

EFFECTS OF PHYTASE SUPPLEMENTATION ON THE PERFORMANCE OF BROILER CHICKS FED LOW PHOSPHORUS DIETS

A.M.H. Abou-Ashour, S.A.A. Abd EL-Rahman, G.A. Zanaty
and Manal K. Abou-ELnaga.

Poult. Prod. Dept., Fac. of Agric., Minufiya Univ., Shebin EL-Kom, Egypt

(Received: Jun. 8, 2009)

ABSTRACT: *This study was conducted to evaluate the overall performance of 1- to - 42 d old, unsexed Ross broiler chicks when graded levels of dietary phytase were supplemented in excess of industry standards. A total of 315 Ross broiler chicks, were distributed at random into 7 groups each in 3 replicates. The experimental diets consisted of a basal corn-soybean meal diets that contained 0.90% Ca, low total P (t P) level of 0.46 % and calculated ME of 3100 kcal /kg diet, in addition to a positive control diet that contained 0.70% t P. The dietary microbial phytase levels evaluated were 750, 1500, 3000, 6000 and 12000 U / kg diet. The results showed that body weight and body weight gain were significantly ($p \leq 0.05$) increased with increasing dietary phytase levels. Also, feed intake (86.23 vs.74.37), feed conversion (1.94 vs. 2.40) and performance index (PI) (91.13 vs. 50.21) were significantly ($p \leq 0.05$) improved with increasing dietary phytase levels up to 3000 FTU / kg low P diet (T5) vs. T2 (low P, no phytase supp.). Dressing percentage was significantly affected but liver percentage was not affected. Tibia length and tibia breaking strength were affected. Tibia calcium % was not affected but tibia phosphorus % was significantly increased. Findings of this study indicate that broilers consuming a t P- deficient corn – soybean meal diet can achieve maximum performance and economical efficiency when supplemented with 3000 FTU phytase / kg diet.*

Key words: *Broiler, microbial phytase, performance, phosphorus.*

INTRODUCTION

About 2/3 of the total phosphorus in cereal grains and oil seed meals exist in a phytate – bound form. The availability of phytate phosphorus from plant – derived feedstuffs is low in monogastric animals, such as chickens, because of very low or no phytase activity in their digestive tract (Common, 1989). A large proportion of phytate in the feed consumed by chickens is passed through the digestive tract and excreted in the manure. Hence, in poultry production, producers have to supplement expensive phosphates to feeds to meet poultry requirements (Lan *et al.*, 2002). Attention has been focused on means of reducing phosphorus excretion while maintaining productivity. Because of the demands for adequate skeletal development of rapidly growing broilers, it is necessary to provide adequate levels of

phosphorus with a sufficient margin of safety in broiler diets (Yan *et al.*, 2003). The low availability of phytate phosphorus poses two problems: 1) the need to add inorganic phosphorus supplements to diets thereby increasing the cost of the diet. 2) The excretion of large amounts of phosphorus in the manure. This excess phosphorus eventually finds its way into either crop, adsorbed onto soil particles or in the runoff water (BASF). Broilers lack adequate endogenous enzymes to effectively hydrolyze the phosphorus from the phytate present in corn and soybean meal. Phytate is an anionic acid that binds phosphorus and other cationic substances, which does not allow them to be completely utilized by broilers (Payne *et al.* 2005). To help increase the availability of phytate P (PP), exogenous phytase enzymes are added to commercial diets. The phytase enzyme dephosphorylates the phytate molecules, which releases P and other cations to be used by the broilers. The increased availability of PP decreases the need for supplementing inorganic phosphorus sources to meet the broiler's P requirement, and the increase in available P decreases P excretion by improving use of phytate bound P (Payne *et al.* 2005). Phytase belongs to the group of acid phosphatases which catalyze the hydrolytic cleavage of phosphoric acid esters of inositol. Thus, it liberates ortho-phosphates which can be absorbed. This phytase releasable phosphorus account for about 2/3 of the total P present in most cereals. For instance, the PP availability in corn and soybean is nearly zero. At the same time, minerals like Ca and Mg or trace elements may be liberated into an absorbed form. Therefore, the hypothesis of this study is the supplementation of different levels of phytase up to 12,000 U/ kg of a corn – soybean meal diet to improve both broiler performances and overall nutrient utilizations when compared to a diet with an adequate level of total phosphorus.

MATERIALS AND METHODS

The present study was conducted at the Poultry Research Farm, Minufiya University, Shebin EL- Kom, in order to investigate the efficacy of microbial phytase supplementation to basal diet on growth performance, carcass traits and some bone measurements of broiler chicks under Egyptian conditions. In this study, a total number of 315 unsexed one day old Ross broiler chicks were randomly distributed and divided equally into seven experimental groups nearly similar in average body weight (43g). Each group was represented in three replicate pens of 15 chicks each and kept under similar management conditions. The 1st group was fed the basal diet contained 0.70% total phosphorus without microbial phytase addition (positive control). Groups 2 to 7 were fed the low phosphorus diet which contained 0.46% total phosphorus with microbial phytase supplementation at levels 0 (negative control), 750, 1500, 3000, 6000 and 12000 FTU phytase/ kg diet, respectively. The used microbial phytase was Natuphos¹ (10,000 phytase units (FTU) / g).

¹FAST Crop, MI, Olive, NJ. After the experiment was conducted, this product was assayed by BASF using the in-house procedure. The product was determined to have 6.0540 U, where 1 U is equivalent to one phytase unit (FTU) and is the amount of enzyme that liberates 1 µmol of inorganic P per minute from 0.0051 mg of sodium phytate at 37 °C and pH 5.50 under the condition of the test.

Effects of phytase supplementation On the performance

Two experimental diets were used in the two stages of this study (0-21d as starter and 22-42 d as finisher). The diet contained 22 % CP and 3100 kcal ME /kg diet was fed during the first stage and that contained 20 % CP and 3100 kcal ME / kg diet was offered to birds during the second stage of growth. All diets were formulated to meet the nutrient requirements of the chicks according to the strain catalog recommendations. Artificial light was used beside the normal day light to provide 24- hours / day photo period. Feed and water were provided *ad libitum*. Dietary composition and chemical analysis of the experimental diets are shown in Table (1). Feed consumption and body weight of the birds were recorded weekly. Body weight gain, feed conversion, and economical efficiency were calculated.

Performance index (PI) was calculated according to North, 1984.

Where $PI = \text{live body weight (kg)} \times 100 / \text{feed conversion}$.

Table (1): Composition and chemical analysis of the experimental diets fed during starting (0 – 21) and finishing (22-42 days) periods of age.

Ingredients	Starter period		Finisher period	
	Positive control	Negative control	Positive control	Negative control
Ground yellow corn (8.5 %)	50.25	51.68	57.54	58.65
Soybean meal (44 %)	40.36	39.91	34.42	34.17
Cottonseed oil	5.86	5.46	4.57	4.26
Limestone, ground	1.11	1.83	1.08	1.83
Dicalcium phosphate	1.81	0.32	1.71	0.43
Vitamin and mineral mixture ¹	0.30	0.30	0.30	0.30
DL- methionine ²	0.21	0.20	0.06	0.06
Sodium chloride	0.30	0.30	0.30	0.30
Total	100	100	100	100
<u>Calculated nutrient content³:</u>				
Dry matter%	89.96	89.96	89.98	89.98
Crude protein, %	22.03	21.95	20.03	20.02
ME , k cal / kg	3099	3101	3098	3102
C/P ratio	141	141	155	155
Lysine, %	1.20	1.20	1.07	1.07
Methionine , %	0.55	0.54	0.39	0.38
Methionine + Cystine, %	0.90	0.89	0.72	0.72
Calcium, %	0.90	0.90	0.90	0.90
Total phosphorous, %	0.70	0.46	0.70	0.46
<u>Chemical analysis:</u>				
Crude protein,%	22.00	21.75	19.62	19.89
Ether extract,%	6.02	6.02	8.28	8.28
Crude fiber, %	3.76	3.76	3.57	3.57

¹ Vitamin and mineral mixture at 0.30 % of the diet supplies the following / kg of the diet: Vit. A, 12000 IU; Vit. D₃, 2500 IU; Vit. E, 10 mg; Vit. K₃, 3 mg ;Vit B₁, 1 mg; Vit. B₂, 4 mg; Pantothenic acid ,10 mg ;Nicotinic acid ,

20 mg; Folic acid, 1 mg; Biotin, 0.05 mg; Niacin, 40 mg; Vit.B₆, .3. Mg; Vit B₁₂, 20 mcg; Choline chloride, 400 mg; Mn, 62 mg; Fe, 44 mg; Zn, 56 mg; I, 1 mg; Cu, 5 mg and Se, 0.01 mg.

² DL - Methionine: 98% feed grade (98 % Methionine).

³ Calculated according to NRC (1994)

At 21 and 42 days of age, 6 birds were randomly taken from each treatment, weighed and slaughtered to complete bleeding, followed by plucking the feathers. Dressing, giblets and abdominal fat weight were expressed relative to live body weight. The left tibia of each chick was oven dried at 75°C. Bone breaking strength (force necessary to break bone) was tested. The proximate analysis of feed, Ca and P were carried out according to the methods of (A.O.A.C., 2003).

The economical efficiency was calculated from the input – output analysis (Heady and Jensen, 1954), assuming that other head costs were constant, as follows: $[(\text{price of kg weight gain} - \text{feed cost /kg gain}) / \text{feed cost /kg gain} \times 100]$ under local conditions. The data obtained were statistically analyzed by the completely randomized design using SPSS 9.05 (1993) program and the differences among means were determined using Duncan's multiple range test (Duncan 1955).

Percentages were transformed to the corresponding arcsine values before statistical analysis.

The model applied was:

$Y_{ij} = \mu + \alpha_i + E_{ij}$, Where:

Y_{ij} = an observation. μ = Overall mean.

α_i = effect of treatment (i = 1,2,3,4,.....7), and

E_{ij} = Random error.

RESULTS AND DISCUSSION

Broiler chick performance:

Body weight, Body weight gain, and protein efficiency ratio and protein index.

Results on the effect of microbial phytase supplementation on body weight (BW) and body weight gain (BWG) of broiler chicks at 21 and 42 days are presented in Table (2). Results showed that at 21 days, the average values of BW and BWG were significantly ($p \leq 0.05$) increased with phytase supplementation to low phosphorus diets. Chicks consuming the control diet (0.70%P) had a BWG of 452.26 g /chick. Chicks consumed the basal diet without phytase addition had a BWG of 414.00 g/chick compared to 553.33 g / chick fed diet supplemented with 6000 FTU phytase / kg diet (T6). In general, at 42 days; birds fed diet with 3000 FTU microbial phytase /kg diet (T5) had heavier body weights (1822.57 g/ chick) and better weight gains (1780.1 g /chick) in comparison with the positive (T1) and the basal negative control (T2) being 1514.28 vs. 1349.92 (LBW) and 1470.11 vs. 1306.59 g (BWG) , respectively. Performance index (PI) at 42 d of age was significantly higher in broiler chicks fed diets supplemented with microbial phytase at 3000 FTU / kg compared to those fed low phosphorus diet without phytase supplementation (91.13 vs. 50.21). However, there was no significant detected between the different levels of supplementation except at the level of 3000 FTU phytase / kg diet in protein efficiency ratio (PER) at 21 and 42

Effects of phytase supplementation On the performance

days. The improvement in growth performance observed herein may be due to that phytase enzyme releases phosphorus and other minerals from phytate mineral complex and liberates proteins from phytate – protein complex making them more available to the bird (Sebastian *et al.* 1996). These results are in agreement with those obtained by Ahmed *et al.* (2000); Shirely and Edwards (2003); Onyango *et al.* (2004); Watson *et al.* (2006) and Ghazalah *et al.* (2006) who found that supplemental microbial phytase to low P diets improved the average values of BW and BWG. In contrast to these results, Sohail and Roland (1999) observed significant decreases in BW when P was reduced from 0.325 to 0.225% beside, phytase addition significantly increased BW at the lower AP level but not at the higher AP level. While, Lesson *et al.* (2000); Waldroup *et al.* (2000); and Yan *et al.* (2003) found that there were no significant differences in the average values of BW and BWG when microbial phytase was added to low AP broiler diets. Also, Abo EL- Wafa *et al.* (2005) noted that there were no significant differences in BW and BWG values due to the use of different sources of phosphorus (bone meal or di- calcium phosphate) in broiler chicks diet.

Table (2): Effect of dietary phytase supplementation on the performance of broiler chicks at 21 and 42 days.

Treatments ¹	Body weight (g) at		Body weight gain (g) at		Performance index at	
	21d	42d	21d	42d	21d	42d
T1	496.44±26.09 ^{ab}	1514.28±85.36 ^b	452.26±26.10 ^{ab}	1470.11±85.45 ^b	21.57±1.00 ^{ab}	63.67±1.14 ^{bc,cd}
T2	457.33±17.30 ^d	1349.92±49.64 ^c	414.00±17.20 ^d	1306.59±49.52 ^c	19.03±0.37 ^d	50.21±0.25 ^d
T3	513.21±19.09 ^{abc}	1762.96±43.11 ^a	469.94±19.11 ^{abcd}	1719.02±43.58 ^a	23.23±0.52 ^c	77.22±1.73 ^a
T4	549.18±17.97 ^{abc}	1758.65±43.52 ^a	505.24±17.86 ^{abcd}	1715.39±43.06 ^a	24.77±0.58 ^{bc}	77.42±0.96 ^a
T5	561.67±1.91 ^{ab}	1822.57±43.82 ^a	519.28±19.87 ^{ab}	1780.1±848.22 ^a	29.25±0.70 ^a	91.13±2.08 ^a
T6	569.78±17.86 ^a	1713.46±43.24 ^a	553.33±17.76 ^a	1670.02±43.08 ^a	26.88±0.46 ^{ab}	74.83±0.83 ^a
T7	594.38±20.98 ^a	1752.37±36.30 ^a	551.49±20.18 ^a	1709.57±36.24 ^a	24.32±2.71 ^{bc}	76.87±0.61 ^a

¹T1; Positive control, T2; Negative control+ 0 FTU phytase / kg diet, T3; Negative control+ 750 FTU phytase / kg diet, T4; Negative control+ 1500 FTU phytase / kg diet, T5; Negative control+ 3000 FTU phytase / kg diet, T6; Negative control+ 6000 FTU phytase / kg diet and T7; Negative control+ 12000 FTU phytase / kg diet.

²means ± S.E. of 3 replicates / treatment.

³a,b,c.....etc: Means within the same column with different superscripts are significantly different (P≤0.05).

Feed intake and feed conversion ratio.

Feed intake (FI) was significantly (p≤0.05) increased with phytase supplementation from 750 FTU/ kg (T3) to 12000 FTU / kg (T7) relative to the low P diet without phytase addition (T2) either at 21 or 42 days. Feed conversion ratio (FCR) was significantly (p≤0.05) improved due to phytase supplementation at 21 or 42 days (Table, 3). The best ratios (1.88 and 1.94) were achieved at the level of 3000 FTU phytase /kg (T5) at 21 or 42 days compared to the positive control or T1 (2.24 and 2.29) at the same order, respectively. These results are in harmony with findings of Shirely and Edwards (2003); Banks *et al.* (2004); Dilger *et al.* (2004); Ibrahem (2006) ; Watson *et al.* (2006) and Ghazalah *et al.* (2006) who reported a significant improvement in FCR values due to addition of different levels of microbial phytase to broiler chick diets. On the other hand, Yan *et al.* (2000) ; Lan *et al.*

(2002); Viveros *et al.* (2002) and Yan *et al.* (2003) noted that, the level of non-phytate phosphorous (NPP) or phytase supplementation had no significant effect on FCR during 6-9 wks. of age, indicating that the lowest dietary levels of NPP were sufficient to support these live parameters for chicks.

Table (3): Effect of dietary phytase supplementation on feed intake and feed conversion* of broiler chicks at 21 and 42 days.

Treatments ¹	Feed Intake(g/bird/day)at		Feed conversion at	
	21d	42d	21d	42d
T1	49.50±0.57 ^d	86.15±0.88 ^b	2.24±0.01 ^b	2.29±0.01 ^b
T2	41.77±0.71 ^g	74.37±1.14 ^c	2.29±0.02 ^a	2.40±0.02 ^a
T3	47.82±0.60 ^e	90.49±1.12 ^a	2.09±0.01 ^c	2.19±0.02 ^d
T4	51.64±0.64 ^c	91.11±1.07 ^a	2.13±0.02 ^d	2.17±0.05 ^c
T5	46.71±0.56 ^f	86.23±1.47 ^b	1.88±0.20 ^f	1.94±0.02 ^e
T6	55.78±0.80 ^b	87.88±1.36 ^b	2.07±0.01 ^e	2.17±0.02 ^d
T7	56.96±0.46 ^a	90.80±0.93 ^a	2.13±0.01 ^d	2.20±0.02 ^c

¹ T1; Positive control, T2; Negative control+ 0 FTU phytase / kg diet, T3; Negative control+ 750 FTU phytase / kg diet, T4; Negative control+ 1500 FTU phytase / kg diet, T5; Negative control+ 3000 FTU phytase / kg diet, T6; Negative control+ 6000 FTU phytase / kg diet and T7; Negative control+ 12000 FTU phytase / kg diet.

² means ± S.E. of 3 replicates / treatment.

³ a,b,c,.....etc: Means within the same column with different superscripts are significantly different (P<0.05).

*Feed conversion=g feed/ g gain.

Carcass characteristics.

Experimental results on the effect of phytase supplementation on carcass characteristics at 21 and 42 days of age are shown in Tables (4 and 5). At 21 days of age, data indicated that the addition of phytase enzyme significantly (P≤0.05) affected dressing, heart and gizzard percentages, while no significant differences in liver percentage were observed. Also, at 42 days, no significant differences were observed in percentages of liver and gizzard. However, phytase supplementation significantly increased dressing percentage. These finding are in agreement with those reported by Korngay *et al.* (1998), Soliman *et al.* (1999), Attia *et al.* (2001) and EL-Sherbiny *et al.* (2005).

On the other hand, Abd- ELSamee (2002) and Abd EL- Hakim *et al.* (2003) found that there were no significant differences in carcass composition due to microbial phytase supplementation.

Bone measurements at 42 days of age.

Similar to BW, BWG, FI and FCR, data were indicative of a better phytate phosphorus utilization due to phytase supplementation. Data regarding bone measurements are presented in Tables (6 and 7). At 21 days, addition of phytase at the level of 3000 FTU / kg diet significantly (P≤ 0.05) increased tibia length (5.70 cm) and % of tibia P (33.40) in comparison to the low phosphorus diet without enzyme addition (5.32 cm and 27.56 %). Though not significant, tibia breaking strength and tibia Ca were, in general, slightly increased. At 42 days, microbial phytase supplementation did not affect tibia length or % of tibia Ca. While, tibia breaking strength (20.50 vs. 14.80kg / cm²) and % of tibia P 34.26 vs. 31.04) were significantly affected by phytase

Effects of phytase supplementation On the performance

supplementation up till 12000 FTU/ kg (T7). These findings are in agreement with Cheng *et al.* (2004), Onyango *et al.* (2004), Snow *et al.* (2004) and Timmons *et al.* (2004) who noted that bone characteristics were improved as the level either of t P or phytase was increased in the diet.

Table (4): Effect of dietary phytase supplementation on carcass characteristics of broiler chicks at 21 days*.

Treatments ¹	Carcass traits (%) at 21 days			
	Dressing	Liver	Heart	Gizzard
T1	67.82±0.82 ^{abc}	2.70±0.10	0.73±0.10 ^a	2.85±0.10 ^{a,2,3}
T2	67.33±0.33 ^{bc}	2.60±0.10	0.63±0.10 ^c	2.50±0.15 ^b
T3	68.36±0.36 ^{ab}	2.50±0.10	0.64±0.10 ^c	2.60±0.10 ^b
T4	67.83±0.17 ^{abc}	2.50±0.10	0.65±0.10 ^c	2.60±0.10 ^b
T5	68.26±0.38 ^{ab}	2.54±0.10	0.60±0.10 ^c	2.75±0.10 ^a
T6	68.43±0.43 ^{ab}	2.60±0.10	0.57±0.10 ^d	2.70±0.10 ^{ab}
T7	68.92±0.08 ^a	2.60±0.10	0.71±0.10 ^b	2.70±0.10 ^{ab}

¹ T1; Positive control, T2; Negative control+ 0 FTU phytase / kg diet , T3; Negative control+ 750 FTU phytase / kg diet, T4; Negative control+ 1500 FTU phytase / kg diet, T5; Negative control+ 3000 FTU phytase / kg diet, T6; Negative control+ 6000 FTU phytase / kg diet and T7; Negative control+ 12000 FTU phytase / kg diet.

² means ± S.E. of 3 replicates / treatment.

³ a,b,c.....etc: Means within the same column with different superscripts are significantly different (P<0.05).

*Calculated as % of live body weight.

Table (5): Effect of dietary phytase supplementation on carcass characteristics of broiler chicks at 42 days*.

Treatments ¹	Carcass traits % at 42days				
	Dressing	Liver	Heart	Gizzard	Abdominal fat
T1	74.18±0.18 ^a	2.20±0.10	0.65±0.10 ^a	1.70±0.10	1.24±0.06 ^{cd,2,3}
T2	71.76±0.24 ^c	2.60±0.10	0.62±0.10 ^a	1.80±0.10	1.52±0.02 ^b
T3	73.73±0.52 ^b	2.10±0.10	0.49±0.10 ^b	1.70±0.10	1.42±0.08 ^{bc}
T4	73.48±0.52 ^b	2.04±0.10	0.43±0.10 ^{cd}	1.90±0.10	1.07±0.07 ^d
T5	75.52±0.19 ^a	1.90±0.10	0.42±0.10 ^d	1.90±0.10	1.19±0.01 ^d
T6	74.19±0.19 ^{ab}	2.03±0.10	0.44±0.10 ^{cd}	1.90±0.10	1.83±0.07 ^a
T7	73.68±0.32 ^b	2.90±0.10	0.46±0.10 ^{bc}	1.90±0.10	1.83±0.07 ^a

¹ T1; Positive control, T2; Negative control+ 0 FTU phytase /kg diet, T3; Negative control+ 750 FTU phytase / kg diet, T4; Negative control+ 1500 FTU phytase / kg diet, T5; Negative control+ 3000 FTU phytase / kg diet, T6; Negative control+ 6000 FTU phytase / kg diet and T7; Negative control+ 12000 FTU phytase / kg diet

² means ± S.E. of 3 replicates / treatment.

³ a,b,c.....etc: Means within the same column with different superscripts are significantly different (P<0.05).

*Calculated as % of live body weight.

Table (6): Effect of dietary phytase supplementation on bone measurements of broiler chicks at 21 days.

Treatments ¹	Tibia measurements at 21days			
	Tibia length(cm)	TBS*	Tibia Ca (%)	Tibia P (%)
T1	5.50±0.13 ^{ab}	9.00±0.37	37.21±3.91	30.70±0.96 ^{ab}
T2	5.32±0.07 ^b	8.83±0.60	32.45±1.46	27.56±0.86 ^c
T3	5.25±0.17 ^b	8.88±1.00	29.74±1.54	29.67±2.10 ^b
T4	5.63±0.13 ^a	9.00±0.43	30.48±0.51	29.79±2.46 ^b
T5	5.70±0.26 ^a	9.65±0.75	34.00±3.61	33.40±1.56 ^a
T6	5.57±0.10 ^{ab}	10.33±0.42	40.41±7.11	32.42±0.32 ^a
T7	5.48±0.06 ^{ab}	10.33±0.49	48.07±10.57	32.55±0.78 ^a

¹ T1; Positive control, T2; Negative control, T3; Negative control+ 750 FTU phytase / kg diet,T4; Negative control+ 1500 FTU phytase / kg diet,

T5; Negative control+ 3000 FTU phytase / kg diet,tT6; Negative control+ 6000 FTU phytase / kg diet,T7; Negative control+ 12000 FTU phytase / kg diet

² means ± S.E. of 3 replicates / treatment.

³ a,b,c.....etc. Means within the same column with different superscripts are significantly different (P<0.05).

⁴TBS: tibia breaking strength kg /cm²

Table (7): Effect of dietary phytase supplementation on bone measurements of broiler chicks at 42 days.

Treatments ¹	Tibia measurements at 42days			
	Tibia length(cm)	TBS*	Tibia Ca(%)	Tibia P (%)
T1	7.85±0.24	15.00±0.82 ^b	32.73±0.89	32.33±0.54 ^{cde2}
T2	7.24±0.19	14.80±1.32 ^b	30.71±0.62	31.04±0.33 ^e
T3	7.73±0.27	16.50±1.44 ^{ab}	32.21±0.97	31.25±1.73 ^{de}
T4	7.75±0.14	16.50±1.44 ^{ab}	35.02±2.45	33.04±2.31 ^c
T5	7.50±0.20	18.25±1.65 ^{ab}	35.07±1.88	34.11±3.65 ^b
T6	7.28±0.10	19.17±1.01 ^{ab}	36.29±1.39	32.67±0.92 ^d
T7	7.73±0.25	20.50±1.75 ^a	35.88±1.03	34.26±1.71 ^a

¹ T1; Positive control, T2; Negative control+ 0 FTU phytase / kg diet, T3; Negative control+ 750 FTU phytase / kg diet,T4; Negative control+ 1500 FTU phytase / kg diet,T5; Negative control+ 3000 FTU phytase / kg diet,tT6; Negative control+ 6000 FTU phytase / kg diet and T7; Negative control+ 12000 FTU phytase / kg diet.

² means ± S.E. of 3 replicates / treatment.

³ a,b,c.....etc. Means within the same column with different superscripts are significantly different (P<0.05).

⁴TBS: tibia breaking strength kg /cm²

Economical efficiency.

In general, the results indicate that supplementation of microbial phytase to low – phosphorus containing broiler diets increases economical and relative economical efficiency. The best values were obtained with 3000 FTU microbial phytase / kg diet (Table 8).

It could be concluded that the addition of 3000 FTU phytase / kg diet (T5) to corn-soybean meal broiler diets with low phosphorus content improved growth performance, carcass characteristics, bone mineralization and economical efficiency.

Effects of phytase supplementation On the performance

Table (8): The economical efficiency of the experimental diets which contains different levels of phytase supplementation.

Items	Dietary treatments ¹						
	T1	T2	T3	T4	T5	T6	T7
Initial body weight, (g)	44.17	43.33	43.26	43.94	42.39	43.44	42.80
Final body weight, (kg)	1.51	1.35	1.76	1.76	1.82	1.71	1.75
Body weight gain, (kg)	1.47	1.31	1.72	1.71	1.78	1.67	1.71
Total revenue,(L.E)	17.64	15.68	20.64	20.57	21.36	20.04	20.52
Feed intake, (kg) / chick	3.63	3.20	3.81	3.83	3.62	3.65	3.82
Price of kg feed,(L.E)	2.00	1.99	2.01	2.03	2.05	2.10	2.20
Feed cost, (L.E)	7.26	6.36	7.67	7.75	7.43	7.66	8.42
Net revenue,(L.E) ² / chick	10.38	9.32	12.97	12.83	13.93	12.38	12.10
Economical efficiency,(%) ³	143.00	146.45	169.05	165.50	187.51	161.48	143.73
Relative economical efficiency, (%) ⁴	100	102.42	118.23	115.74	131.14	112.93	100.52

¹ T1; Positive control, T2; Negative control+ 0 FTU phytase / kg diet, T3; Negative control+ 750 FTU phytase / kg diet, T4; Negative control+ 1500 FTU phytase / kg diet, T5; Negative control+ 3000 FTU phytase / kg diet, T6; Negative control+ 6000 FTU phytase / kg diet and T7; Negative control+ 12000 FTU phytase / kg diet.

Price of one kg live body weight was 12 L.E.

Price of one kg phytase 170 L.E.

²Net revenue = Total revenue – Feed cost.

³Economical efficiency = (Net revenue / Feed cost) × 100.

⁴ assuming that the relative economical efficiency of the positive control diet = 100

REFERENCES

- Abd EL-Hakim, A.S. and O.M. Abd -EL same (2003). Effect of feeding systems and phytase supplementation on the performance of broiler chicks during summer season. *Egypt. Poult. Sci.*, 23:297-310.
- Abd- EL Samee, M.O. (2002). Effect of different levels of crude protein, sulphur amino acids, microbial phytase and their interactions on broiler chick performance *Egypt. Poult. Sci.*, 22:999-1021.
- Abou El-Wafa,S., O.M. Hussein and M. Shabaan (2005). Influence of microbial phytase and energy levels on broiler performance fed low phosphorous diets. 3rd International Poultry Conference, 4-7 Apr. 2005, Hurgada, Egypt., 391-406 .
- Ahmed, T., S. Rasool and M. Sarwar (2000). Effect of microbial phytase produced from fungus *Aspergillus Niger* on bioavailability of phosphorous and calcium in broiler chickens. *Anim. Feed Sci. Technol.* 83:103-114.
- Association of Official Analytical Chemists (2003). Pages 57-58in Official Methods of Analysis of the Association of Official Analytical Chemists. Vol.2. 16th ed., Washington, DC..
- Attia, Y. A. A., S. Abd- EL Rahman and E. M. A. Qota (2001). Effect of microbial phytase with or without cell - wall splitting enzymes on the performance of broiler fed marginal levels of dietary protein and metabolizable energy *Egypt. Poult. Sci.*, 21: 521- 547.
- Banks, K. M., K. L. Thompson, P. Jaynes and T. J. Applegate (2004). The effects of copper on the efficacy of phytase on growth and phosphorous retention in broiler chicks . *Poult. Sci.*, 83: 1335-1341.

- Cheng Y. H., J. P. Goff, J. I. Sell, M. E. Dallorso, S. E. Pawiak and R.L. Horst (2004). Utilizing *Solanum glaucophyllum* alone or With Phytase to improve Phosphorous Utilization in Broilers. Poul. Sci., 83: 406- 413.
- Common, F.H. (1989). Biological availability of phosphorous for pigs. Nature. 43: 370- 380.
- Dilger, R. N., E. M. Onyango, J. S. Sands and O. Adeola (2004). Evaluation of microbial phytase in broiler diets. Poult. Sci. 83: 962- 970.
- Duncan, D.B. (1955). Multiple range and multiple F tests. Biometrics. 11:1-42.
- EL-Sherbiny, A.M., Y. A. F. Hammouda, H. M. A. Hassan and M. A. Mohamed (2005). Performance, bone mineralization and carcass characteristics of broilers fed low phosphorous diets supplemented with phytase. Egypt. Poult. Sci., 25: 653-688.
- Ghazalah, A.A., M.O. Abd-EL Samee, M. A. El-Manyalawi and Eman, S. Moustafa (2006). Response of broiler chicks to microbial phytase supplementation in diets differ in available phosphorus sources and levels. Egypt. Poult. Sci.,26 (IV):1321-1341.
- Heady, E. O. and H. R. Jensen (1954). Farm Management Economics. Pentice-Hall Inc. Englewood Cliffs, N. J., USA
- Ibrahim, M. R. (2006). Effect of different dietary levels of Okara meal and phytase on broiler performance. Egypt. Poult. Sci., 26:235-247.
- Kornegay, E. T., Z. Zhang and D.M. Denbow (1998).Influence of microbial phytase supplementation of a low protein amino acid on performance, ileal digestibility of protein and amino acids and carcass measurements of finishing broilers. Poult. Sci., 77 (suppl.1):117 (Abst.).
- Lan, G. Q., N. Abdullah, S. Jalaludinii and Y. W. Ho (2002). Efficacy of supplementation of a phytase - producing bacteria culture on performance and nutrient use of broiler chickens fed corn –soybean meal diets. Poul. Sci. 81: 1522-1532 .
- Lesson, S., H. Namkung, M. Cottrill and C.W. Forsberg (2000). Efficiency of new bacterial phytase in poultry diets.Canadian.J.Anim.Sci.,80 : 527-528
- National Research Council. NRC (1994). Nutrient requirements of poultry.9th Ed. National Academic Press, Washington, DC .
- North, M.O. (1984). Commercial chicken production manual.3rd Ed.. The AVI. Publishing Co.Inc., West-port, Connecticut, U.S.A.
- Onyango, E. M., M. R. Bedford and O. Adeola (2004). The Yeast Production System in Which *Escherichia Coli* Phytase Is Expressed May Affect Growth Performance, Bone Ash, and Nutrient Use in Broiler Chicks. Poult. Sci. 83: 421- 427.
- Payne, R. L., T. K. Lavergne and L. L. Southern (2005). A comparison of two sources of phytase in liquid and dry forms in broilers. Poult. Sci., 84:265- 272.
- Sebastian, S., S. P. Touchburn and P.C. Lague (1996). The effect of supplemental microbial phytase on the performance and utilization of

Effects of phytase supplementation On the performance

- dietary calcium, phosphorous, copper and zinc in broiler chickens fed a corn-soybean diets. *Poult. Sci.*, 75:729- 736.
- Shirley, R. B. and H. M. Edwards, Jr (2003). Graded Levels of Phytase Past Industry Standards Improves Broiler Performance. *Poult. Sci.*, 82:671-680.
- Snow, J. L., D. H. Baker and C. M. Parsons (2004). Phytase, Citric acid, and 1 α Hydroxycholecalciferol improve phytate phosphorous utilization in chicks fed a corn – soybean meal diet. *Poult. Sci.*, 83: 1187- 1192.
- Sohail, S. S. and D. A. Sr. Roland (1999). Influence of supplemental phytase on performance of broilers four to six weeks of age. *Poult. Sci.*, 78:550-555.
- Soliman, A. Z., A. A. Ghazalah, M. R. EL- Abbadly and M. O. Abd-EL Same (1999). Broiler performance as affected by crude protein, metabolizable energy and fat during summer season. Proceeding of 7th Scientific Conference for Animal, Poultry and Fish Nutrition, Oct.1999. EL- Arish, Egypt. Pp.621-631.
- SPSS (1993). SPSS x for Windows. Release .0.05. copyright SPSS inc.,1989-1993, New York. USA.
- Timmons, J. R., J. M. Harter- Dennis and A. E. Sefton (2004). Evaluation of the available phosphorous requirements and optimal phytase level of 21- 42 day old male broilers. *Poult. Sci.*,80. (suppl.1) (Abst.).
- Viveros, A., A. Brenes, I. Arija and C. Centeno (2002). Effects of microbial phytase supplementation on mineral utilization and serum enzyme activities in broiler chicks fed different levels of phosphorous. *Poult. Sci.*, 81:1172-1183 .
- Waldroup, P. W., J. H. Kersey, E. A. Saleh, A. Fritts, F. Yan, H. L. Stilborn, R. C. Crum, Jr Raboy (2000). Non-phytate phosphorous requirement and phosphorous excretion of broilers chicks fed diets composed of normal or high available phosphate corn with and without microbial phytase. *Poult. Sci.*, 79: 1451- 1459 .
- Watson, B. C., J. O. Mathews, L. L. Southern and J. L. Shelton (2006). The effects of phytase on growth performance and intestinal transit time of broilers fed nutritionally adequate diets and diets deficient in calcium and phosphorous. *Poult. Sci.* 85: 493- 497 .
- Yan, F., J. H. Kersey, C. A. Fritts and P. W. Waldroup (2000). Phosphorous requirements of broilers 6- 9 weeks of age as influenced by phytase supplementation. *Poult. Sci.*, 79 (Suppl.1): p (1-149) (Abstr.).
- Yan, F., J. H. Kersey, C. A. Fritts and P. W. Waldroup (2003). Phosphorous Requirements of Broiler Chicks Six to Nine Weeks of age as influenced by Phytase Supplementation. *Poult. Sci.* 82: 294- 300

تأثير إضافة إنزيم الفيتيز على أداء كتاكيت التسمين المغذاة على علائق منخفضة في الفوسفور

عاطف محمد حسن أبو عاشور - سيد عبد الفتاح عبد الرحمن -

جمال عبد الستار زناتي - منال كمال عبد العليم أبو النجا

قسم إنتاج الدواجن - كلية الزراعة - جامعة المنوفية - شبين الكوم - مصر

الملخص العربي

أجريت هذه الدراسة بهدف تقدير الأداء الإنتاجي لكتاكيت التسمين Ross عمر (١ - ٤٢ يوم) باستخدام مستويات متدرجة من إنزيم الفيتيز. اشتملت علائق التجربة على عتيقة أساسية من الذرة الصفراء وكسب فول الصويا حيث تحتوي على ٩.٠٠% كالسيوم و منخفضة في محتواها من الفوسفور الكلي (٠.٤٦%) و طاقة ممثلة ٣١٠٠ كيلو كالوري / كجم بالإضافة لعتيقة المقارنة والتي تحتوي على ٧.٠٠% فوسفور كلي. تم إضافة مستويات مختلفة من إنزيم الفيتيز ٧٥٠، ١٥٠٠، ٣٠٠٠، ٦٠٠٠ و ١٢٠٠٠ وحدة / كجم عتيقة إلى العلائق المنخفضة في مستوى الفوسفور الكلي. و قد استخدم في هذه التجربة ٣١٥ كتكوت غير مجنس قسمت عشوائيا إلى ٧ مجموعات بكل منها ٤٥ كتكوت موزعة في ٣ مكررات .

أوضحت النتائج زيادة كل من وزن الجسم و معدل الزيادة في وزن الجسم معنويا (عند مستوى ٠.٥%) بزيادة إضافة إنزيم الفيتيز . كما تحسن معنويا كل من الغذاء المستهلك (٨٦.٢٣ مقابل ٧٤.٣٧ جم) و معدل التحويل الغذائي (١.٩٤ مقابل ٢.٥٠) و دليل الأداء الإنتاجي (٩١.١٣ مقابل ٥٠.٢١%) في المعاملة الخامسة (٣٠٠٠ وحدة / كجم عتيقة منخفضة فوسفور) مقارنة بالمعاملة الثانية (منخفضة الفوسفور وبدون إضافة إنزيم). كذلك تأثر معنويا كل من نسبة التتافي و طول عظمة الساق و مقاومتها للكسر .

و قد أوضحت نتائج هذه الدراسة أن تغذية كتاكيت التسمين Ross على عتيقة أساسية تكون من الذرة الصفراء وكسب فول الصويا و منخفضة في محتواها من الفوسفور الكلي (٠.٤٦%) من الممكن أن تحقق أفضل أداء إنتاجي و كفاءة اقتصادية بإضافة إنزيم الفيتيز الميكروبي بمعدل ٣٠٠٠ وحدة / كجم عتيقة.