G.J.A.S.R

GLOBAL JOURNAL OF ANIMAL SCIENTIFIC RESEARCH

Journal homepage: www.gjasr.com

Print ISSN:2345-4377 Online ISSN:2345-4385

Original Article

Impact of Phytase Enzyme Usage on Performance and Egg Quality of lying hens

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ABSTRACT

This experiment was carried out to identify the effects of the inclusion of different levels of phytase enzyme in laying hen's diets, on performance and egg quality. Hundred commercial layer hens (Lohmann) breeds at 32 weeks of age were distributed in a completely randomized design with four dietary treatment groups of twenty-five hens each. The treatments included 250, 500, and 750 gm phytase enzyme/ton feed respectively. Each treatment was divided into 5 replicates of 5 birds each. The replicate in the study was represented by battery cage (length 47cm, width 40cm, and height 47cm). All experimental diets were formulated according to the guidelines given in the manual provided by the breeder company. The performance and egg quality parameters were recorded. Results revealed that all performance parameters were significantly affected by dietary treatments except egg weight which was not influenced by treatments. No significant differences were observed in egg quality of all treatment groups, except for (shape index, albumin weight, yolk

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Cite this Article: Habib, A.B., Yusif, E.M., Ahmed, S.G., and Abdelwahid, H.H. (2021). The Current Food Insecurity and the Need of Livestock Products for Food Security and Future Prospects of Livestock Production in Eastern Gojjam. *Global Journal of Animal Scientific Research*, 9(1), 21-29.

Retrieved from http://www.gjasr.com/index.php/GJASR/article/view/66

Article History: Received: 2021.01.09 Accepted: 2021.03.12

diameter, and Haugh unit). It is concluded that adding phytase enzyme at 750 g ⁄ ton, in diets of layer hens can improve feed intake, egg production, and feed conversion ratio.

Keywords: Phytase enzyme, Performance, Egg quality, Layer hens.

INTRODUCTION

The provision of good protein in short period of time in form of meat and eggs is the major contributing role of poultry in human nutrition (Daffa alla *et al*., 2015). In poultry management, nutrition is considered as a master prerequisite for a successful production. Approximately 70 % of the total cost of broiler feed is required to meet energy needs (Abdelgadir, 2009).Therefore feed cost represents the largest portion of the variable costs of poultry production .

Phosphorus (P) is an essential mineral in all diets for poultry. Due to the low content of available phosphorus in plants and the low phytase activity in birds, diets must be supplemented with an inorganic phosphorus source. However, P is considered as an expensive nutrient that commonly supplemented in poultry feed. It represents the third most expensive nutrients following proteins and energy. Bird's diets are generally formulated based on corn, soya bean meal, approximately two-thirds of the total P in plants, which are the major constituents of poultry diets, is in the form of phytate (Viveros *et al*., 2000).

A number of researches have demonstrated that use of microbial phytase supplementation in feeding poultry has the ability to hydrolysis, releasing phytic acid in phosphate form (NRC, 1994). Adding microbial phytase in laying hen feed improves phytate P utilization and productive performance (Boling *et al*., 2000a, b; Jalal and Scheideler, 2001; Narahari and Jayaprasad, 2001; Keshavarz, 2003; Lim *et al*., 2003; Plumstead, 2007). Also maximize plasma P but had no effect on plasma Ca or Mn. Plasma Zn concentration was improved only when a high level of AMJC (equivalent to 1,000 U phytase kg-1 of feed) was used. Lan *et al*., (2002.) Francesch *et al*. (2005) and Jalal and Scheideler (2001) observed an enhancement in egg production, hen weight gain, feed conversion rate, egg mass and feed consumption in hens that were fed a diet supplemented by phytase when compared to hens fed a diet without phytase supplementation. Jong Hyuk Kim *et al*., (2017) mentioned that, superdosing level of 20,000 FTU/kg phytase in diets has a positive effect on egg production rate, but no beneficial effect on egg quality in laying hens. The objective of the present study was to find out the effect of phytase enzyme supplementation on performance of laying hens (feed intake, percentage of egg production, eggs weight and mortality rate), and to assess the internal and external quality of egg (shape index, yolk index, shell thickness, yolk color, the height of albumin and Haugh unit).

MATERIALS AND METHODS

Experimental site and duration

The study was conducted at the Poultry Production Training and Research Farm, College of Animal Production, University of Bahri. The period of the experiment was nine weeks.

Experimental animals and design

Hundred commercial layer hens (Lohmann) breed at 32 weeks of age was used. Birds were kept in standard management conditions (semi-closed system house prepared with battery cages). The averages of minimum and maximum temperature were documented during the experiment period, which ranged between 28 –30 C̊. Chickens were randomly assigned into four dietary treatment groups in completely randomized design. Each group was represented by 25birds which were distributed into 5 replicates of 5 birds each. The replicate in the study was represented by battery cage (length 47 cm, width 40 cm and height 47cm).

Experimental feed:

Basal diet was formulated according to the guidelines given in the manual provided by the breeder company. Four experimental diets which were approximately iso-caloric and iso-nitrogenous but differing in the level of phytase enzyme were formulated. Phytase enzyme was included at graded levels of 250, 500 and 750grams / 1000 kg. of diet designated as groups 2, 3 and 4 respectively. The control diet (group 1) on the other hand contains no phytase enzyme. The four diets were randomly assigned to birds in different groups (1, 2, 3 and 4).

Performance and egg quality

Birds were acclimatized for the first week of the experiment. Afterwards, the number of eggs produced by birds in each pen was recorded in a daily basis during the remaining 8 weeks of the experiment. For egg quality investigations, 40 eggs were collected by the end of week 5 (2 eggs from each pen with a total of 10 eggs per treatment). Following the same procedure, additional 40 eggs were also collected at the end of week 9 of the experiment (Table 2**).**

Eggs from each treatment were sampled to measure, egg weight, shape index, %age of shell, shell strength, shell thickness, albumin height, albumen diameter, albumin weight, yolk height and diameter, yolk weight and Haugh units. Egg weight was determined by digital scale while shape index was determined by measuring the width and the length of the egg using slide caliper and the shape index was expressed as Shape index= (width/length) X 100. Shell strength was obtained by using shell weight percentage to total of egg weight, Shell thickness was a mean value of measurements at three locations on the egg (air cell, equator, and sharp end) measured by using dial pipe gauge. Albumin height and diameter were determined by standard tripod micrometer. On the other hand, Yolk height was determined by a micrometer and yolk width by a slide caliper to determine the standing up quality of the yolk. Moreover, Haugh units were calculated with the HU formula (log H+7.37-1, 7.) based on the height of albumen determined by a micrometer5 and egg weight, where H=height of white.

Table 1: Ingredients and chemical composition of the basal diet.

Ingredients	(%)
Sorghum grain	52
Groundnut cake	14.91
Wheat bran	18
Super concentrate*	5
Dicalcium phosphate	0.35
Limestone	9
NaCl	0.3
Lysine	0.2
Methionine	0.04
Antimyctoxins	0.2
Total	**100**
Chemical analysis	
ME (kcal/kg)	2750
Crude protein (%)	18.5
Methionine	0.38
Met+cystien	0.67
Lysine	0.76
Calcium	4.5
Available phosphorus	0.40

***Each kg of super concentrate contained:** crude protein 35%, crude fat t2%, crude fiber 4.5%, calcium 6-8%, phosphorus 4.6%, lysine 6%, methionine 2.5%, methionine+cysteine 3%, sodium 2.3 ME:2000kca/kg.

Added vitamins/kg: vitamin A 200.000 IU, vitamin D3 40.000 IU. Vitamin E 300 mg, vitamin K3 40 mg, vitamin B1 30 mg, vitamin B2 80mg, vitamin B3 180 mg, vitamin B6 40mg, vitamin B12 120mg,niacin 500mg,folic acid 15mg,biotin 400mgcholine chloride 10.000mg.

Added minerals/kg: iron 1.200 mg, zinc 1.000mg, copper 120mg, manganese 1.200mg, iodine 10mg and selenium 4mg.

Table 2: Time table of experiment procedures

Age of layer hens/weeks	Task	Remarks
At the 30 weeks	Feed formulation	
At the 31 weeks	Commencement of the feed trial	
At the 32 weeks	Acclimatization	
At the 33 weeks	The beginning for taking performance parameters	
At the end of 36 weeks	First egg samples for investigate	Total number of samples 40
At the end of 40 weeks	Second egg samples for investigate	Total number of samples 40

Statistical Analysis

The collected data from the four experiments were analyzed using one way analysis of variance (ANOVA) and PROC GLM of SAS. (SAS, 2003). Means were separated by Duncan multiple range test (Steel and Torrie, 1980) at $P<0.05$.

RESULTS AND DISCUSSION

Effect of graded level of phytase enzyme supplementation on the performance of laying hens is shown in Table (3). Enzyme supplementation produced significant ($p<0.05$) reduction in feed intake at the highest level of inclusion (750g) and showed no effects at the other levels. This result disagree with Ciftic et al (2005) who reported improved feed intake of layers fed graded levels of microbial phytase with increasing phytatse level. The present results also disagree with Keshavarz (2003) who reported no significance effect of phytase supplementation on the performance of four strains of laying hens fed different levels of non phytate phosphorus with and without phytase. However, no significant difference ($p>0.05$) in feed intake was noted between birds fed 250 and 500 grams phytase and those fed the control diet. This means that, certain level of phytase is necessary to cause the feed depression observed under this study. However, results showed that there was no significant ($p>0.05$) difference between treatment groups in egg weight, all treatment group values were similar. These result agree with (Scott. *et al*. (1999, Ingrid, et al, 2018) who indicated that phytase supplementation had no significant effect on egg weight. On the other hand this result disagree with Ciftic, et al (2005) who reported improved egg weight in layers fed increasing levels of microbial phytase. Difference in these results could be attributed to the source of phytase. On the other hand, result showed significantly ($p<0.05$) higher percentage in both of feed conversion ratio and egg production. These result agree with Jalal and Scheideler, (2001) who found that supplementation of phytase in normal, corn soybean meal diets improved feed conversion ratio. On the other hand, Augspurger, *et al*, (2007) and Silversides *et al., (2006)* found no change in FCR when different doses from a 6-phytase, produced by *E. coli* in White Leghorn hens.

Table 3: Effect of different levels of Phytase enzyme on Performance of layer hens

Parameters	Treatments				±SE	L.S
	1 (control) 0 g	2 250g	3 500 g	4 750 g		
Feed intake (g)	0.537[a]	0.537[a]	0.549[a]	0.523[b]	0.002	**
Feed conversion ratio	2.552[a]	2.523[a]	2.400[ab]	2.320[b]	0.032	*
Egg weight	52.753	53.224	52.480	52.271	0.291	NS
Egg production	28.600[b]	29.200[ab]	30.800[a]	29.875[ab]	0.310	*

a ,b = mean followed by the different letters are significantly different($p<0.05$).
LS= level of significance,±SE= Standard Error.
NS= NO Significance ($p>0.05$),* = Significance ($p<0.05$).
** = High Significance.

Table 4: Effect of different levels of Phytase enzyme on egg Characteristics of layer hens

Parameters	Treatments				±SE	L.S
	(Control) 0 g	1 250 g	2 500 g	3 750 g		
Egg Weight	50.78	52.30	51.56	52.73	0.49	NS
Shape index	73.94 [ab]	72.71[b]	75.88 [a]	76.10 [a]	0.42	*
Shell weight	6.85	7.01	6.97	6.93	0.07	NS
Percentage of the shell	13.53	13.29	13.40	13.14	0.14	NS
Shell strength	4.83	4.57	4.31	4.43	0.09	NS
Shell thickness	0.35	0.34	0.32	0.34	0.01	NS
Albumin height	5.46	6.69	5.51	5.60	0.22	NS
Albumin diameter	65.40	65.96	65.23	64.92	0.81	NS
Albumin weight	20.81[b]	27.90[a]	28.17[a]	28.18 [a]	0.83	*
Yolk height	10.97 [b]	16.49[a]	15.67[a]	15.48 [a]	0.52	*
Yolk diameter	38.71 [b]	42.17 [a]	41.04[ab]	40.15 [ab]	0.40	*
Yolk weight	15.00	16.36	15.33	15.84	0.34	NS
Haugh unit	73.50 [b]	85.04 [a]	74.76[ab]	74.39 [ab]	1.63	*

Means within the same raw in each category carry different superscripts are significantly different ($P<0.05$).

It has been well documented that the phytase supplementation improved egg production and reduced percentages of broken and soft eggs and P excretion, Lim *et al.* (2003). A positive effect on egg production was seen when phytase was included in the diet where Layers fed 1 200 FTU/kg phytase had higher egg production

percentage than those fed no phytase. Mellef *et al.*(2011) reported that inclusion of 1 200 FTU/kg of a 6-phytase from *A. oryzae* produced a greater number of eggs laid in comparison to 800 FTU/kg, and likewise 800 FTU/kg was better than 400 FTU/kg in Hy-Line W36 hens. Ingrid *et al.*, (2018) and Hassanien and Sanaa (2011) reported that high inclusion levels of phytase improved eggshell formation, leading to a stronger structure, probably due to more mineral availability, decreasing the incidence of broken eggs. Contrary to the current study, Meyer and Parsons (2011) and Augspurger *et al.*, (2007) did not find changes in productive responses when using different levels of phytase from *E. coli* in W-36 Hy-Line layers and single comb white leghorn respectively. They attributed this to variation of the effects of phytase dose on shell parameters, which in turn can influence the production of marketable eggs.
In the present study (Table 4) increasing levels of Phytase produced significant effects (P<0.05) in shape index**,** albumin weight, yolk diameter and Haugh unit and showed no observed effects in other parameters of egg characteristics**.** The obtained results agree with that specified by Jalal and Scheideler (2001) who reported no significant effects of phytase supplementation in normal, corn-soybean meal feed on dry and wet shell percentage. Other researchers, In contrast, Hassanien and ELnagar (2011) indicated that dietary supplementation with phytase enzyme increased Haugh unit significantly compared to control group.

CONCLUSIONS

Based on the results of the present study, it can be concluded that the inclusion of the phytase enzyme up to 750 g ⁄ ton, which represent (0.075%), in diets of layer hens can decrease feed intake and improves egg production and feed conversion ratio and thus improve hen's productivity. In addition phytase supplementation has no negative effects on egg shell quality and thickness.

ACKNOWLEDGMENTS

The authors would like to extend their sincere appreciation to the staff of the Training and Research Farm, College of Animal Production, University of Bahri for their great help in performing this feed trial.

REFERENCES

Abdelgadir, M. O. (2009). Use of dietary plant oils in broiler rations Ph.D. Thesis. Faculty of Agricultural Studies. Sudan University of Science and Technology.

Augspurger NR, Webel DM, Baker DH (2007). An *Escherichia coli* phytase expressed in yeast effectively replaces inorganic phosphorus for finishing pigs and laying hens. Asian Journal of Animal Science. 85(5):1192-8.

Boling, S.D., M.W. Douglas, M.L. Johnson, X. Wang, C.M. Parsons, K.W. Koelkebeck and R.A. Zimmermant. (2000). The effect of dietary levels of available phosphorus and phytase on performance of young and older laying hens. *Poultry. Science. 79: 224-230.*

Ciftic, M. Bestami, D. and Azman, A. A. (2005). Effects of Microbial phytase supplementation on feed consumption and egg production of laying hens. *International journal of Poultry Science. 4(10):758-760*

Daffa alla AA, Mukhtar, A. M. and Mohamed K.A. (2015). Effect of feeding full fat safflower seed with and without enzyme on the performance and carcass characteristics of broiler chicks. *International Journal of Phytopharmacology 6, 1:36-41.*

Francesch, M., J. Broz and J. Brufau. (2005). Effects of an experimental phytase on performance, egg quality, tibia ash content and phosphorus bioavailability in laying hens fed on maize- or barley-based diets. *Br. Poultry. Science. 46: 340-348.*

Hassanien, H. and Sanaa.H.M.ELnagar, (2011).Comparison difference levels of phytase enzyme supplementation on laying hen performance, egg quality and some blood parameters. *Asian Journal of Poultry Science 5(2):77-85.*

Jalal, M.A. and S.E. Scheideler. (2001). Effect of supplementation of two different sources of phytase on egg production parameters in laying hens and nutrient digestibility. *Poultry. Science. 80: 1463-1471.*

Jong Hyuk Kim, Franco Martinez Pitargue, Hyunjung Jung, Gi Ppeum Han Hyeon Seok Choi, and Dong Yong Kil. (2017). Effect of superdosing phytase on productive performance and egg quality in laying hens. *Asian-Australasian Journal of Animal Sciences. Vol. 30, No. 7:994-998.*

Ingrid Y. Martinez Rojas, C. López Coello E. Ávila González J. Arce Menocal (2018). Effect of phytase dose on productive performance and bone status of layers fed with graded levels of digestible lysine. *Veterinaria México OA vol.5 no.3 México Jul. / Sep.*

Keshavarz, K. (2003). The effect of different levels of non phytate phosphorus with and without phytase on the performance of four strains of laying hens. *Poultry. Science. 82: 71-91.*

Lan, G.Q., N. Abdallah, S. Jalaludin and Y.W. Ho. (2002). Efficacy of supplementation of phytase producing bacterial culture on the performance and nutrient use of broiler chickens fed corn soybean meal diets. *Poultry. Science. 81: 1522-1532.*

Lim, H.S., H. Namkung and I.K. Paik. (2003). Effects of phytase supplementation on the performance, egg quality and phosphorous excretion of laying hens fed different levels of dietary calcium and non phytate phosphorous. *Poultry. Science. 82: 92-99.*

Mellef J, Dridi A, Agrebi A, Belhaj O (2011). Effets de l'ajout de phytase dans la ration alimentaire sur les performances de ponte des poules pondeuses. R Med Vet.; 162(6):304

Meyer E and Parsons C. (2011). The efficacy of a phytase enzyme fed to Hy-Line W-36 laying hens from 32 to 62 weeks of age. The Journal of Applied Poultry Research. 2011;20(2):136-42.

Narahari, D. and I.A. Jayaprasad. (2001). Effect of replacement of non-phytate phosphorus and phytase supplementation on layers performance. *Indian Journal Animal. Science. 71: 491-492.*

NRC. (1994). Nutrient Requirements of Poultry. 9th Edn. National Academy Press, Washington, DC. USA. ISBN-13: 9780309048927, Pages: 155.

Plumstead, P.W. (2007). Strategies to reduce fecal phosphorus excretion in the broiler industry without affecting performance. Ph.D. Thesis, North Carolina State University.

SAS, (2003). User's Guide: Statistics. 9.1 ed. Cary, NC. SAS Institute Inc.

Scott, T.A., R.Kampen and F.G.Silversides. (1999). The effect of phosphorus, phytase enzyme and calcium on the performance of layers fed corn.based diets.*poultryScience. 78:1742.1749.*

Silversides FG, Scott TA, Korver DR, Afsharmanesh M, Hruby M (2006).

A Study on the interaction of xylanase and phytase enzymes in wheat-based diets fed to commercial white and brown egg laying hens 1. Poultry Science.;85 (2):297-305.

Steel ,R.G., Torrie, J.H.,. (1980). Principles and Procedures of Statistics: Abiometric Approach. McGraw-Hill Book, New York.

Viveros, A., C. Centeno, A. Brenes, R. Canales and A. Lozano (2000). Phytase and acid phosphatase activities in plant feedstuffs. *Journal of Agricltural Food Chemistry, 48: 4009-4013.*