

## COMPARISON OF TWO PHYTASE SOURCES IN CORN-SOYBEAN MEAL-BASED DIETS FOR COMMERCIAL LAYING HENS

By

**Haitham M. Yakout**

Poultry production department. Faculty of agriculture 21545. Alexandria university. Alexandria- Egypt

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**Abstract:** *An experiment was conducted to compare the effects of feeding two phytase sources on performance of commercial Leghorns fed corn-soy diets. Seven dietary treatments were fed to 280 Hy-Line W-36 hens. A basal corn-soy based diet served as a positive control diet [0.31 NPP; Trt.1]. Two phytase sources (Natuphos and Phyzyme) were supplemented to the basal diet at 0, 300 or 450 FTU/kg feed (Trt. 2, 3, 4, 5, 6, and 7; respectively). All diets were fed from 38 to 48 weeks of age. Birds were housed in cages, and each cage was considered as an experimental replicate (4 hens/ cage) in a randomized complete block design, and each treatment was replicated 10 times.*

*Overall, Natuphos fed hens (diet 4 to 7) consumed more feed (**FI**) averaging 83.49 g./ h./ d. Similarly, egg production (**EP**) ranged from 90.32 for the positive control and 89.10% for Natuphos (300 FTU/ kg feed) to 77.92% for hens fed diet 2 (negative control; 0.12 NNP). Egg mass (**EM**) was higher for hens fed dietary treatments of Natuphos and the control as compared to the Phyzyme fed group. No significant differences were proved among dietary treatments with the control group having numerically better feed conversion ratio (**FCR**) of 1.67 g feed/ g egg. Excreta **P** were not affected by phytase source or dietary levels. All dietary treatments had no significant effects on egg components. The highest albumen was obtained with diet 6 (59.77%), and the highest yolk was (26.70%), while the highest shell (13.30%) with the control group, respectively. Egg specific gravity (**SG**) was also not affected by dietary treatments. Bone mineral content (**BMC**), and bone mineral density (**BMD**) were not significantly affected by any of the dietary treatments. Bone minerals content ranged from 35.51 to 42.30 g., diet 4 vs. diet 5, respectively.*

*Based on the information generated from this trial, supplementing corn-soy bean based diets with Phyzyme XP (300 FTU/kg) was comparable*

*to both Natophus (450 FTU/kg feed), and the positive control in some of production parameters especially EP, FCR and EW.*

## INTRODUCTION

The primary constituents of poultry diets are plant-based ingredients and most of the stored phosphorus (P) in plant is in seeds as a component of a molecule known as phytin (Nasroallah Vali (2010)). Phosphorus is an essential mineral for laying hens in the formation of egg shell and metabolism (Frost and Roland, 1991; Summers, 1995; Usayran and Balnave, 1995, Sohail and Roland, 2002), is stored in plant seeds mainly as a molecule known as Phytate (myo-inositol hexaphosphate; Ravindran et al. 1998). These salts of phytic acid render the P relatively unavailable to mono-gastric animals. Phytase enzyme is the only recognized enzyme responsible for releasing the P from the phytate making it available to poultry (Nasroallah Vali, 2010). Poultry can not produce enough amounts of endogenous phytase to hydrolyze and release P from phytate (Ravindran et al. 1998; Sebastian et al., 1998). Even with adequate total P in the feedstuffs, and to meet dietary P requirement of laying hens, inorganic P such as di-calcium phosphate and mono-calcium phosphate or exogenous phytase enzymes are commonly added to commercial corn-soy layer diets (Wu et al. 2006). However, inorganic P supplementation is not only expensive but also leads to environmental problems by over-supplementation. Excess P from the excreta of hens can easily add to the P loading of ground water, rivers, lakes, and oceans and can contribute to eutrophication of aquatic systems and stimulate algae growth, resulting in the mortality of aquatic animals (Ryden et al., 1973).

Many researchers have demonstrated that phytase supplementation [from 100 to 2,000 phytase units (FTU)/kg of feed] to diets containing 0.1% dietary non-phytate P (NPP) has positive effects on egg production, mass, weight, specific gravity, bone ash, and eggshell quality by improving P use (Boling et al., 2000a,b; Jalal and Scheideler, 2001; Roland et al., 2003; Keshavarz, 2003). Furthermore, phytase supplementation reduced P excretion in manure and potential environmental problems (Jalal and Scheideler, 2001).

Currently, there are several commercial phytase products in the market originated from *Aspergillus niger* including Natuphos<sup>1</sup> and Ronozyme<sup>2</sup> with Natuphos phytase extensively used in the poultry industry. Recently, a new

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<sup>1</sup> BASF Corp., Mt. Olive, NJ

<sup>2</sup> Roche Vitamins, Parsippany, NJ

bacterial phytase, Phyzyme<sup>3</sup>, which originates from the bacteria *Escherichia coli* and is produced by *Schizosaccharomyces pombe*, has been introduced into market. Phytases from different sources may have different biochemical and biophysical properties such as pH activity profile and sensitiveness to pepsin, which can affect the in vivo bio-efficacy of phytase.

Little research has been conducted to evaluate the effect of the novel phytase Phyzyme on commercial Leghorns fed corn-soy diets. The objective of this experiment was to compare the effects of two phytase sources (Phyzyme and Natuphos) on performance of commercial Leghorns fed corn-soy diets from 38 to 48 weeks of age.

## MATERIALS AND METHODS

Seven diets were fed to Hy-line W-36 hens in a 10 weeks trial (38 to 48 wks of age). Treatments consisted of a control diet containing 0.31% NPP and a 2×3 factorial arrangement of two phytase sources (Natuphos and Phyzyme) with 3 dietary concentrations (0, 300 and 450 FTU/ kg feed; Table 1).

Hy-line W-36 hens (n: 280) were randomly assigned into dietary treatments (10 replicates of 4 hens/ treatment). Replicates were equally distributed into upper and lower cages to minimize cage level effect. All hens were housed in an environmentally controlled house with temperature maintained at approximately 25.6°C. Light was on for 16 hrs/ d. All hens were supplied with feed and water *ad libitum*. Egg production was recorded daily, EW, FC, non phytate phosphorus intake (NPPI), total non phytate phosphorus intake (TNNPI) and FCR were recorded and calculated weekly, and SG was measured biweekly. Egg weight and SG were measured using all eggs produced during two consecutive days. Egg components (albumin, yolk and shell) percentages were recorded every other week. . Egg SG was determined using 11 gradient saline solutions varying in specific gravity from 1.060 to 1.100 at 0.005-unit increments (Holder and Bradford, 1979; Strong, 1989).

At the end of the experiment, excreta samples were obtained (3 replicates per treatment) by placing a pan under cages for 24 h. Excreta samples were then dried for 48 h at 100°C and were analyzed for P concentration according to AOAC (1984) procedures. All hens per group were weighed and body weights were obtained every four weeks throughout the entire experimental period.

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<sup>3</sup> Danisco Animal Nutrition, Carol Stream, NJ

Live hens (1 hen/ replicate) were subjected to DXA analysis using a Hologic QDR-L4500<sup>4</sup> bone densitometer as described by Hester et al. (2004) at 43 wks of age. Hens were placed individually on a 7mm thick Lucite tablet, live body and skeleton were scanned and analyzed using the Small Animal Total Body software (*version 4.6d*) in the high resolution-medium scan mode. Results for each hen were reported as bone mineral content (**BMC**, g) and bone mineral density (**BMD**, g/ cm<sup>2</sup>). These values represent all types of bone (cortical, cancellous and medullary) for each individual hen.

Statistical analyses of data were performed by using the GLM procedure of SAS (SAS, 2000). A 2×3 factorial arrangement of two phytase sources (Natuphos and Phyzyme) and three dietary concentrations of each source (0, 300 and 450 FTU/ kg feed) was used to analyze the main effects of phytase and dietary levels and their interactions (Diets 2 to 7). If differences in treatment means were detected by ANOVA, orthogonal contrasts were applied to separate means. Three preplanned additional non-orthogonal contrasts were also carried out to compare control diet and several specific diets. Statements of statistical significance are based on a probability of  $P \leq 0.05$ .

## RESULTS AND DISCUSSION

A significant interaction ( $P \leq 0.01$ ) between dietary phytase levels and sources was observed on FC, NPPI and TNPPI (Table 2). Dietary supplementation of Natuphos resulted in a significantly ( $P \leq 0.01$ ) higher FC than that of hens fed diets with phyzyme or control diets as it was 83.48 vs. 77.57 and 83.82 g./ h./ d., respectively. Natuphos phytase addition to diets containing 0.12% NPP recorded a significant ( $P \leq 0.01$ ) impact on FC, as phytase addition might have prevented the decline of FC of hens fed the P-deficient diets (0.12% NPP).. These results are in agreement with those of Gordon and Roland (1997), Jalal and Scheideler (2001), and Roland et al. (2003), who reported that the addition of phytase to diets containing 0.1% NPP significantly increased feed intake. A significant interaction ( $P \leq 0.01$ ) was noted between phytase sources and levels. As feeding diets supplemented with 450 FTU/ kg feed Natuphos resulted in higher FC (83.79 g./ h./ d.) followed by (300 FTU/ kg feed) Natuphos of 83.86 g./ h./ d., while hens fed Phyzyme (450 FTU/ kg feed) had statistically similar; but lower FC of 81.74 g./ h./ d. which was even lower than those fed the positive control of 83.82 g./ .h/ d.

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<sup>4</sup> Hologic, Inc. Bedford, MA

A significant interaction ( $P \leq 0.01$ ) between dietary phytase sources and levels was observed for NPP and TNPP intakes (Table 2). Dietary NPP concentration had a significant effect on NPP intake. When dietary NPP was 0.31% (positive control), NPP intake of hens was 259.84 mg/ hen per day, which matches the dietary NPP requirement of hens recommended by NRC, 1994 (250 mg/ hen per day). Non phytate P intake of hens fed the diets containing 0.12% NPP ranged from 86.25 to 100.55 mg/hen per day, which was much lower than that of NRC (1994). In the industry, a wider range of NPP, from 290 to 470 mg/hen per day is used (Roland, 1994). The NRC recommended value of dietary NPP has declined from 350 mg/ hen per day (NRC, 1984) to 250 mg/ hen per day (NRC, 1994). Sohail and Roland (2002) reported that dietary NPP requirement of young laying hens for maximum performance ranged from 250 to 325 mg/ hen per day, and a higher margin of safety for dietary P might be necessary. Total P intake of hens fed the diets containing 0.12% NPP was significantly lower than that of hens fed the control diet containing 0.31% NPP diets (Table 2). In the same respect, Natuphos phytase fed group (450 FTU/ kg feed) consumed more TNPP 326.78 mg/ hen per day but was statistically similar to Phyzyme fed hens at the same level of 318.79 mg/ hen per day.

The different EP response to phytase supplementation can be attributed to the fact that 0.31% NPP concentration in the positive control diet (259 mg of NPP intake/hen per day) has fulfilled the laying hens requirements, and 0.12% NPP concentration in the diets (negative control; diet 2) or 86 mg of NPP intake/hen per day was not enough for laying hens to produce comparable eggs to other dietary diets. These results are consistent to those of Gordon and Roland (1997), Jalal and Scheideler (2001), and Roland et al. (2003), who reported that supplementing diets containing 0.10% NPP with phytase significantly increased EP to the level of hens fed adequate P diets. Egg production of hens fed the control diet containing 0.31% NPP (90.32%) was similar to that of hens fed the diet containing 0.12% NPP with Natuphos phytase at 300 or 450 FTU/ kg feed (89.10 and 91.10%) and significantly higher than all Phyzyme dietary levels. Furthermore, control diet fed group had higher EP as compared to P-deficient diet (0.12% NPP) negative control diets 2; 77.92% and 5; 82.10%, respectively.

A significant interaction ( $P \leq 0.01$ ) was proved between dietary phytase sources and level on EM (Table 2). As dietary Natuphos level increased from 300 up to 450 FTU/ kg feed in layers diets, EM significantly increased from 50.16 and 50.36 g egg/ hen per day to 45.82 and 46.54 g egg/ hen per day for hens fed 300 and 450 FTU/ kg feed Phyzyme, respectively. Phytase supplementation significantly increased ( $P \leq 0.01$ ) EM

in diets containing 0.12% NPP resulting in a higher EM for hens fed Natuphos supplemented diets than that of hens fed diets with Phyzyme. There were non-significant differences between the positive control diet containing 0.31% NPP and diets supplemented with 300, 450 FTU/ kg feed Natuphos. Similarly, Francesch et al. (2005) and Jalal and Scheideler (2001) reported that phytase supplementation significantly increased EM of hens fed the 0.10% NPP diet. Egg mass of hens fed the control diet was significantly higher than that of hens fed the P-deficient diet without phytase (0.12% NPP), but was similar to that of hens fed the diet containing 0.12% NPP with phytase, especially Natuphos hens.

Feed conversion ratio was not affected by dietary phytase sources or levels (Table 3). There was no significant difference in FCR between Natuphos and Phyzyme. Numerically better FCR was noted for hens fed diets supplemented with higher dietary Phyzyme (450 FTU/ kg feed) or Natuphos (300 and 450 FTU/ kg feed). It is obvious that phytase supplementation improved FCR values for all diets with 0.12% NPP as feeding negative control diets resulted in the worst FCR values of the whole experiment. It is worth noting that FC for hens fed diets supplemented with Phyzyme or Natuphos was significantly similar to that of hens fed the control diet, and similar trend was also noted for EM and EP values. Also, FCR for hens fed diets supplemented with Phyzyme was not significantly impaired in comparison to that of hens fed the positive control diet. Similarly, Roland et al. (2003) reported that even though less feed was consumed, there was no difference in EP between P-adequate diets and the P-deficient diets supplemented with phytase. Therefore, phytase supplementation might have improved not only P availability but also the availabilities of some other nutrients, such as energy and amino acids. This conclusion was supported by Namkung and Lesson (1999), who reported that phytase supplementation improved AME and digestibilities for some amino acids such as valine and isoleucine in broilers.

Dietary phytase source and levels had no significant effect on egg SG (Table 3). Egg specific gravity of hens fed diets supplemented with Natuphos was similar to that of hens fed Phyzyme supplemented diets. Also, supplementing diets with Phyzyme phytase resulted in heavier ( $P \leq 0.01$ ) body weights when compared to Natuphos fed group (1.41 vs. 1.52 kg/ hen), respectively. These findings could be related to excreta P contents, as hens fed Natuphos phytase non-significantly lost more P in the excreta than those fed the Phyzyme phytase. Hens fed Phyzyme phytase might have got better utilization of P in their body bones resulting in higher body weights in comparison to Natuphos fed group. These body weight data are supported by those of

Francesch, et al., (2005) who reported that phytase addition increased weight gain, on both maize and barley diets over the P deficient diets.

Feeding low NPP diets supplemented with different phytase sources and levels resulted in a considerable reduction of the P content in excreta, without compromising performance. No significant effects of supplementing different levels of two phytase sources were revealed on excreta P contents (Table 3). However, significant differences ( $P \leq 0.01$ ) were proved between feeding the positive control diet and all other diets. When NPP concentration decreased from 0.31 to 0.12%, a 19.39 or 16.36% reduction in excreta P was obtained by supplementing diets containing 0.12% NPP with Phyzyme or Natuphos, respectively. These results are in agreement with the excreta P content reduction of 40 or 41% reported by Simons et al. (1990) for broiler chickens and by Um and Paik (1999) for laying hens, respectively. Also, a bit lower than that reported by Boling et al. (2000a), who reported that phytase supplementation reduced excreta P concentration approximately 50%. Phytase supplementation can greatly reduce potential P environmental pollution problems caused by organic P in feed. Scott et al., (2000) reported that exogenous enzymes supplementation may be expected to result in symptoms of excess P. However, these symptoms were not seen, possibly because of differences between plant and microbial phytase (Liu et al. 1998). These diets were fed as pelleted diets, and endogenous enzyme activity of used feed ingredients is effectively destroyed by pelleting.

Results from the densitometric scans showed that BMD and BMC values of bones of live hens decreased linearly when hens consumed diets with increasing dietary phytase levels (Table 4). Phytase source approached significant ( $P \leq 0.08$ ) with hens fed the Natuphos having higher BMC vs. those fed Phyzyme of 40.33 vs. 37.98 g, respectively. These findings are supported by the results reported by (Hester et al. 2004) who stated that densitometry effectively detected changes in bone integrity of live birds fed different dietary calcium levels. Similar results were also reported by Kim et al., (2004) as there were no differences in bone parameters or egg shell quality parameters due to feeding different molting dietary treatments.

Egg quality results are presented in Table (5) with no clear effects of either phytase source or supplementation level. Some authors found a reduction in eggshell quality with NPP-deficient diets and this reduction was overcome when diets were supplemented with phytase (Gordon and Roland, 1997). On the other hand, in agreements with our results, other

investigators (van der Klis et al., 1997; Lim et al., 2003; Kim et al., 2005) did not find any consistent effect of phytase on eggshell quality.

Phyzyme or Natuphos supplementation in the diets containing 0.12% NPP did not significantly reduce excreta P of tested diets in comparison to the control, meanwhile maintained EP and EM. Significant improvements in FC, NPPI intake, TNPPI, EP, EW, EM, and BW among diets supplemented with Natuphos and diets supplemented with Phyzyme or the control diets. Higher dietary Natuphos levels had positive effects on performance of commercial Leghorns fed corn-soy diets over Phyzyme supplemented diets. The improvement was dose-related and P absorption responded linearly to increasing level of supplemental phytase.

**Table (1):** Composition and calculated analysis of positive and negative basal diets

<b>Ingredients</b>	<b>Positive Control</b>	<b>Negative Control</b>
Corn yellow (8.7% CP)	59.79	61.60
SBM, (48% CP)	23.62	23.29
Rice bran	4.00	4.00
Soybean Oil	2.03	1.46
Salt	0.40	0.40
DL-Methionine	0.16	0.16
Limestone	8.31	8.68
Dical Phosphate	1.09	0.00
Vit./ Min. Premix <sup>1</sup>	0.35	0.35
Sand	0.25	0.06
<b>Total</b>	<b>100.00</b>	<b>100.00</b>
<b>Nutrients Analysis (calculated), %</b>		
CP	16.50	16.50
ME MJ/kg	2800	2800
Ca	3.50	3.38
Total P	0.58	0.39
Non-phytate P	0.31	0.12
Phytate P	0.27	0.27
Methionine	0.42	0.42
TSAA	0.70	0.70
Lysine	0.80	0.80
Threonine	0.62	0.62
Tryptphan	0.18	0.18

<sup>1</sup>Provided (/kg of diet): vitamin A (retinyl acetate), 8,000 IU; cholecalciferol, 2,200 ICU; vitamin E (DL- $\alpha$ -tocopheryl acetate), 8 IU; vitamin B12, 0.02 mg; riboflavin, 5.5 mg; D-pantothenic acid, 13 mg; niacin, 36 mg; choline, 500 mg; folic acid, 0.5 mg; vitamin B1 (thiamin mononitrate), 1 mg; pyridoxine, 2.2 mg; D-biotin, 0.05 mg; and vitamin K (menadione sodium bisulfate complex), 2 mg. manganese, 65 mg; iodine, 1 mg; iron, 55 mg; copper, 6 mg; zinc, 55 mg; and selenium, 0.3 mg.

**Table 2.** Effects of phytase source and level on performance of Hy-line W-36 hens from 38 to 48 wks of age

	Phytase	Dietary level	FC <sup>1</sup> (g./ h./ d.)	NPPI <sup>2</sup> (mg/ h./ d.)	TNPPI <sup>3</sup> (mg/ h./ d.)	EP <sup>4</sup> (%)	EW <sup>5</sup> (g.)	EM <sup>6</sup> (g. /h. /d.)
Control			83.82 <sup>a</sup>	100.59 <sup>a</sup>	486.18 <sup>a</sup>	90.32 <sup>a</sup>	55.34 <sup>ab</sup>	49.98 <sup>a</sup>
Diet 2	Phyzyme	0	71.87 <sup>c</sup>	86.25 <sup>c</sup>	416.89 <sup>c</sup>	77.92 <sup>c</sup>	52.63 <sup>c</sup>	41.08 <sup>c</sup>
Diet 3		300	79.10 <sup>b</sup>	94.92 <sup>b</sup>	458.80 <sup>b</sup>	80.89 <sup>bc</sup>	53.95 <sup>d</sup>	45.82 <sup>a</sup>
Diet 4		450	81.74 <sup>ab</sup>	98.09 <sup>ab</sup>	474.13 <sup>ab</sup>	86.10 <sup>bc</sup>	54.06 <sup>cd</sup>	46.54 <sup>a</sup>
Diet 5	Natuphos	0	83.31 <sup>a</sup>	99.97 <sup>a</sup>	483.22 <sup>a</sup>	92.10 <sup>a</sup>	54.75 <sup>bcd</sup>	50.43 <sup>a</sup>
Diet 6		300	83.36 <sup>a</sup>	100.03 <sup>a</sup>	483.50 <sup>a</sup>	89.10 <sup>a</sup>	56.30 <sup>a</sup>	50.16 <sup>a</sup>
Diet 7		450	83.79 <sup>a</sup>	100.55 <sup>a</sup>	486.00 <sup>a</sup>	91.10 <sup>a</sup>	55.27 <sup>abc</sup>	50.36 <sup>a</sup>
Phytase Source								
Phyzyme			77.57	93.09	449.94	81.64	53.55	44.48
Natuphos			83.48	100.18	484.24	90.77	55.44	50.32
SEM			0.78	0.93	1.50	1.43	0.24	0.64
Level								
0			77.59	93.11	450.05	85.01	53.69	45.75
300			81.23	97.48	471.15	85.00	55.13	47.99
450			82.77	99.32	480.06	88.60	54.66	48.45
SEM			0.95	1.14	5.52	1.75	0.30	0.79
				<b>P</b>				
Phytase			0.001	0.001	0.001	0.001	0.001	0.001
Level			0.001	0.001	0.001	NS	0.01	0.05
Phytase x level			0.001	0.001	0.001	NS	NS	0.01
Control vs. all rest			0.05	0.05	0.05	NS	NS	0.001
Control vs. diets with Phyzyme			0.001	0.001	0.001	0.01	0.01	0.001
Control vs. diets with Natuphos			NS <sup>7</sup>	NS	NS	NS	NS	0.001

<sup>a-c</sup> Means within a column with no common superscripts differ significantly ( $P \leq 0.05$ ).

<sup>1</sup>FC: feed consumption      <sup>2</sup>NPPI: non phytate phosphorus intake

<sup>3</sup>TNPPI: total non phytate phosphorus intake      <sup>4</sup>EP: egg production      <sup>5</sup>EW: egg weight

<sup>6</sup>EM: egg mass      <sup>7</sup>NS: not significant

**Table 3.** Effects of phytase source and level on performance of Hy-line W-36 hens from 38 to 48 wks of age

	Phytase	Dietary level	FCR <sup>1</sup> (g. feed/ g. egg )	SG <sup>2</sup>	BW <sup>3</sup> (kg.)	Excreta P (%)
<b>Control</b>			1.67	1.0817	1.50 <sup>a</sup>	1.65
<b>Diet 2</b>	<b>Phyzyme</b>	<b>0</b>	1.79	1.0810	1.37 <sup>c</sup>	1.34
<b>Diet 3</b>		<b>300</b>	1.74	1.0812	1.42 <sup>b</sup>	1.35
<b>Diet 4</b>		<b>450</b>	1.71	1.0820	1.44 <sup>b</sup>	1.30
<b>Diet 5</b>		<b>0</b>	1.72	1.0830	1.51 <sup>a</sup>	1.20
<b>Diet 6</b>	<b>Natuphos</b>	<b>300</b>	1.71	1.0820	1.52 <sup>a</sup>	1.46
<b>Diet 7</b>		<b>450</b>	1.71	1.0819	1.53 <sup>a</sup>	1.47
<b>Phytase Source</b>						
<b>Phyzyme</b>			1.75	1.0815	1.52 <sup>a</sup>	1.34
<b>Natuphos</b>			1.72	1.0823	1.41 <sup>b</sup>	1.38
<b>SEM</b>			0.02	0.0004	0.008	0.04
<b>Level</b>						
<b>0</b>			1.75	1.0820	1.49 <sup>a</sup>	1.27
<b>300</b>			1.73	1.0816	1.47 <sup>a</sup>	1.40
<b>450</b>			1.72	1.0820	1.44 <sup>b</sup>	1.38
<b>SEM</b>			0.03	0.0004	0.007	0.05
			<b>P</b>			
<b>Phytase</b>			NS <sup>3</sup>	NS	0.001	NS
<b>Level</b>			NS	NS	0.01	NS
<b>Phytase x level</b>			NS	NS	NS	NS
<b>Control vs. all rest</b>			NS	NS	0.05	0.01
<b>Control vs. diets with Phyzyme</b>			0.08	NS	0.001	0.01
<b>Control vs. diets with Natuphos</b>			NS	NS	NS	0.01

<sup>a-c</sup> Means within a column with no common superscripts differ significantly ( $P \leq 0.05$ ).

<sup>1</sup>FCR: feed conversion ration

<sup>2</sup>BW: body weights

<sup>3</sup>NS: not significant

phytase, egg production, egg mass, bone minerals content, laying hens

**Table 4.** Effects of phytase source and level on bone mineralization of Hy-line W-36 hens from 38 to 48 wks of age

	Phytase	Dietary level	BMC <sup>1</sup> (gm)	BMD <sup>2</sup> (gm/ cm <sup>2</sup> )
<b>Control</b>			41.45	0.28
<b>Diet 2</b>	<b>Phyzyme</b>	<b>0</b>	39.10	0.27
<b>Diet 3</b>		<b>300</b>	39.33	0.28
<b>Diet 4</b>		<b>450</b>	35.51	0.26
<b>Diet 5</b>	<b>Natuphos</b>	<b>0</b>	42.30	0.29
<b>Diet 6</b>		<b>300</b>	41.22	0.27
<b>Diet 7</b>		<b>450</b>	37.48	0.28
<b>Phytase Source</b>				
<b>Phyzyme</b>			37.98	0.27
<b>Natuphos</b>			40.33	0.28
<b>SEM</b>			0.91	0.005
<b>Level</b>				
<b>0</b>			40.70 <sup>a</sup>	0.28
<b>300</b>			40.27 <sup>a</sup>	0.27
<b>450</b>			36.50 <sup>b</sup>	0.27
<b>SEM</b>			1.11	0.006
			<b><i>P</i></b>	
<b>Phytase</b>			0.08	0.08
<b>Level</b>			0.05	NS
<b>Phytase x level</b>			NS <sup>3</sup>	NS
<b>Control vs. all rest</b>			NS	NS
<b>Control vs. diets with Phyzyme</b>			NS	NS
<b>Control vs. diets with Natuphos</b>			0.07	0.06

<sup>a-e</sup> Means within a column with no common superscripts differ significantly ( $P \leq 0.05$ ).

<sup>1</sup>BMC: bone minerals content

<sup>2</sup>BMD: bone mineral density

<sup>3</sup>NS: not significant

**Table 5.** Effects of phytase source and level on egg wet components of Hy-line W-36 hens from 38 to 48 wks of age

	Phytase	Dietary level	Albumen (%)	Yolk (%)	Shell (%)
<b>Control</b>			59.41	26.70	13.70
<b>Diet 2</b>	<b>Phyzyme</b>	<b>0</b>	59.34	27.23	13.39
<b>Diet 3</b>		<b>300</b>	59.40	27.46	13.12
<b>Diet 4</b>		<b>450</b>	58.83	26.96	13.82
<b>Diet 5</b>		<b>0</b>	58.78	27.30	13.76
<b>Diet 6</b>	<b>Natuphos</b>	<b>300</b>	59.77	26.23	12.88
<b>Diet 7</b>		<b>450</b>	58.95	26.47	13.53
<b>Phytase Source</b>					
<b>Phyzyme</b>			58.89	26.54	12.98
<b>Natuphos</b>			58.97	26.32	12.89
<b>SEM</b>			0.36	0.27	0.13
<b>Level</b>					
<b>0</b>			58.91	26.76	12.93
<b>300</b>			59.49	26.34	12.95
<b>450</b>			58.39	26.21	12.92
<b>SEM</b>			0.44	0.34	0.16
			<b><i>P</i></b>		
<b>Phytase</b>			NS <sup>1</sup>	NS	NS
<b>Level</b>			NS	NS	NS
<b>Phytase x level</b>			NS	NS	NS
<b>Control vs. all rest</b>			NS	NS	NS
<b>Control vs. diets with Phyzyme</b>			NS	NS	NS
<b>Control vs. diets with Natuphos</b>			NS	NS	NS

<sup>a-c</sup> Means within a column with no common superscripts differ significantly ( $P \leq 0.05$ ).

<sup>1</sup>NS: not significant

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## الملخص العربي

### مقارنة تغذية مصدرين من انزيم الفاييتيز للدجاج البياض المغذى على اعلاف من الذرة الصفراء و كسب فول الصويا

د. هيثم محمد ياقوت

كلية الزراعة – جامعة الاسكندرية – الشاطبي

تم اجراء تجربة لمقارنة تأثير التغذية على نوعين من انزيم الفاييتيز على الاداء الانتاجي للدجاج البياض من سلالة اللجهورن المغذى على اعلاف من الذرة الصفراء و كسب فول الصويا. غذيت 280 دجاجة هاى لاين W-36 على 7 اعلاف تجريبية ( 4 مكررات بكل مكررة 10 دجاجات). استخدمت عليقة من الذرة الصفراء و كسب فول الصويا كعليقة قاعدية (معاملة 1) احتوت على 0.31% فوسفور حر. اضيف مصدران من الأنزيم Natuphos و Phyzyme إلى العليقة القاعدية بنسبة 0 ، 300 أو 450 FTU / كجم علف (معاملات: 2 و 3 و 4 و 5 و 6 و 7، على التوالي). تم التغذية على جميع العلائق خلال الفترة من 38-48 أسبوع من العمر. تم تربية الطيور في أقفاص، واعتبر كل قفص وحدة تجريبية ( 4 دجاجات / قفص) في تصميم قطاعات عشوائى، وكررت كل معاملة 10 مرات.

عامه فإن الدجاجات المغذاه على Natuphos (معاملات 4-7) استهلكت علف أكثر في المتوسط 83.49 جم / دجاجة / يوم. وبالمثل، تراوح إنتاج البيض من 90.32 لعليقة الكنترول الموجبة و 89.10% لمعاملة 300 FTU Natuphos / كجم علف) إلى 77.92% للدجاج المغذى على معاملة 2 (العليقة الأساسية السلبية؛ 0.12% فوسفور حر). وكانت كتلة البيض أعلى فى الدجاجات المغذاه على المعاملات المحتوية على Natuphos و العليقة الكنترول الموجبة مقارنة بالمجموعة المغذاه على Phyzyme. لم تكن هناك فروق معنوية بين المعاملات الغذائية المختلفة مع وجود مجموعة أفضل عدديا فى نسبة تحويل العلف (1.67 جم علف / جم بيض).

لم تتأثر نسبة فوسفور الزرق بمصدر phytase أو المستويات الغذائية. و جميع المعاملات الغذائية لم يكن لها أي تأثير على مكونات البيضة. تم الحصول على أعلى نسبة بياض مع التغذية على معاملة 6 (59.77%) ، وكذلك أعلى نسبة صفار (26.70%)، في حين أن أعلى نسبة قشرة (13.30%) كانت مع التغذية على مجموعة الكنترول، على التوالي. لم تتأثر كثافة البيض النوعية بأى من المعاملات الغذائية المستخدمة. كذلك لم يتأثر محتوى العظام من المعادن، و كذلك كثافة العظام (كثافة معادن العظام) بشكل كبير بأى من المعاملات الغذائية المستخدمة. وتراوح محتوى العظام من المعادن من 35.51 الى 42.30 جم ، بالنسبة لمعاملة 4 مقابل التغذية على معاملة 5 على التوالي.

إستنادا إلى المعلومات التي تم الحصول عليها من هذه التجربة، فإن اضافة Phyzyme بنسبة 300 FTU/ kg feed كان مماثل فى التأثير لاستخدام Natuphos بنسبة 450 FTU/ kg feed و العليقة الكنترول الموجبة وذلك فى اعلاف الدجاج البياض المعتمدة على الذرة الصفراء و الصويا، خاصة بالنسبة لبعض الصفات الإنتاجية مثل انتاج البيض و الكفاءة الغذائية و وزن البيض.