtained agrees with Lucky (2010). The data also impressed that; increased productivity of layer spent hens may be obtained irrespective of group size. Providing phytase in the diet at 0.05, 0.10, 0.15 and 0.2 % increased egg production by 7.67, 12.17, 12.04 and 15.87 % respectively. Availability and retention of P and Ca are decreased in hens at older ages (Al-Batshan *et al.*, 1994). On the other hand,

Table 2. Egg quality of spent hens (76-82) weeks on different level of exogenous phytase

Variable	Dietary Phytase level (%)					SED	Significance
	0	0.05	0.1	0.15	0.2		
Shell Weight(g/egg)	6.85	6.96	7.12	7.30	7.23	0.341	NS
Shell (per cent)	0.35	0.35	0.35	0.36	0.36	0.019	NS
Shell thickness (mm)	0.39	0.40	0.39	0.42	0.43	0.027	NS
Shape Index	74.28	75.03	71.34	69.29	69.77	2.089	NS
Albumen Index	0.06	0.06	0.06	0.064	0.07	0.008	NS
Yolk Index	0.45	0.44	0.45	0.45	0.45	0.012	NS
Yolk percent	0.90	0.88	0.89	0.88	0.89	0.038	NS
Haugh Unit	72.30	68.20	69.80	72.30	71.50	5.330	NS
Yolk color Index	06.33	6.00	6.00	6.00	6.00	1.116	NS

$^{+}$NS, p>0.05; all SED's are against 10 error degrees of freedom egg production is also depleted with the advance of age (Banerjee, 1992). Such results imply that there may be a relation between decreased availability of P and egg production of hens at older ages. The remarkably higher egg production on different doses of exogenous phytase gave an impression that the economic productive life and egg production of hens can be extended and prolonged by increased P availability. The possible relation of phytase, availability of Ca and P and egg production has been supported by Francesch *et al.*, (2005), Cabuk *et al.*, (2004), Um and Paik (1999), Gordon and Roland (1998). Increased feed conversion of hens at increasing level of phytase obtained (Table 1) is supported by various researchers. Francesch *et al.*, (2005) reported that supplementation of microbial dietary phytase (0, 300 and 600Ukg-1) improved egg production, egg weight and feed conversion in layer hens. Phytase supplementation with 3.0g available P/kg diet improved ($P<0.05$) feed conversion. Jalal and Scheideler (2001) also reported that phytase supplementation ($p<0.05$) improved feed conversion of laying hens. Contradicting current results, Van Der Klis *et al.*, (1997) and Um and Paik (1999) reported that phytase supplementation to the diets containing 3.3 and 3.7g available phosphorus/kg had no beneficial effect on feed conversion. Similar egg weight noted on varying levels of phytase supplementation in the current study (Table 1) is getting support from Liu *et al.* (2007), Carlos and Edwards (1998), Jalal and Scheideler (2001). However, several previous reports demonstrated that supplementation of phytase generally enhanced egg production of chicken coupled with increased egg weight (Um and Paik, 1999 and Silversides *et al.*, 2006). In this study, egg shell per cent and egg shell thickness increased with the increasing level phytase, althrough no significant differences were found (Table 2). These results are in agreement with those of Nezhad and Kandi (2008), Panda *et al.*, (2005), Lim *et al.*, (2003) and Roland *et al.*, (2003). Nezhad and Kandi (2008) also reported that phytase addition in low available P diets increased eggshell weight and eggshell thickness. Panda *et al.*, (2005) reported that the addition of phytase to corn and soybean based diets containing 0.12% non-phytate P improved the egg production and eggshell quality of layers to the level of those fed diets containing 0.18 to 0.30% NPN (Non Protein Nitrogen). The increased shell thickness was not reflected as shell hardness and the exact reason of hardness is unknown. The result obtained (Table 2) is in agreement with the report of Um and Paik (1999). They suggested the association between eggshell hardness and thickness was not inevitable. Shell thickness mainly depends on *Ca* aggregations as calcium carbonate, whereas shell hardness mainly depends on the texture, composed of Ca carbonate, organic materials, and trace minerals (Chowdhury and Smith, 2002; Mabe *et al.*, 2003 and Nakano *et al.*, 2003). There were no differences ($p>0.05$) in shape index, albumen index, yolk index, per cent yolk,

yolk color and HU among the levels of phytase in the current study (Table 2) is supported by Park *et al.*, (2009) and Um and Paik (1999).

Conclusion

In conclusion, increased egg production with the addition of phytase signifies that decreased egg production at older ages may be the function of phosphorus unavailability. It may be possible to extend the production life of hens by supplementation of exogenous phytase in the diet of older hens. This study using limited number of layers signals the possibility to up hold the desirable and profitable egg production by supplementing phytase in diet. Studies using larger layer population of chicken in cluster could be conducted to confirm the result of this study.

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