Egypt Poult. Sci. Vol (25) (III): (533- 552)

EFFECT OF PHYTASE ENZYME IN BROILER PLANT PROTEIN DIETS CONTAIN DESCENDING LEVELS OF AVAILABLE PHOSPHORUS.
2- CARCASS CHARACTERISTICS, BONE QUALITY AND MINERAL RETENTION

By

A. M. S. Hammad*

* Dept. of Animal & Poultry Nutrition, Desert Research Center, Cairo.

Received: 03/05/2005 **Accepted**: 22/06/2005

Abstract*: A trail was performed to study the effect of two levels of available phosphorus (0.35 and 0.25% in grower diets or 0.25 and 0.15 in finisher dies), and four levels of phytase enzyme (0, 250, 500 and 750 U/Kg in grower diets or 0, 500, 750 and 1000, U/Kg in finisher diets, respectively) on the performance of broiler chicks fed diets based on corn-soybean meal compared to positive control diet. Data showed no significant effects of available phosphorus (AP) level or phytase addition upon the relative weight of total edible parts, carcass, front part, hind part, giblets, gizzard, and heart. The decrease in AP caused significant (P<0.05) increases in relative liver weight by about 12.5%. The highest level of phytase increased abdominal fat significantly (P<0.05)by about 31%. Reduction in AP level content of the diet caused regularity (P<0.05) decreases in relative weight of feather by 15 and 17% for 0.35-0.25 and 0.25-0.15 of AP levels, respectively. Reducing dietary AP to 0.35-0.25 and 0.25-0.15% resulted in decreased (P<0.05) breaking strength of tibia by 22.6 and 19.9%, respectively and of femur by 17.7 and 14.6%, respectively. Reducing dietary AP resulted in shorter tibia and femur, while phytase addition significantly (P<0.05) increased these bone lengths similar to control group. Birds fed low-AP without phytase decreased (P<0.05) mean wall thickness of tibia and femur by 22.2 and 17.05%, respectively. Supplemental phytase improved these wall thickness but still under that of control group. Low-AP without phytase resulted in decreased (P<0.05) tibial wet weight, dry weight, and ash weight by 13.3, 14.9, and 16.6%, respectively. Adding phytase restore these weights to be comparable to control group. Phytase addition to low-AP diets improved (P<0.05) the retention of DM, ash, P and Ca to the levels of positive control group. phytase addition can reduced fecal phosphorus significantly (P<0.05) by about 21%.*

INTRODUCTION

Excess phosphorus can go through land and enter water reservoirs, wells and rivers causing severe environmental, health, and economic problems. Chickens are lacking phytase, the enzyme that is necessary for breakdown of molecule and subsequent release of phosphorus for absorption (**Waldroup *et al.* 2000**). It is well documented that microbial phytase supplementation enhances phytic acid hydrolysis and increases the availability of minerals bound to the phytic acid (**Sebastian *et al.* 1997**).

Huff *et al.* (1998) found no significant effects of phytase addition on carcass yield. While **Zyla *et al.* (2001)** reported that phytase and phosphatase addition gave higher carcass weight than those received control diet. **Scheideler and Ferket (2000)** showed that phytase addition did not affect total carcass weight but did significantly affect leg quarters weight. No change in wing, tenderloin, or breast meat weights. **Viveros *et al.* (2002)** found that the decrease in AP content in the diet caused a significant reduction of liver and spleen weights while low-P diets without phytase showed an increased in relative liver weight.

Ravindran *et al.* (1995), Ahmed *et al.* (2000), Yan *et al.* (2000), and **Waldroup *et al.* (2000)** found that phytase addition improved tibia ash. While **Huff *et al.* (1998)** and **Scheideler and Ferket (2000)** found that bone ash showed no significant effects in chicks fed low AP plus phytase diet. **Huff *et al.* (1998)** found no effects on bone diameter while **Orban *et al.* (1999)** reported that phytase addition in duck finisher diets enhanced development. **Viveros *et al.* (2002)** found that phytase addition increased tibia weight. **Perney *et al.* (1993), Orban *et al.* (1999)** and **Sohail and Roland (1999)** found that phytase had greater influence on bone breaking strength. While **Huff *et al.* (1998)** reported that there is no significant effects on bone breaking strength.

Sebastian *et al.* (1996), Zhang *et al.* (2000), Ahmed *et al.* (2000), and **Viveros *et al.* (2002)** indicated that additional phytase increased apparent retention of P and Ca. **Denbow *et al.* (1998), Vetesi *et al.* (1998), Zhang *et al.* (2000),** and **Yan *et al.* (2000)** found that P levels and phytase addition markedly reduced fecal phosphorus. While **Keshavarz (2000)** showed that total P excretion were reduced due to lowering dietary AP, but phytase did not have an effect on P excretion.

The objective of this study was to determine the effects of decreasing AP in broiler diets supplemented with phytase on carcass characteristics, bone quality, and phosphorus reduction in excreta.

MATERIAS AND METHODS

This trail was conducted in Ras Sedr Experimental Station-South Saini. Chicks were divided into nine groups. Birds of control (T1) were fed 0.45 and 0.35% AP for age period of 0-5 and during 6^{th} wk, respectively. The AP level was reduced by an interval of 0.1% in each phase in diets of T2 to T5. While it was reduced by an interval of 0.2% in each phase in diets of T6 to T9. Birds at groups T2, T3, T4 and T5 received 0, 250, 500 and 750 units, respectively of phytase enzyme per Kg diet containing 0.35% AP. Birds at groups T6, T7, T8 and T9 received the same levels of phytase, respectively with diet containing 0.25% AP through 0-5 wk. These levels increased to 0, 500, 750 and 1000 U/Kg during 6^{th} wk.

All diets were formulated without animal protein sources to contain 3100 Kcal ME/Kg through trail weeks (0-6 wk), 22 and 18% CP through 0-5 wk and 6^{th} wk, respectively. Table 1. shows formulation and calculated composition of different experimental diets during growing and finishing periods.

A total of 270, one-day-old Hubbard chicks were housed in electrically stainless steel starter battery brooders in 9 groups, each pen contained 30 chicks. At the end of 2 wk, chicks were moved from starter to grower batteries, at the end of 4 wk of age birds moved to the floor pens until the end of trail. Diets and water were provided *ad libitum*. Light was provided 22 hr daily.

A digestibility trail was carried out to study the effect of adding phytase enzyme on ash, phosphorus and calcium retention. At the end of the experiment, numbers of 3 birds of each group were housed individually in a digestion battery. The birds were fed the test diets for 4 days for adaptation. Through another 4 days excreta collection trays were used and the feed intake was calculated.

At the end of the trail (42 days of age) six birds (3 males and 3 females) were randomly taken from each group for slaughter study. Organs of carcass were weighed. Dressed carcass percentage was calculated as percentage of empty carcass / live body weight. Ready to cook percentage was calculated as percentage of weight of total edible parts (carcass plus gizzard, liver, and heart) / live body weight.

Both the right and left tibia and femur were excised and frozen for subsequent analysis. The bone were later thawed and stripped of all soft tissues. After weights and dimensions had been recorded, left tibiae and femurs were cut at midshafts using coping saw. Wall thickness and diameter at midshaft were taken by calipers. Then, left tibiae and femurs were dried (100° C for 10 hour), weight, extracted with ether using Soxhlet procedure, dried again and weighed. The ground fat-free dry bones were ashed in muffle furnce at 600° C. Ash weight was calculated as a percentage of dry fat-free bone weight. Right tibiae and femurs were tested for breaking strength using an Instron Universal Testing Machine. Nutrient composition of diets were calculated according to **NRC, (1994)** Chemical analysis of excreta and bone was carried out as described in **Association of Official Analytical Chemists (1980)**.

Data were subjected to analysis of variance using the General Linear Model of SAS software (**SAS Institute, 1990**). Means were compared ($P<0.05$) using Duncan's multiple range test (**Duncan, 1955**).

RESULTS AND DISCUSSION

The effects of phosphorus and phytase levels on carcass parts at the end of 6 wk of age are summarized in Table 2. The main effect data showed no significant effects of AP level or phytase addition upon the relative weights of total edible parts, carcass, front part, hind part, giblets, gizzard and heart. These results are in agreement with **Huff *et al.* (1998)** who found no significant effects on parts yield. **Scheideler and Ferket (2000)** reported that overall component yield showed no detrimental effects of AP level with or without phytase, but leg quarters weight increased with phytase addition. On the other hand, **Zyla *et al.* (2001)** found that broilers consuming low phosphorus diets supplemented with phytase gave more carcass weight than birds fed the positive control diet. Also, **Ahmed *et al.* (2004)** found that phytase addition increased dressing and total meat yield.

Treatment groups of T5 and T7 attained relative liver weight higher ($P<0.05$) than that of positive control (T1). The main effect data (Table 2 and Fig 1) indicated that the decrease in AP caused significant ($P<0.05$) increases in relative liver weight by about 12.5%. However, the phytase addition (250-500 and 750-1000 U/kg diet) also increases ($P<0.05$) relative liver weight by about 13.30 and 14.2% respectively. In an agreement with the recent result, **Viveros *et al.* (2002)** found that birds fed low-P diets without phytase showed an increase ($P<0.05$) in relative liver weight, but main effect data showed no significant effect to AP level on relative liver weight. In agreement with recent result, **Ahmed *et al.* (2004)** indicated that phytase addition increased relative liver weight. While **Viveros *et al.* (2002)** reported that phytase addition reduced ($P<0.0161$) the relative liver weight. Because of the importance of phosphorus in many function of energy metabolism (**Robert *et al.*, 1999**), the increases in relative liver weight with reducing dietary AP may be due to the inefficient use of energy, so accumulate of fat in liver is responsible for liver weight.

Fig. (1): Effect of dietary phytase level on percentage of abdominal fat and liver.

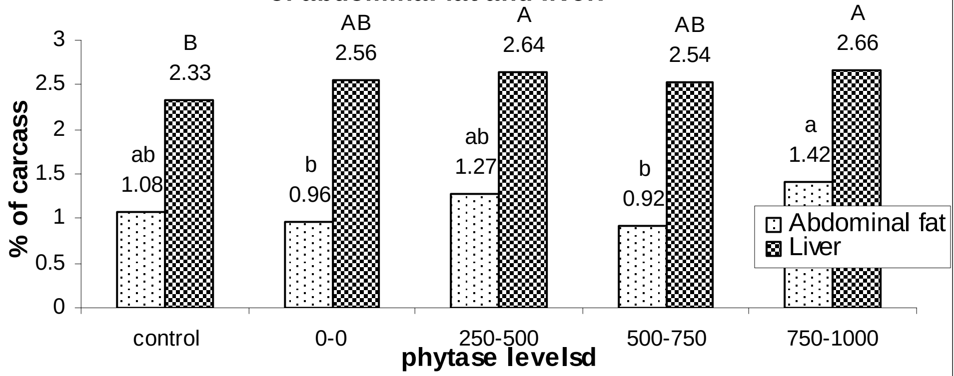


Table (3) shows the effects of phosphorus and phytase levels on relative weights of inedible parts at the end of 6 wk of age. The interaction between AP and phytase was significant for relative abdominal fat weight. The main effect data showed that AP level had no effect on abdominal fat, while phytase addition showed inconstantly effect , but highest level of phytase increased abdominal fat significantly ($P<0.05$) as shown in Table 3 and Fig 1. These results are in agreement with **Zyla *et al.* (2001)** who used a cocktail of phosphorolytic enzymes, while **Ahmed *et al.* (2004)** found a significant decrease in abdominal fat due to phytase addition.

The interaction between AP and phytase resulted in a significant effect on relative spleen weight. The main effect data showed an increase ($P<0.05$) in relative spleen weight related to reduce AP level. The addition of phytase showed the same effect except the level of 500-750 U/kg diet. **Viveros *et al.* (2002)** found that reducing AP level decreased spleen weight significantly (($P<0.0176$) but relative weight of spleen showed no significant difference due to AP level or phytase addition.

The interaction between AP level and phytase addition resulted in significant ($P<0.05$) differences among relative weights of blood, leg, head, wing, and G. I. tract while relative feather weight showed no differences (Table 3). These results of relative blood weight confirmed the results of **Ahmed *et al.* (2004)**.

The reduction in AP level content of the diet caused decreases ($P<0.05$) in relative weight of feather by 15 and 17% for 0.35-0.25 and 0.25-0.15 of AP levels respectively. The phytase addition by 250-500 and 500-

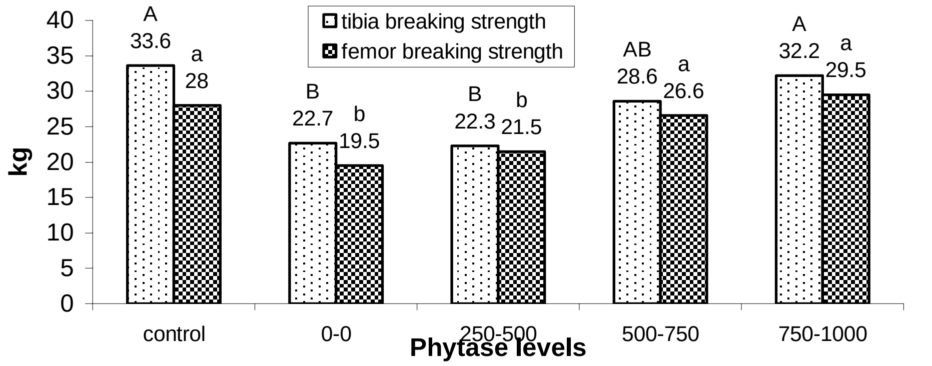
750 U/kg diet could compensate this decrease in relative weight of feather. But 750-1000 U/kg diet decreased relative weight of feather significantly. **Ahmed *et al.* (2004)** found that phytase supplementation reduce relative weight of feather significantly. It is well known that phosphorus had an important functions in amino acid metabolism and protein formation **(Robert *et al.*, 1999).**

The main effect data indicated that decreased AP level increased relative weights of leg and wing ($P<0.05$) by 10.8 and 16.8%, respectively as compared to control. The increases in leg may be unhealthy where phytase addition could restore these increases to the positive control range. Phytase addition also increased relative wing weight.

Relative head weight was decreased insignificantly with the decrease of AP level. Phytase addition regardless of AP level showed significant ($P<0.05$) but inconsistent effect on relative head weight. The main effect data showed that AP at 0.35-0.25 level significantly ($P<0.05$) increased G. I. tract, however, 0.25-0.15 level was not affected this trait as compared to control. Irrespective of AP levels, the results showed that phytase levels decreased G. I. tract percentage and could restore these decrease to the positive control range.

Data present in Table 4 showed significant interaction ($P<0.05$) between AP level and phytase for tibial and femural dimensions. The main effects data indicated that reducing dietary AP to 0.35-0.25 and 0.25-0.15% resulted in decrease ($P<0.05$) breaking strength for tibia by 22.6 and 19.9%, respectively, and the corresponding values for femur decreased by 17.7 and 14.6%, respectively as compared to control. Regardless of AP levels, birds fed low AP without phytase reduced tibial and femural breaking strength by 32.4 and 30.4%, respectively. Added phytase by 500-750 and 750-1000 U /kg diet increased ($P<0.05$) tibial breaking strength by 26.0 and 41.9%, respectively, and femural breaking strength by 36.4 and 51.3%, respectively comparing to these diets without supplementation (Fig 2). These results were in agreement with those of **Denbow *et al.* (1998), Vetesi *et al.* (1998),** and **Sohail and Roland (1999).**

Fig. (2): Effect of dietary phytase on bone breaking strength.



In the same manner, reducing dietary AP level resulted in shorter tibia and femur, while phytase addition significantly (P<0.05) increased these bone length similar to control group. While dietary AP levels had no significant (P<0.05) effect on the proximal epiphysis width, phytase addition regardless of AP levels exhibited significant (P<0.05) improve in this trait. On the other hand, the main effects data showed that width at midshaft for tibia and femur were not affected (P<0.05) by dietary AP or phytase levels. In fact, the proximal epiphysis is the growth plate region of the bone, so mineral mobilization and accretion in this area would be expected to be high, while the shaft consists of cortical bone with mineral settled together, this might explain the differences in response between the width at midshaft and proximal epiphysis.

Irrespective of dietary AP levels, birds fed low-AP without phytase insignificantly decreased mean wall thickness of tibia and significantly (P<0.05) decreased it in femur by 22.2 and 17.05%, respectively, as compared to control. Supplemental phytase improved these wall thickness but still less than the control group. While phytase levels of 750-1000 U/kg exhibited an increase in femural wall thickness comparable to those of control group. In agreement with these results, **Orban *et al.* (1999)** reported that ducks tibial thickness at midshaft exhibited a quadratic response to phytase. These bone dimension showed that dietary phytase at the level of 750-1000 U /kg improved P availability and therefore supported tibia and femur development as indicated by breaking strength, length, and wall thickness.

Data presented in Table 5 showed significant (P<0.05) interaction between P and phytase on wet weight, dry weight, and ash_weight of tibia and femur. While differences among fat free dry weight (FFDW) were not significant (P>0.05). Regardless of phytase addition, reducing AP levels resulted in decreased, tibial and femural dry weights significantly (P<0.05), while tibial and femural wet weight, FFDW, and ash weight insignificantly affected. Irrespective of AP levels, low-AP level without phytase resulted in decrease (P<0.05) tibial wet weight, dry weight, and ash weight by 13.3, 14.9, and 16.6%, respectively, as compared to control. Adding phytase increased these weights to be comparable to the control group. FFDW insignificantly affected by phytase supplementations. Phytase addition affected femur traits in the same manner. These results were in agreement with those of **Denbow *et al.* (1998)** who reported that phytase addition regularity increased toe ash weight. Also **Orban *et al.* (1999)** found that wet weight, dry weight, and ash weight of femur showed quadratic response to phytase level.

Table 6 shows the effects of phosphorus and phytase level on percentage of fat free DM, total ash, calcium and total P in tibia and femur bone of chicks. The decrease in AP level decreased fat free DM and total ash percentage of tibia and femur significantly (P<0.05), and decreased calcium and total phosphorus insignificantly. Phytase addition improved these items significantly (P<0.05).

The results on bone ash are in agreement with the results of **Atia *et al.* (2000), Yan *et al.* (2000), Zyla *et al.* (2000a), Desouky (2001), Viveros *et al.* (2002)** and **Abou-El-Wafa *et al.* (2005)** who found that phytase supplementation improved bone ash percentage markedly at lower level of AP in the diets. On the other hand, **Vetesi et al. (1998)** and **Scheideler and Ferket (2000)** reported that bone ash showed no significant dietary effect in birds fed the low AP plus phytase diet. **Abd El-Hakim (2005)** reported no significant differences were observed in broiler Ca and P retention due to the dietary AP levels, of phytase band their interaction. In agreement of recent results**, Ahmed *et al.* (2000)** and **Abou El-Wafa *et al.* (2005)** found that phytase did increase (P<0.05) P and Ca in tibia DM. In contrary**, Viveros *et al.* (2002)** reported that Ca content in tibia were increased in response to decreasing dietary AP.

The main effects data present in Table 7 shows that, birds received low-AP diets without phytase addition showed less apparent retention of DM, ash, P, Ca significantly (P<0.05). Phytase addition to low-AP diets improved (P<0.05) the retention of these items to the levels of positive control group. These results agreed with those of **Sebastian *et al.* (1996), Denbow *et al.* (1998), Zyla *et al.* (2000b), Zhang *et al.* (2000), Ahmed *et al.* (2000)** and **Viveros *et al.* (2002)** who found that phytase addition to low-P diet increased (P<0.05) the relative retention of P and Ca. However **Abou El-Wafa *et al.* (2005)** found that phytase addition to low-AP diets significantly (P<0.05) increased P retention, but insignificant differences were observed in Ca retention.

Table 7 also shows that fecal phosphorus levels were not significantly affected (P<0.05) by dietary AP levels. Phytase addition can reduce fecal phosphorus significantly (P<0.05) by about 21%. These results agreed with those of **Vetesi *et al.* (1998)**, **Waldroup *et al.* (2000), Zhang *et al.* (2000), Yan *et al.* (2001)**, and **Abou El Wfaf *et al.* (2005)** who found that P and Ca output decreased by 21 and 11%, respectively. On the other hand, **Keshavarz (2000)** reported that total P excretion were reduced due to lowering dietary AP (P<0.05) and phytase did not have any effect on P excretion.

It may be concluded that, microbial phytase supplementation to low-AP diets up to 1000 U/kg diet resulted in reduced fecal phosphorus without affecting mineral retention, carcass characteristics and bone quality.

Table (1) Ingredients and nutrient composition of grower and finisher diets.

	Grower (0-5 wk)									Finisher (6th wk)								
AP %	0.45	0.35				0.25				0.35	0.25				0.15			
Phytase U/Kg	-	0	250	500	750	0	250	500	750	-	0	500	750	1000	0	500	750	1000
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
Corn yellow	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	66.6	66.6	66.6	66.6	66.6	66.6	66.6	66.6	66.6
Soybean meal (44%)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6
Vegetable oil	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Sawdust	-	0.15	0.15	0.15	0.15	0.5	0.5	0.5	0.5	0.05	0.20	0.20	0.20	0.20	0.49	0.49	0.49	0.49
Calcium carbonate	1.44	1.8	1.8	1.8	1.8	2.0	2.0	2.0	2.0	1.2	1.6	1.6	1.6	1.6	1.86	1.86	1.86	1.86
Dicalcium phosphate	1.56	1.05	1.05	1.05	1.05	0.50	0.50	0.50	0.50	1.15	0.60	0.60	0.60	0.60	0.05	0.05	0.05	0.05
Vit.-Mineral mix.*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DL-methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	-	-	-	-	-	-	-	-	-
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Calculated values**																		
Crude protein %	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
ME (Kcal /kg)	3094	3094	3094	3094	3094	3094	3094	3094	3094	3101	3101	3101	3101	3101	3101	3101	3101	3101
Calcium %	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Av. Phosphorus %	0.45	0.35	0.35	0.35	0.35	0.25	0.25	0.25	0.25	0.35	0.25	0.25	0.25	0.25	0.15	0.15	0.15	0.15
Met + Cys %	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Lysine %	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96

* To supply Kg diet by: Vit A, 12000 IU; Vit. D, 2200 IU; Vit. E, 10 mg; Vit K_3 , 2 mg; B_1 , 1 mg; Vit B_2 , 4 mg; Vit B_6 , 1.5 mg; Vit B_{12} , 10 µg; Niacin, 30mg; Pantothenic acid, 10 mg; Folic acid, 1mg; Biotin, 50 µg; Choline chloride, 500 mg; Copper, 10 mg; Iodine, 1 mg; Iron, 30 mg; Manganese, 60 mg; Zinc, 50 mg; Cobalt,0.1mg and Selenium, 0.1 mg.

** According to NRC (1994)

Table (2): Carcass characteristics of broilers as affected by available phosphorus and phytase levels and there interactions.

Treat.	AP (%) 0-5wk	AP (%) 6th wk	Phytase U/Kg 0-5 wk	Phytase U/Kg 6th wk	Total edible parts %	Carcass %	Front part %	Hind part %	Giblets %	Gizzard %	Liver %	Heart %
T1	0.45	0.35	-	-	73.9 [ab]	68.7	38.5	30.2	5.20	2.87	2.33 [b]	0.52 [ab]
T2	0.35	0.25	0	0	72.6 [b]	67.3	36.9	30.4	5.32	2.71	2.60 [ab]	0.56 [ab]
T3	0.35	0.25	250	500	73.0 [ab]	67.4	37.4	30.0	5.61	3.10	2.51 [ab]	0.62 [ab]
T4	0.35	0.25	500	750	73.3 [ab]	67.8	37.9	29.9	5.52	3.05	2.47 [ab]	0.56 [ab]
T5	0.35	0.25	750	1000	74.8 [a]	69.1	38.2	30.9	5.71	2.98	2.73 [a]	0.61 [ab]
T6	0.25	0.15	0	0	73.9 [ab]	68.5	38.0	30.5	5.34	2.83	2.51 [ab]	0.66 [a]
T7	0.25	0.15	250	500	73.7 [ab]	67.9	38.1	29.8	5.86	3.10	2.76 [a]	0.53 [ab]
T8	0.25	0.15	500	750	74.7 [a]	69.1	38.9	30.2	5.60	2.99	2.61 [ab]	0.60 [ab]
T9	0.25	0.15	750	1000	74.1 [ab]	68.6	38.3	30.3	5.48	2.88	2.60 [ab]	0.49 [b]
Main effects												
Dietary AP levels:												
Control (0.45 – 0.35)					73.9	68.7	38.5	30.2	5.20	2.87	2.33 [b]	0.52
0.35 – 0.25					73.4	67.9	37.6	30.3	5.54	2.96	2.58 [a]	0.59
0.25 – 0.15					74.1	68.5	38.3	30.2	5.57	2.95	2.62 [a]	0.57
Phytase levels:												
Control					73.9	68.7	38.5	30.2	5.20	2.87	2.33 [b]	0.52
0 - 0					73.2	67.9	37.5	30.5	5.33	2.77	2.56 [ab]	0.61
250 – 500					73.4	67.6	37.8	29.9	5.73	3.10	2.64 [a]	0.58
500 – 750					74.0	68.4	38.4	30.0	5.56	3.02	2.54 [ab]	0.58
750 - 1000					74.4	68.8	38.2	30.6	5.59	2.93	2.66 [a]	0.55

Means in column with the same letter are not significantly different ($P>0.05$).
AP = Available Phosphorous.

Table (3): Inedible parts of broiler carcass as affected by available phosphorus and phytase levels and there interactions.

Treat.	AP (%) 0-5wk	AP (%) 6^{th} wk	Phytase U/Kg 0-5 wk	Phytase U/Kg 6^{th} wk	Abdominal fat %	Spleen %	Blood %	Feather %	Leg %	Head %	Wing %	G. I. tract %
T1	0.45	0.35	-	-	1.08 ^{ab}	0.08 ^{cd}	2.35 ^{ab}	6.63	4.43 ^{b}	3.19 ^{ab}	0.95 ^{c}	6.17 ^{b}
T2	0.35	0.25	0	0	0.91 ^{b}	0.07 ^{cd}	2.71 ^{ab}	5.70	4.93 ^{ab}	2.85 ^{bc}	0.98 ^{c}	8.70 ^{a}
T3	0.35	0.25	250	500	1.23 ^{ab}	0.10 ^{bc}	3.32 ^{a}	5.48	4.62 ^{b}	2.75 ^{c}	1.00 ^{c}	7.88 ^{ab}
T4	0.35	0.25	500	750	1.01 ^{b}	0.04 ^{d}	2.33 ^{ab}	6.05	4.62 ^{b}	3.18 ^{ab}	1.04 ^{bc}	7.88 ^{ab}
T5	0.35	0.25	750	1000	1.22 ^{ab}	0.19 ^{a}	2.75 ^{ab}	5.28	4.74 ^{ab}	3.07 ^{abc}	1.07 ^{abc}	6.32 ^{b}
T6	0.25	0.15	0	0	1.01 ^{b}	0.14 ^{b}	1.73 ^{b}	5.44	5.37 ^{a}	3.35 ^{a}	1.19 ^{a}	7.22 ^{ab}
T7	0.25	0.15	250	500	1.31 ^{ab}	0.12 ^{bc}	3.07 ^{ab}	6.07	4.90 ^{ab}	2.96 ^{bc}	1.16 ^{ab}	6.13 ^{b}
T8	0.25	0.15	500	750	0.83 ^{b}	0.10 ^{bc}	2.68 ^{ab}	5.23	4.62 ^{b}	2.99 ^{abc}	1.04 ^{bc}	7.23 ^{ab}
T9	0.25	0.15	750	1000	1.61 ^{a}	0.12 ^{bc}	2.63 ^{ab}	5.24	4.75 ^{ab}	2.82 ^{bc}	1.06 ^{abc}	6.40 ^{b}
Main effects												
Dietary AP levels:												
Control (0.45 – 0.35)					1.08	0.08 ^{b}	2.35	6.63 ^{a}	4.43 ^{b}	3.19	0.95 ^{b}	6.17 ^{b}
0.35 – 0.25					1.09	0.10 ^{ab}	2.78	5.63 ^{b}	4.73 ^{ab}	2.96	1.02 ^{b}	7.70 ^{a}
0.25 – 0.15					1.19	0.12 ^{a}	2.53	5.50 ^{b}	4.91 ^{a}	3.03	1.11 ^{a}	6.75 ^{ab}
Phytase levels:												
Control					1.08 ^{ab}	0.08 ^{bc}	2.35	6.63 ^{a}	4.43 ^{b}	3.19 ^{a}	0.95 ^{b}	6.17 ^{b}
0 - 0					0.96 ^{b}	0.11 ^{bc}	2.22	5.57 ^{b}	5.15 ^{a}	3.10 ^{ab}	1.08 ^{a}	7.96 ^{a}
250 – 500					1.27 ^{ab}	0.11 ^{b}	3.20	5.78 ^{ab}	4.76 ^{ab}	2.85 ^{b}	1.08 ^{a}	7.01 ^{ab}
500 – 750					0.92 ^{b}	0.07 ^{c}	2.51	5.64 ^{ab}	4.62 ^{b}	3.08 ^{ab}	1.04 ^{ab}	7.56 ^{ab}
750 - 1000					1.42 ^{a}	0.15 ^{a}	2.69	5.26 ^{b}	4.75 ^{ab}	2.94 ^{ab}	1.07 ^{a}	6.36 ^{b}

Means in column with the same letter are not significantly different ($P>0.05$).
AP = Available Phosphorous.

Table (4): Breaking strength and measurements of broiler tibia and femur bones as affected by AP and phytase levels and there interactions.

Treat.	AP (%)		Phytase U/Kg		Tibia					Femur				
					Breaking Strength	Length	Width at proximal epiphysis	Width at midshaft	Mean Thickness	Breaking Strength	Length	Width at proximal epiphysis	Width at midshaft	Mean Thickness
	0-5wk	6^{th} wk	0-5 wk	6^{th} wk	kg	cm	cm	cm	cm	kg	cm	cm	cm	cm
T1	0.45	0.35	-	-	33.6 ^{a}	9.403 ^{a}	2.240 ^{abc}	0.900	0.179 ^{a}	28.0 ^{ab}	6.920 ^{a}	1.703 ^{bc}	0.955 ^{cd}	0.135 ^{bc}
T2	0.35	0.25	0	0	24.2 ^{b}	8.518 ^{d}	1.983 ^{d}	0.900	0.148 ^{ab}	19.2 ^{d}	6.040 ^{c}	1.483 ^{d}	1.075 ^{ab}	0.108 ^{de}
T3	0.35	0.25	250	500	20.8 ^{b}	9.380 ^{a}	2.333 ^{ab}	0.905	0.145 ^{ab}	21.0 ^{d}	7.012 ^{a}	1.825 ^{ab}	0.985 ^{abcd}	0.108 ^{de}
T4	0.35	0.25	500	750	29.7 ^{ab}	8.870 ^{cd}	2.170 ^{c}	0.940	0.129 ^{b}	26.3 ^{bc}	6.345 ^{bc}	1.740 ^{abc}	1.090 ^{a}	0.131 ^{cd}
T5	0.35	0.25	750	1000	29.4 ^{ab}	9.010 ^{bc}	2.225 ^{bc}	0.895	0.158 ^{ab}	31.7 ^{a}	6.537 ^{b}	1.770 ^{abc}	0.975 ^{abcd}	0.159 ^{a}
T6	0.25	0.15	0	0	21.2 ^{b}	8.805 ^{cd}	2.088 ^{cd}	0.868	0.145 ^{ab}	19.7 ^{d}	6.185 ^{bc}	1.730 ^{abc}	0.888 ^{d}	0.117 ^{cde}
T7	0.25	0.15	250	500	23.9 ^{b}	8.915 ^{c}	2.150 ^{c}	0.833	0.141 ^{ab}	21.9 ^{cd}	6.445 ^{b}	1.705 ^{bc}	0.970 ^{bcd}	0.098 ^{e}
T8	0.25	0.15	500	750	27.5 ^{ab}	8.920 ^{c}	2.113 ^{cd}	0.945	0.173 ^{ab}	26.8 ^{abc}	6.377 ^{bc}	1.660 ^{c}	0.943 ^{cd}	0.123 ^{cd}
T9	0.25	0.15	750	1000	34.9 ^{a}	9.328 ^{ab}	2.383 ^{a}	0.925	0.161 ^{ab}	27.2 ^{ab}	6.965 ^{a}	1.843 ^{a}	1.028 ^{abc}	0.154 ^{ab}
Main effects														
Dietary AP levels:														
Control (0.45 – 0.35)					33.6 ^{a}	9.403 ^{a}	2.240	0.900	0.179 ^{a}	28.0 ^{a}	6.920 ^{a}	1.703	0.955	0.153
0.35 – 0.25					26.0 ^{b}	8.944 ^{b}	2.178	0.910	0.145 ^{b}	24.6 ^{b}	6.484 ^{b}	1.704	1.031	0.126
0.25 – 0.15					26.9 ^{b}	8.992 ^{b}	2.183	0.893	0.154 ^{b}	23.9 ^{b}	6.493 ^{b}	1.734	0.957	0.123
Phytase levels:														
Control					33.6 ^{a}	9.403 ^{a}	2.240 ^{ab}	0.900	0.189 ^{a}	28.0 ^{a}	6.920 ^{a}	1.703 ^{a}	0.955	0.135 ^{b}
0 - 0					22.7 ^{b}	8.661 ^{c}	2.035 ^{c}	0.884	0.147 ^{ab}	19.5 ^{b}	6.113 ^{b}	1.606 ^{c}	0.981	0.112 ^{cd}
250 – 500					22.3 ^{b}	9.147 ^{ab}	2.241 ^{ab}	0.869	0.143 ^{b}	21.5 ^{b}	6.729 ^{a}	1.765 ^{ab}	0.978	0.103 ^{d}
500 – 750					28.6 ^{ab}	8.895 ^{bc}	2.141 ^{bc}	0.943	0.151 ^{ab}	26.6 ^{a}	6.361 ^{b}	1.700 ^{b}	1.016	0.127 ^{bc}
750 - 1000					32.2 ^{a}	9.169 ^{ab}	2.304 ^{a}	0.910	0.159 ^{ab}	29.5 ^{a}	6.751 ^{a}	1.806 ^{a}	1.001	0.157 ^{a}

Means in column with the same letter are not significantly different (P>0.05).
AP = Available Phosphorous.

Table (5): Wet weight, dry weight, fat free dry weight and ash weight of broiler tibia and femur bones as affected by available phosphorus and phytase levels and there interactions.

Treat.	AP (%)		Phytase U/Kg		Tibia				Femur			
	0-5wk	6th wk	0-5 wk	6th wk	Wet weight	Dry weight	Fat free dry weight	Ash weight	Wet weight	Dry weight	Fat free Dry weight	Ash weight
					g	g	g	g	g	g	g	g
T1	0.45	0.35	-	-	5.93 a	5.56 a	4.15	2.258 a	4.07 abcd	3.77 ab	2.67	1.364 abc
T2	0.35	0.25	0	0	4.80 c	4.38 c	3.88	1.695 c	3.28 e	2.97 de	2.56	1.068 d
T3	0.35	0.25	250	500	6.06 a	5.16 abc	4.26	2.210 ab	4.16 abc	4.00 a	2.88	1.468 ab
T4	0.35	0.25	500	750	5.85 ab	5.44 ab	4.16	2.135 ab	4.38 ab	4.07 a	3.03	1.548 a
T5	0.35	0.25	750	1000	5.48 abc	5.09 abc	4.23	2.134 ab	3.79 abcde	3.63 abc	2.89	1.417 abc
T6	0.25	0.15	0	0	5.48 abc	5.09 abc	4.10	2.072 abc	3.62 bcde	3.34 bcd	2.51	1.125 d
T7	0.25	0.15	250	500	4.90 bc	4.52 bc	3.74	1.836 bc	3.43 cde	3.20 cde	2.52	1.208 cd
T8	0.25	0.15	500	750	5.55 abc	5.13 abc	4.28	2.178 ab	3.36 de	2.71 e	2.53	1.245 bcd
T9	0.25	0.15	750	1000	6.18 a	5.74 a	4.44	2.304 a	4.51 a	4.07 a	2.96	1.496 a
Main effects												
Dietary AP levels:												
Control (0.45 – 0.35)					5.93	5.56 a	4.15	2.258	4.07	3.77 a	2.57	1.365
0.35 – 0.25					5.55	5.01 b	4.13	2.044	3.90	3.67 ab	2.84	1.375
0.25 – 0.15					5.53	5.12 ab	4.14	2.135	3.73	3.33 b	2.63	1.268
Phytase levels:												
Control					5.93 a	5.56 a	4.15	2.258 a	4.07 a	3.77 ab	2.57	1.365 a
0 - 0					5.14 b	4.73 b	3.99	1.884 b	3.45 b	3.15 c	2.54	1.096 b
250 – 500					5.48 ab	4.84 ab	4.00	2.086 ab	3.80 ab	3.60 ab	2.70	1.338 a
500 – 750					5.70 ab	5.28 ab	4.22	2.153 ab	3.87 ab	3.40 bc	2.78	1.396 a
750 - 1000					5.83 ab	5.41 ab	4.33	2.219 a	4.15 a	3.85 a	2.92	1.457 a

Means in column with the same letter are not significantly different (P>0.05).
AP = Available Phosphorous.

Table (6): Minerals content in broiler tibia and femur bones as affected by available phosphorus and phytase levels and there interactions.

Treat.	AP (%)		Phytase U/Kg		Tibia				Femur			
	0-5wk	6^{th} wk	0-5 wk	6^{th} wk	Fat free dry Matter %	Total ash %	Total phosph. %	Total calcium %	Fat free dry matter %	Total ash %	Total phosph. %	Total calcium %
T1	0.45	0.35	-	-	92.14 ^{a}	54.41 ^{a}	12.73 ^{ab}	37.50	92.49 ^{a}	53.18 ^{a}	13.15 ^{ab}	33.63 ^{ab}
T2	0.35	0.25	0	0	90.87 ^{c}	43.76 ^{c}	9.84 ^{c}	28.18	91.05 ^{c}	41.74 ^{d}	11.49 ^{b}	30.45 ^{b}
T3	0.35	0.25	250	500	91.83 ^{ab}	52.30 ^{ab}	13.00 ^{ab}	30.00	91.79 ^{b}	51.55 ^{ab}	12.92 ^{ab}	37.12 ^{ab}
T4	0.35	0.25	500	750	91.53 ^{b}	51.41 ^{ab}	13.30 ^{ab}	37.73	91.61 ^{bc}	51.18 ^{ab}	13.78 ^{ab}	41.36 ^{a}
T5	0.35	0.25	750	1000	91.96 ^{a}	50.56 ^{b}	11.45 ^{bc}	31.14	91.45 ^{bc}	49.09 ^{b}	15.52 ^{a}	37.27 ^{ab}
T6	0.25	0.15	0	0	91.98 ^{a}	50.74 ^{ab}	8.85 ^{c}	27.23	91.61 ^{bc}	44.75 ^{cd}	11.16 ^{b}	33.18 ^{ab}
T7	0.25	0.15	250	500	91.81 ^{ab}	49.43 ^{b}	9.48 ^{c}	31.59	91.33 ^{bc}	48.23 ^{bc}	13.26 ^{ab}	33.18 ^{ab}
T8	0.25	0.15	500	750	92.14 ^{a}	50.85 ^{ab}	14.87 ^{a}	37.28	91.47 ^{bc}	49.07 ^{b}	12.44 ^{ab}	36.82 ^{ab}
T9	0.25	0.15	750	1000	92.17 ^{a}	52.03 ^{ab}	15.60 ^{a}	38.41	91.70 ^{bc}	50.72 ^{ab}	12.25 ^{ab}	29.03 ^{b}
Main effects												
Dietary AP levels:												
Control (0.45 – 0.35)					92.14 ^{a}	54.41 ^{a}	12.73	37.50	92.49 ^{a}	53.18 ^{a}	13.15	33.63
0.35 – 0.25					91.54 ^{b}	49.50 ^{b}	11.90	31.76	91.47 ^{b}	48.39 ^{b}	13.43	36.55
0.25 – 0.15					92.02 ^{a}	50.76 ^{b}	12.20	33.62	91.53 ^{b}	48.19 ^{b}	12.28	33.05
Phytase levels:												
Control					92.17 ^{a}	54.41 ^{a}	12.73 ^{ab}	37.50 ^{a}	92.49 ^{a}	53.18 ^{a}	13.15	33.63 ^{ab}
0 - 0					91.42 ^{c}	47.25 ^{c}	9.34 ^{c}	27.70 ^{b}	91.33 ^{b}	43.24 ^{c}	11.32	31.81 ^{b}
250 – 500					91.82 ^{b}	50.86 ^{b}	11.24 ^{bc}	30.80 ^{ab}	91.56 ^{b}	49.89 ^{b}	13.09	35.15 ^{ab}
500 – 750					91.84 ^{ab}	51.13 ^{b}	14.08 ^{a}	37.50 ^{a}	91.54 ^{b}	50.12 ^{b}	13.11	39.09 ^{a}
750 - 1000					92.06 ^{ab}	51.29 ^{b}	13.52 ^{a}	34.77 ^{ab}	91.57 ^{b}	49.91 ^{b}	13.89	33.81 ^{b}

Means in column with the same letter are not significantly different ($P>0.05$).
AP = Available Phosphorous.

Table (7): Apparent retention and fecal phosphorus as affected by available phosphorus and phytase levels and there interactions.

Treat.	AP (%) 0-5wk	AP (%) 6th wk	Phytase U/Kg 0-5 wk	Phytase U/Kg 6th wk	Apparent retention DM	Apparent retention Ash	Apparent retention P	Apparent retention Ca	Fecal phosph.
T1	0.45	0.35	-	-	77.34 abc	34.32 a	56.98 a	41.21 abc	0.980
T2	0.35	0.25	0	0	75.20 bc	22.70 ab	42.11 ab	33.80 c	0.947
T3	0.35	0.25	250	500	77.80 abc	24.48 ab	45.01 a	44.32 abc	0.880
T4	0.35	0.25	500	750	75.77 bc	36.05 a	53.21 a	46.75 a	0.837
T5	0.35	0.25	750	1000	75.92 bc	21.18 ab	45.64 a	42.60 abc	0.777
T6	0.25	0.15	0	0	73.03 c	14.10 b	26.26 b	34.69 bc	0.887
T7	0.25	0.15	250	500	78.38 ab	34.93 a	42.15 ab	42.13 abc	0.893
T8	0.25	0.15	500	750	78.38 ab	35.73 a	42.30 ab	46.04 ab	0.850
T9	0.25	0.15	750	1000	81.41 a	36.44 a	52.98 a	51.36 a	0.773
Main effects									
Dietary AP levels:									
Control (0.45 – 0.35)					77.34	34.32	56.98 a	41.21	0.980
0.35 – 0.25					76.17	26.10	46.50 ab	41.87	0.860
0.25 – 0.15					77.80	30.30	40.92 b	43.56	0.851
Phytase levels:									
Control					77.34 ab	34.32 a	56.98 a	41.21 ab	0.980 a
0 - 0					74.11 b	18.40 b	34.18 b	34.25 b	0.917 ab
250 – 500					78.09 a	29.71 ab	43.58 ab	43.22 a	0.887 ab
500 – 750					77.08 ab	35.89 a	47.76 a	46.40 a	0.843 ab
750 - 1000					78.67 a	28.81 ab	49.31 a	46.98 a	0.775 b

Means in column with the same letter are not significantly different (P>0.05).
AP = Available Phosphorous.

REFERENCES

Abd El-Hakim, A. S. (2005) *Effect of using different levels of available phosphorus and microbial phytase on the performance of broiler. 3rd International Poultry Conference, Hurgada – Egypt.*

Abd El-Hakim, A. S. and Abd-Elsamee, M. O. (2004) *Effect of feeding systems and phytase supplementation on the performance of broiler chicks during summer season. Egypt. Poultry Sci. 24:297-310.*

Abou El-Wafa, S.; El-Husseiny, O. M. and Shabaan, M. (2005) *Influence of microbial phytase and energy levels on broiler performance fed low-phosphorus diet. 3rd International Poultry Conference, Hurgada – Egypt.*

Ahmed, T.; Rasool, S.; Sarwar, M.; Haq, A. and Zia-ul Hasan (2000). *Effect of microbial phytase produced from a fungus Aspergillus niger on bioavailability of phosphorus and calcium in broiler chickens. Anim. Feed Sci. Technol. 83: 103-114.*

Ahmed; A.; Rahman, M. S.; Ahmed, S. U. and Miah, M. Y. (2004). *Performance of broiler on phytase supplemented soybean meal based diet. Inernational Journal of Poultry Science 3 (4):266-271.*

Association of Official Analytical Chemists (1980). *Official Methods of Analysis. 13 th ed., pub. By the "A.O.A.C." Benjamin Franklin Station Washington, D. C.*

Atia, F. A.; Waibel, P. E.; Hermes, I; Carlson, C. W., and Walser, M. M. (2000) *Effect of dietary phosphorus, calcium, and phytase on performance of growing Turkeys. Poultry Sci. 78:231-239.*

Denbow, D. M.; Elizabeth A. Grabau; George H. Lacy; E. T. Kornegay; David R. Russell and Paul F. Umbeck (1998) *Soybean transformed with a fungal phytase gene improve phosphorus availability for broilers. Poultry Sci. 77:878-881.*

Desouky, Zeinb, M. A. (2001) *Effect of supplemental microbial phytase on productive performance of broiler chickens. Ph. D. Thesis, Faculty of Agric., Ain Shams University, Egypt.*

Duncan, D. B. (1955) *Multiple Range and Multiple F Tests. Biometric, 11:1-42.*

El-Nagmy, K. Y.; Abd-Elsamee, M. O. and Ibrahim, M. R. M. (2004) *Effect of dietary plant protein and microbial phytase levels on performance of broiler chicks. Egypt. Poultry Sci. 24:101-121.*

Huff, W. E.; Moore, P. A.; Waldroup, P. W.; Waldroup, A. L.; Balog, J. M.; Huff, G. R.; Rath, N. C.; Daniel, T. C.; and Raboys, V. (1998). *Effect of dietary phytase and high available phosphorus corn on broiler chicken performance. Poultry Sci. 77:1899-1904.*

Keshavarz, K (2000) *Nonphytate phosphorus requirement of laying hens with and without phytase on a phase feeding program. Poultry Sci. 79:748-63.*

National Research Council, NRC, (1994). *Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press. Washington, DC.*

Orban, J. I.; Adeola, O.; and Stroshine, R. (1999). *Microbial phytase in finisher diets of white Pekin ducks: Effect on growth performance, plasma phosphorus concentration, and leg bone characteristics. Poultry Sci. 78:366-377.*

Perney, K. M.; Cantor A. H.; Straw, M. L. and Herkelman, K. L. (1993) *The effect of dietary phytase on growth performance and phosphorus utilization of broiler chickens. Poultry Sci. 72: 2106-2114.*

Ravindran, V.; Kornegay, E. T.; Denbow, D. M.; YI, Z.; Hulet, R. M. (1995). *Response of turkey poults to tiered levels of natuphos phytase added to soybean meal-based semi-purified diets containing three levels of nonphytate phosphorus. Poultry Sci. 74:1843-1854.*

Robert K. Murray; Daryl K. Granner; Peter A. Mayes; and Victor W. Rodwell (1999) *HARPER'S BIOCHEMISTRY. 25th edition. Appelton & Lange Norwalk, Connecticut/San Mateo, California.*

SAS Institute (1990) *SAS/State User's guide 6-03 ed.,SAS institute inc.,Cary NC. USA.*

Scheideler, S. E. and Ferket, P. R. (2000). *Phytase in broiler rations: effects on carcass yields and incidence of tibial dyschondroplasia. J. Appl. Poultry Res. 9:468-475.*

Sebastian S.; Touchburn SP; Chavez ER and Lague PC (1996) *Efficacy of supplemental microbial phytase at different dietary calcium levels on growth performance and mineral utilization of broiler chickens. Poultry Sci. 75: 1516-23.*

Sebastian S.; Touchburn SP; Chavez ER and Lague PC (1997) *Apparent digestibility of protein and amino acids in broiler chickens fed a corn-soybean diet supplemented with microbial phytase. Poultry Sci. 76:1760-1769.*

Sohail, S. S. and Roland, D. A. (1999) *influence of supplemental phytase on performance of broilers four to six weeks of age. Poultry Sci.78(4):550-5.*

Vetesi, M.; Mezes M.; Baskay G. and Gelencser E. (1998) *Effects of phytase supplementation on calcium and phosphorus output, production traits and mechanical stability of the tibia in broiler. Acta Vet Hung; 46: 231-42.*

Viveros, A.; Brenes, A.; Arija, I. and Centeno, C. (2002) *Effects of Microbial phytase supplementation on mineral utilization and serum enzyme activities in broiler chicks fed different levels of phosphorus. Poultry Sci. 81:1172-1183.*

Waldroup, P. W.; Kersey, J. H.; Saleh, E. A.; Fritts, C. A.; Yan, F.; Stilborn, H. L. and Crum, R. C. (2000) *Nonphytate phosphorus requirement and phosphorus excretion of broiler chicks fed diets composed of normal or high available phosphate corn with and without microbial phytase. Poultry Science 78:1451-1459.*

Yan, F.; Kersey, J. H.; Fritts, C. A.; Waldroup, P. W.; Stilborn, H. L. and Crum, R. C. (2000) *Evaluation of normal yellow dent corn and high available phosphorus corn in combination with reduced dietary phosphorus and phytase supplementation for broiler grown to market weights in litter pens. Poultry Sci. 79:1282-1289.*

Yan, F.; Kersey, J. H.; and Waldroup, P. W. (2001). *Phosphorus requirements of broiler chicks three to six weeks of age as influenced by phytase supplementation. Poultry Sci. 80:455-459.*

Zhang, Z. B.; Kornegay, E. T.; Radcliffe, J. S.; Denbow, D. M.; Veit, H. P. and Larsen, C. T. (2000) *Comparison of genetically engineered microbial and plant phytase for young broilers. Poultry Sci. 78: 709-717.*

Zyla, K.; Koreleski, J.; Swiatkiewcz, S.; Ledouxs, D. R. and Piironen, J. (2001). *Influence of supplemental enzymes on the performance and phosphorus excretion of broilers fed wheat-based diet to 6 weeks of age. Animal Feed Science and Technology 89:113-118.*

Zyla, K.; Koreleski, J.; Swiatkiewicz, S.; Wikiera, A.; Kujawski, M., Piironen, J., and Ledouxs, D. R. (2000a) *Effects of phosphorolytic and cell wall-degrading enzymes on the performance of growing broilers fed wheat-based diets containing different calcium levels. Poultry Sci. 78:66-76.*

Zyla, K.; Wikiera, A.; Koreleski, J.; Swiatkiewicz, S.; Piironen, J., and Ledouxs, D. R. (2000b) *Comparison of the efficacies of a novel Aspergillus niger mycelium with separate and combined effectiveness of phytase, acid phosphatase, and pectinase in dephosphorylation of wheat-based feeds fed to growing broilers. Poultry Sci. 78:1434-1443.*

الملخص العربي

تأثير إنزيم الفيتيز في علائق بدارى المائدة النباتية المحتوية على مستويات متدرجة الانخفاض من الفوسفور المتاح
٢- خصائص الذبيحة وجودة العظام واحتجاز المعادن

أيمن محمد صبري حماد*

* قسم تغذية الحيوان والدواجن – مركز بحوث الصحراء – المطرية - القاهرة

أجريت هذه التجربة في محطة بحوث رأس سدر- سيناء لاختبار تأثير مستويان من الفوسفور المتاح (٠,٣٥ ، ٠,٢٥% في علائق النمو ؛ ٠,٢٥ ، ٠,١٥% في علائق الإنهاء على الترتيب) وأربعة مستويات من إنزيم الفيتيز (٠ ، ٢٥٠ ، ٥٠٠ ، ٧٥٠ وحدة/ كجم في علائق النمو و ٠ ، ٥٠٠ ، ٧٥٠ ، ١٠٠٠ وحدة / كجم في علائق الإنهاء على الترتيب) على أداء بدارى المائدة المغذاة على عليقة بروتين نباتي مقارنة بعليقة التحكم.

أظهرت النتائج عدم وجود تأثير معنوي لمستوى الفوسفور أو الفيتيز المضاف على الوزن النسبي لكل من الأجزاء المأكولة ، الأجزاء الأمامية ، الأجزاء الخلفية ، القانصة ، القلب. أدى انخفاض الفوسفور المتاح إلى زيادة معنوية (P<0.05) في الوزن النسبي للكبد بمقدار ١٢,٥%. كما أدى انخفاض الفوسفور المتاح في العليقة إلى نقص معنوي في الوزن النسبي للريش بمقدار ١٥ ، ١٧% لمستويات ٠,٣٥-٠,٢٥ ، ٠,٢٥-٠,١٥ % فوسفور متاح على الترتيب.

أدى انخفاض الفوسفور المتاح (٠,٣٥-٠,٢٥ ، ٠,٢٥-٠,١٥ %) إلى نقص قوة تحمل العظام للضغط عظمة الساق بمقدار ٢٢,٦ ، ١٩,٩% على الترتيب وعظمة الفخذ بمقدار ١٧,٧ ، ١٤,٦% على الترتيب. كما أدى انخفاض الفوسفور المتاح في العليقة إلى نقص طول عظمة الساق والفخذ. أدت إضافة الفيتيز إلى زيادة طول هذه العظام معنويا (P<0.05) . عظام الساق والفخذ للطيور التي حصلت على علائق منخفضة الفوسفور المتاح دون إضافة فيتيز أظهرت نقصا في سمك الجدار بمقدار ٢٢,٢ ، ١٧,٠٥% على الترتيب، إضافة الفيتيز حسنت سمك الجدار ولكنها ظلت أقل من مجموعة التحكم. أدت التغذية على علائق منخفضة الفوسفور المتاح دون إضافة فيتيز إلى نقص الوزن الرطب والوزن الجاف ووزن الرماد في عظمة الساق بمقدار ١٣,٣ ، ١٤,٩ ، ١٦,٦% على الترتيب ، إضافة الفيتيز أعاد هذه الأوزان إلى مستوى مجموعة التحكم.

أدت إضافة الفيتيز إلى العلائق منخفضة الفوسفور إلى تحسن معنوي(P<0.05) في احتجاز المادة الجافة والرماد والفوسفور والكالسيوم. كما أدت إلى خفض فوسفور الزرق معنويا(P<0.05) بمقدار ٢١%، وإلى تحسن الكفاءة الاقتصادية لتصبح ١٢٠% من مجموعة التحكم.

مما سبق نستنتج أن إضافة الفيتيز الميكروبي في علائق بدارى المائدة منخفضة الفوسفور المتاح بمعدل يصل إلى ١٠٠٠ وحدة/كجم أدت إلى انخفاض فوسفور الزرق وزيادة الكفاءة الاقتصادية دون التأثير على جودة الذبيحة والعظام.