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EFFECTS OF PHYTASE SUPPLEMENTATION ON PERFORMANCE AND EGG QUALITY OF LAYING HENS FED DIETS CONTAINING RICE BRAN.

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Abstract: *A total number of three hundred and fifteen 22-weeks old, commercial Hy-line White-36 hens were randomly assigned into five groups, each group contains nine replicate (seven birds per each) to study the effect of phytase supplementation to diets containing rice bran on performance and egg quality of laying hens . The first group was fed basal diet without phytase supplementation (control) and the 2 , 3 , 4 and 5 groups , were fed on basal diet supplemented with phytase at levels 0.1 ,0.15, 0.20 and 0.25 % respectively . The present results indicated that phytase supplementation significantly ($p<0.05$) or ($p<0.01$) increased hen-day production, accumulative eggs number, egg mass and also improved significantly ($p<0.05$) feed conversion ratio . While, egg weight was significantly decreased . However, feed consumption and egg quality measurements expressed as shell thickness, yolk percentage, albumen percentage did not affected by phytase enzyme supplementation . On the other hand , the overall mean of shell percentage was significantly ($p<0.05$) increased, In conclusion , It is concluded that the best level of phytase supplementation was (2 kg phytse / ton feed) in diets contains rice bran for laying hens performance and egg shell percentage.*

INTRODUCTION

Around 50-80% of the total phosphorus in poultry diets is present in the form of phytate (also known as phytic acid). The phytate-bound phosphorus is largely unavailable to monogastric animals as they do not naturally have the enzyme needed to break it down, being phytase. The ability of poultry to utilize phytate phosphorus is poor **(Ravindran *et al.*, (1995) and Kornegay, (1996a))** due to either insufficient quantity or a lack of intestinal phytase secretion. This inadequacy of poultry to utilize phytate phosphorus results in the excretion of large amounts of phosphorus in the

manure, posing an environmental concern especially in areas of intensive animal production.

There are two good reasons for supplementing poultry feeds with phytase. The first reason is to reduce the harmful environmental impact of phosphorus from animal manure in areas with intensive livestock production. Several studies have found that optimizing phosphorus intake and digestion with phytase reduces the release of phosphorus in manure by around 30%. **Wu *et al.* (2005)** reported that Phyzyme or Natuphos supplementation into diets containing 0.11% nonphytate phosphorus significantly reduced excreta phosphorus (approximately 58 and 54%, respectively) with no adverse effect on egg production and egg mass. The second reason is based on the fact that phytate is capable of forming complexes with proteins and inorganic cations such as calcium, magnesium, iron and zinc. The use of phytase not only releases the bound phosphorus but also these other essential nutrients which led to higher nutritional value of the diet (***Boling et al.,2000a ; Keshavarz, 2003; Ceylan et al., 2003; and Panda et al. , 2005***).

Effect of phytase supplementation on productive performance of laying hens have been investigated by several authors . **Francesch *et al.* 2005** reported that Low dietary nonphytate phosphorus (below 1.3 g/Kg) reduced egg production, weight gain and feed consumption but, microbial phytase supplementation (150, 300, 450 U/Kg) to maize or barley based diet improved these parameters . While , **Liebert, *et al.* (2005)** found that no significant differences were observed in feed intake, egg production and egg weight when microbial phytase (300 U/kg) was supplemented to corn-soybean meal and wheat-soybean meal basal diets of Lohmann Brown . In addition , **Plumstead (2007)** illustrated that adding phytase to low dietary non-phytate phosphorus increased eggs per hen housed , hen day egg production (%) , fertility (%) and feed per dozen eggs of broiler breeders .

Also, several authors studied the effect of phytase on egg quality .**Çabuk *et al* (2004)** reported that, there were no significant differences between the treatments in eggshell weight, eggshell thickness, eggshell strength when phytase was added into the control diet . Similar results were obtained by **Panda *et al.* (2005)** who found that no additional advantage resulted from phytase supplementation (500 U/Kg) to a diet containing 1.8 g/Kg non-phytate phosphours on shell weight, shell thickness, shell strength and tibia strength but significantly enhanced egg specific gravity and Haugh units. Also, **Casartelli *et al.* (2005)** found that at the beginning and peak of

laying period, feeding phytase-supplemented diets with low levels of available phosphorus led to insignificant effects on egg shell quality.

Generally, corn soybean meal and rice bran represented the major components in the poultry diet. The major problem with utilizing corn, soybean meal and rice bran in poultry diet is their high phytic content. ***Ravirdarn et al.*** **(1995)** reported that phytate phosphours as % of total phosphorus were 72, 60 and 77% for corn, soybean and rice bran, respectively. At the same time, such ingredients contained little or no phytase ***(Eeckhout and De paepe*** **(1991).** Therefore, the present study aimed to investigate the effect of phytase supplementation to a laying hen diet contained about 90% of total ingredients as corn, soybean meal and rice bran on performance and egg quality of laying hens.

MATERIALS AND METHODS

Three hundred and fifteen 22-weeks old, commercial Hy-line W-36 hens were randomly assigned into five groups; each group contains nine replicates (seven hens each). The first group was fed diet without phytase supplementation (control).While; groups 2, 3, 4, and 5 were fed basal diet with phytase supplementation at levels 1, 1.5, 2 and 2.5 kg phytase / ton diet, respectively. The tested microbial phytase is produced from *Aspergillus neiger* in a powder form by Gist-Brocades, the Netherlands and BASF, Germany. Composition and calculated analysis of experimental basal diet is presented in Table (1). The experiment was durated from 22 to 60 weeks of age.

Measurements and statistical analysis :

Egg production was recorded daily per hen in each cage during the experimental period and calculated as hen day egg production (HDP) for each group periodically every month, and during the whole experimental period. Also, accumulative egg numbers, egg weight, egg mass were calculated monthly and during the whole period . At the same time , feed consumption and feed conversion ratio for each replicate of the experimental groups were calculated per month and during the whole experimental period .

Egg quality measurements were determined monthly after three months from starting of the experiment using 9 eggs per group till the end of the experiment . Egg quality measurements include the percentage of albumin , yolk and shell weight , in addition to the shell thickness .

The data obtained were analyzed using General Linear Models Procedure of SAS software (***SAS* institute, version 6.12, 1996). Duncan (1955)** was used to detect the differences between groups by Duncan' s multiple range test .

Results and Discussion

1. Effect of phytase supplementation on performance of laying hens :

Results presented in Table(2) showed that Phytase supplementation at levels (1 ,1.5 ,2 and 2.5 kg /ton feed) increased ($p<0.01$) hen-day production by 3.25 %, 5.59 %, 7.48 % and 5.42% , respectively, compared to the control group.

These results are in agreement with **Plumstead (2007)** who found that adding phytase increased hen-day production .The addition of phytase at levels (1 kg, 1.5 kg, 2 kg and 2.5 kg / ton feed) increased ($p<0.01$) the average egg number during the whole period of egg period number by 4.49, 7.91, 10.70 and 7.75 % , respectively in comparison with control group (Table 2) . These results are in agreement with **Boling *et al.* (2000b)** who reported that phytase supplementation improves phosphorus utilization for laying hen which supported optimal egg yield.

Results in Table (2) showed that phytase supplementation significantly ($p<0.01$) decreased egg weight. **Scott *et al.* (1999)** indicated that phytase supplementation had no significant effect on egg weight . While , **Peter (1992)** reported that laying hens fed a diet with phytase had significantly higher egg weight than hens fed the same diet without supplemental phytase (control). Increasing egg production as a result of phytase supplementation may be due to that phytate presented in the most ingredients of poultry diet is capable of forming complexes with essential nutrients such as proteins and some inorganic cations . The use of phytase may release these essential nutrients so improving nutritional value of poultry diet , which resulted positively on productive performance of laying hens **(Panda *et al* . , 2005).**

Phytase supplementation at levels (1kg, 1.5 kg, 2 kg and 2.5 kg phytase /ton diet) improved significantly average egg mass during the whole laying egg period by 0.25, 4.14, 5.63 and 4.16% , respectively (Table 2). These results are in agreement with **Jalal and Scheideler (2001)** who found that, supplementation of phytase in corn-soybean meal diets improved egg mass . Data presented in Table (2) indicated that the increase of egg number per hen or hen - day egg production led to an increase of egg mass significantly ($p<0.05$) .

As presented in Table (2), the addition of phytase had insignificant effect on whole period feed consumption. The present results are in agreement with **Keshavarz (2003)** who reported that no significant effect of phytase supplementation (300 U phytase /Kg) was observed on feed consumption.

Data in Table (2) illustrated that the addition of phytase had significant ($p<0.01$) positive effect on the average feed conversion ratios. The values were 2.85, 2.83, 2.70, 2.63 and 2.71 for control, 1 kg phytase, 1.5 kg phytase, 2 kg phytase and 2.5 kg phytase per ton feedd , respectively, phytase supplementation per ton diet respectively,. The results revealed that phytase improved feed conversion ratios by 0.35 %, 5.24%, 7.34 % and 4.55 % at the same order, respectively, compared to the control group. Improving feed conversion ratio (feed consumption / egg mass) as result of phytase supplementation in the diet is due significantly to the significant increase of egg production and at the same time the insignificant differences in feed consumption among treatments (Table 2). The present results are in agreement with **Jalal and Scheideler (2001)** who found that supplementation of phytase in corn-soybean meal diets improved feed conversion.

2-Effect of phytase supplementation on egg quality:

Results presented in Table (3) showed insignificant differences among treatments in egg quality measurements (shell thickness, yolk % and albumen %) due to phytase supplementation to layer's feed. The present results are in agreement with **Çabuk *et al.* (2004)** , **Jalal and Scheideler (2001)** , **Um and Paik (1999)** and **Panda *et al.* (2005)** While, **Narahari and Jayaprasad (2001)** found a beneficial effect of phytase supplementation on shell quality .

Phytase supplementation had significant ($p<0.05$) effect on average egg shell percentage during the period of laying egg. The values were 11.78, 12.09, 12.58, 12.49 and 12.51 % in eggs for birds fed control diet and the diets supplemented with 1 kg phytase, 1.5 kg phytase, 2 kg phytase and 2.5 kg phytase , respectively, Increasing shell percentage as a result of phytase supplementation is firstly due to improving shell thickness and second to beneficial effect of phytase supplementation on the utilization of phosphorus by poultry **(Liebert *et al* . , 2005 and Plumstead, 2007)**.

These result are in agreement with **Casartelli *et al.* (2005)** who studied the effect of phytase supplementation (0, 1000 FTU/ Kg) on egg quality parameters from 32-48 weeks of age and from 48-64 weeks of age , They found an improve in shell percentage during 32–48 weeks of age but, during the post peak period (48-64 weeks) , there were no significant effects of phytase addition. These results are in disagreement with **Jalal and Scheideler (2001)** who indicated that, there were no significant effects of phytase supplementation in corn-soybean meal diets on dry and wet shell percentage .

CONCLUSION

From the present results , it can be concluded that phytase supplementation to laying hen diet contained more than 90% of total ingredients as yellow corn , soybean meal and rice bran, during egg production period had beneficially affect egg production, performance and egg quality.

Table 1: Composition and calculated analysis of the experimental basal diet

Ingredients	%
Yellow corn	57.0
Soybean meal (44 % CP)	23.0
Rice bran	10.30
Premix*	0.30
Dicalcium phosphate	1.76
Limestone	7.20
Common salt	0.40
DL-methionine	0.04
Total	100
Calculated analysis**	
ME, kcal/ Kg	2756
Crude protein %	16.53
Crude fiber %	4.03
Calcium	3.20
Available phosphours	0.67

*Each kilogram contains: Vit. A, 100 IU; Vit. D3 2000 ICU; Vit. E, 10 mg; Vit. K, 1 mg;Vit . B1, 10 mg; Vit. B2, 5 mg; Vit. B6, 1500 mg; Vit. B12, 10 mg; Pantothenic acid, 10 mg; Nicotinic acid, 30 mg; Folic acid, 1 mg ; Biotin , 50 mg; Choline Chloride, 500 mg; Copper, 10 mg;
Iron, 50 mg; Manganese, 60 mg; Zinc, 50 mg and Selenium.
** According to the NRC (1994).

Table 2: Least squares means ± S.E. of laying hen performance as affected by phytase supplementation

Phytase level	HDP %	EN egg /hen	EW g	EM g	FC g /hen	FCR
Control	69.59^{c} ±3.64	239.22^{c} ±4.19	60.34^{a} ±0.93	14434.53^{c} ±222.82	41265.05 ±290.58	2.85^{a} ±0.04
0.10% Phytase	72.84^{bc} ±3.41	249.97^{bc} ±4.15	57.89^{b} ±0.95	14470.76^{bc} ±208.94	41023.77 ±229.41	2.83^{a} ±0.04
0.15% Phytase	75.18^{ab} ±3.26	258.15^{ab} ±3.74	58.22^{b} ±0.52	15029.94^{ab} ±194.35	40616.09 ±212.17	2.70^{b} ±0.04
0.20% Phytase	77.07^{a} ±4.76	264.81^{a} ±5.41	57.58^{b} ±0.72	15247.75^{a} ±282.02	40198.63 ±156.33	2.63^{b} ±0.06
0.25% Phytase	75.01^{ab} ±2.23	257.75^{ab} ±2.56	58.32^{b} ±0.99	15031.98^{ab} ±129.39	40818.49 ±251.39	2.71^{b} ±0.03
Probability	**	**	**	*	NS	**

Means within each column bearing different letters(s) are significantly different ($p \leq 0.05$).
HDP = Hen day egg production EW =Egg weight
EM= Egg mass FC = Feed consumption
FCR = feed conversion ratio EN = Egg number

Table 3: Least squares means ± S.E. of some egg quality parameters as affected by phytase enzyme supplementation

Phytase level	Shell thickness	Shell %	Yolk %	Albumen %
Control	347.46±3.90	11.87 ± 0.19^{c}	26.33±0.20	61.66±0.26
0.10% Phytase	353.47±5.83	12.09 ± 0.09^{bc}	26.88±0.38	61.01±0.47
0.15% Phytase	355.69±2.79	12.58 ± 0.16^{a}	26.16±0.23	61.30±0.28
0.20% Phytase	354.26±6.88	12.49 ± 0.15^{ab}	26.86±0.20	60.63±0.25
0.25% Phytase	355.08±4.60	12.41 ± 0.14^{ab}	26.50±0.27	61.04±0.26
Probability	NS	*	NS	NS

Means within each column bearing different letters(s) are significantly different ($p \leq 0.05$).

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الملخص العربي

تاثير اضافة انزيم الفيتيز على الأداء الانتاجى و جودة البيض للدجاج البياض المغذي على علائق تحتوى على رجيع الكون.

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***قسم النتاج الحيوانى و الدواجن – كلية الزراعة – جامعة المنيا - المنيا**

****قسم النتاج الحيوانى و الدواجن – كلية الزراعة – جامعة جنوب الوادى - قنا**

أجريت هذه الدراسة فى مزرعة الدواجن التابعة لقسم الإنتاج الحيواني بكلية الزراعة – جامعة جنوب الوادى – قنا.إستهدفت الدراسة تاثير اضافة انزيم الفيتيز بمستويات (١كجم ، ١.٥كجم ، ٢كجم ،٢.٥كجم/ طن علف) فى عليقة تحتوى على رجيع الكون و ذلك على كل من الأداء الإنتاجى و جودة البيض لسلالة الهاى لاين الابيض. استخدم عدد ٣١٥ دجاجة هاى لاين الابيض عمر ٢٢ اسبوع قسمت الى ٥ مجموعات وكل مجموعة تتكون من ٩ مكررات وكل مكررة بها ٧ دجاجات. صممت التجربة كالاتى المجموعة الأولى: و فيها الدجاجات تأكل علف الكنترول بدون أى إضافات أما علائق المجموعة الثانية و الثالثة و الرابعة و الخامسة فيها الدجاجات تأكل العليقة الكنترول مع إضافة انزيم الفيتيز بمعدل (١و ١.٥ و٢ و ٢.٥ كيلوجرام فيتيز/ طن) على التوالى.

ادت اضافة الفيتيز الى علائق الدجاج البياض الى زيادة معنوية فى معدل انتاج البيض اليومى للدجاج ومجموع الانتاج الكلى والوزن الكتلى للبيض وتحسين معدل التحويل الغذائى ولكن مع إنخفاض وزن البيض . من ناحية أخرى لم يكن لإضافة الفيتيز الى العلائق اى تأثير معنوى على إستهلاك الغذاء وكذلك صفات جودة البيض ما عدا النسبة المئويه للقشرة .

يستنتج من هذه الدراسة ان اضافة انزيم الفيتيز لعلائق الدجاج البياض المحتوية على رجيع الكون بموستوى ٢ كجم انزيم / طن علف ادى الى افضل نتائج لكل من الاداء الانتاجى والنسبة المئوية لقشرة البيض