J. Agric. Sci. Mansoura Univ., 30 (7): 3599 - 3609, 2005

EFFECT OF PHYTASE SUPPLEMENTATION TO ENERGY-DEFICIENT DIETS ON THE GROWTH PERFORMANCE OF BROILER CHICKS

Abd El-Gawad, A.H. [1], **A. A. Hemid** [2] **and M.M.A. El-Moniary** [1]

(1) Department of Animal Production, National Research Centre, Dokki, Cairo, Egypt.

(2) Department of Poultry Production, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

ABSTRACT

A total number of 175, day-old unsexed "Arbor Acres" broiler chicks were conducted to study the effects of phytase supplementation on growth performance, efficiency of energy utilization, carcass characteristics, and tibia measurements of broiler chicks fed energy-deficient diets. Chicks were divided into five experimental groups, each of 35 chicks (7 replicates of each group) to receive one of the five experimental diets (control, 75 kcal ME less than control, 150 kcal ME less than control, 75 kcal ME less than control + phytase, 150 kcal ME less than control + phytase). The feeding period was extended for 49 days.

The results obtained are summarized as follows:

1-Broiler chicks fed energy-deficient diets recorded lower values ($P<0.05$) of live body weight; weight gain and depressed feed conversion ratio and relative energy efficiency compared to control diet.

2-Addition of phytase to the energy-deficient diets significantly increased live body weight (LBW), body weight gain (BWG) and improved feed conversion ratio and relative energy efficiency.

3-No significant effects were found on percentages of dressing, liver, gizzard, heart, abdominal fat, total edible parts, breast meat, and thighs meat.

4-Tibia measurements (DTW, TL, TW, TBS and tibia content of ash, Ca and P) of birds fed the control diet reformulated with phytase did not differ from those of birds fed energy-deficient or control diets.

In general, it could be recommended that reformulation energy-deficient diets by phytase supplementation could restore body weight gain and improve feed conversion ratio.

INTRODUCTION

Real or perceived health benefits and technological advances have contained to result in change in poultry diet. Interest in the formulation of poultry diets based on plant derived ingredients (grains, legumes and oil seed meal) without feedstuffs of animal origin are increasing.

These products contain phytic acid, which has the ability to bind and form complexes with cations necessary in body function and metabolism. The body cannot properly use cations that are bound by phytate phosphorus (Hatten *et al.*, 2001).

Phytic acid (myo-inositol 1, 2, 3, 4, 5, 6 Hexakis) , an inositol with 1 to 6-phosphodihydrogen phosphate has been considered unavailable to monogasteric animals because they lack the proper enzyme system to hydrolyze phytate (Murai *et al.*, 2002).

Because, phytate can complex with minerals, starch, protein and digestive enzymes, it also has anti-nutritional properties (Kies *et al.*, 2001). Phytase is an enzyme that hydrolyzes phytate to inosital and inorganic phosphate (Viveros *et al.*, 2002). Therefore, the use of exogenous phytase to ameliorate the effect of phytic acid has received increased attention. (Murai *et al.*, 2002). The value of microbial phytase in the rising phytate-bound phosphorous (P) and improving P availability of plant ingredient for poultry is well documented (Coelho and Kornegay, 1996).

Current evidence shows that by releasing phytic-acid-bound nutrients, dietary phytase improves protein digestibility, and dietary nutritive value in monogasteric animals (Yi *et al.*, 1996, Sebastian *et al.*, 1997, Ravindran *et al.*, 1999b).

Rojas and Scott (1969) found that the metabolizable energy values of several different types of cottonseed meal were improved by treatment with phytase obtained from *Aspergillus ficcum*.

Numbers of studies have demonstrated generally positive effect of supplemental phytase on apparent metabolizable energy (AME) of poultry diets (Farrell and Martin 1998, Ledoux *et al.*, 1999, Namkung and Leeson, 1999, Selle *et al.*, 1999 and Ravindran *et al.*, 2000). Most of them used recommend level of AME of diets supplemented with different levels of phytase. Accordingly, this study was designed to investigate the effect of phytase enzyme supplementation on the growth performance of broiler fed phosphorus adequate and AME- deficient diets.

MATERIALS AND METHODS

The present study was carried out at the poultry Nutrition Research Farm, Poultry Production Department, Faculty of Agriculture, Ain Shams University.

Birds and Management:

A total of 175, day-old unsexed "Arbor Acres" broiler chicks were obtained from commercial hatchery. The chicks were allocated to 35 pens, each pen containing 5 chicks; to receive five dietary treatments of corn-soybean meal-based diet with 7 replicates of each treatment. The birds were housed in battery brooders in an open house with 23-h constant overhead fluorescent lighting for 7 weeks. At the end of each experimental period (21, 37 or 49 days of age), birds were weighed and feed consumption was recorded for feed conversion calculation.

Diets:

Five experimental diets, containing varying levels of ME (kcal/kg) were formulated. Control diet (1) was formulated to contain the recommended nutrient requirements of "Arbor Acres". Diets (2) and (3) were similar to control diet (1) except that diet (2) contained lower ME level by 75 Kcal/kg while diet (3) contained 150 Kcal ME/kg less than control diet (1). Diets (2) and (3) were supplemented with 500 FTU phytase/kg diet, resulting diets (4) and (5), respectively.

The birds of the experimental treatments fed starter diets (from 1 to 21 days of age), grower diets (22-37 days of age) and finisher diets (38 to 49 days of age). Feed and water were allowed *ad libitum.*

The composition of the experimental diets and their calculated analysis are shown in Table (1).

Table (1): Formulation and calculated analysis of the experimental diets.

Ingredients	Starter diets (0-21 d.)			Grower diets (22-37 d.)			Finisher diets (38-49 d.)		
	1	2	3	1	2	3	1	2	3
Yellow corn	55.00	56.65	58.30	62.85	64.55	66.25	69.45	71.35	71.10
Soybean meal (44)	29.00	28.85	28.76	21.70	21.55	21.35	15.90	15.45	18.30
Corn gluten meal	8.50	8.40	8.22	7.80	7.65	7.55	8.50	8.54	6.65
Soy oil	3.20	1.80	0.42	3.50	2.10	0.70	2.15	0.66	-
Limestone	1.61	1.61	1.61	1.50	1.50	1.50	1.44	1.44	1.44
Mono Ca phos.	1.60	1.60	1.60	1.58	1.58	1.58	1.45	1.45	1.45
DL. Methionine	0.11	0.11	0.11	0.10	0.10	0.10	0.08	0.08	0.10
L-Lysine HCl	0.25	0.25	0.25	0.25	0.25	0.25	0.32	0.32	0.25
NaCl	0.43	0.43	0.43	0.42	0.42	0.42	0.41	0.41	0.41
Premix*	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100	100	100	100	100
Calculated analysis**									
Crud protein %	23.00	23.0	23	20.00	20.00	20.0	18.5	18.5	18.5
ME (Kcal/kg diet)	3100	3025	2950	3200	3125	3050	3200	3125	3050
Calcium %	0.97	0.97	0.97	0.90	0.90	0.90	0.85	0.85	0.85
Av. phosphorus %	0.47	0.47	0.47	0.45	0.45	0.45	0.41	0.41	0.42
Methionine %	0.51	0.51	0.51	0.46	0.46	0.46	0.43	0.43	0.44
Met.+ Cystine	0.92	0.92	0.92	0.82	0.82	0.82	0.77	0.77	0.78
Lysine %	1.20	1.20	1.20	1.02	1.02	1.02	0.94	0.94	0.94
Na %	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
EE %	5.70	4.37	3.07	5.96	4.90	3.57	5.11	3.70	3.01
CF %	3.35	3.37	3.40	3.00	3.03	3.05	2.75	2.76	2.93

- Phytase supplemented diets (2) and (3) resulted diets (4) and (5).

*Each 3Kg contains: Vit.A 12,000,000 IU ; Vit D_3 2.200,000 IU ; Vit.E 10g ; Vit K 2g ; Vit B_1 1g ; Vit.B_2 5g ; Vit B_6 1.5 g ; Vit B_{12} 10mg ; Niacin 30g ; pantothenic acid 10g ; Folic acid 1g ; Biotin 50mg ; Choline 300g ; Iron 30g ; Iodine 1g ; Zinc 50g ; Manganese 60g ; Copper 4g ; Selenium 100 mg ; Cobalt 100 mg .

** According to Tables of NRC (1994).

Slaughter and bone parameters:

At the end of 7 weeks of age, 7 birds from each experimental treatment were randomly selected and slaughtered. The percentage values of dressing, liver, gizzard, heart, abdominal fat, giblets, total edible parts, breast meat and thighs meat were calculated as a percent of the live body weight of the slaughtered bird's sample.

Tibia of left leg was removed, cleaned of flesh and all soft tissues. Dry tibia weight (DTW) and tibia length (TL) and width (TW) were measured using a caliper as described by Samejima, (1990). Tibia breaking strength (TBS) was measured using a universal testing machine (Tinuls Olsen to ting machine Co.) in Faculty of Engineering, Ain Shams University. Tibia bone was oven-dried at 80°C until obtaining a constant weight to determine the dry tibia weight, then ground, dried at 105 °C up to constant weight and ashed in a muffle furnace at 600 °C for 6-h for conducting the chemical analysis according to the methods of A.O.A.C (1990). Tibia ash was calculated as a percentage of dry tibia weight.

Statistical Analyses:

Data were statistically analyzed using the general linear model (SX, 1992). A simple one-way classification analysis of variance was used followed by LSD test for testing the significance between means.

RESULTS AND DISCUSSION

Growth performance:

The influence of dietary treatments on broiler performance is summarized in Table (2). The decrease in ME content of the experimental diets depressed body weight by 5.7 and 14.9% and impaired feed conversion ratio by 6.9 and 11.1% at 21 days of age for chicks fed diets (2) and (3), respectively. However, at 37 days of age, body weight depressed significantly (P< 0.05) by 12.1 and 15.8% and feed conversion ratio injured significantly (P< 0.05) by 6.0 and 10.4% for birds fed energy-deficient diets (2) and (3), respectively.

Table (2): The effect of dietary treatments on growth performance.

Items	Control Diet (1)	-75 Kcal Diet (2)	-150 Kcal Diet (3)	-75 Kcal + phy* Diet (4)	-150 Kcal + phy* Diet (5)
Initial weight (g/bird)	43.6 ± 1.29	44.7 ± 1.15	45.4 ± 1.80	43.4 ± 1.15	45.0 ± 1.20
(0-21) days of age:					
Body weight (g/bird)	626.6 a ± 13.65	590.9 ab ± 24.99	533.4 b ± 16.21	610.6 a ± 23.52	571.6 ab ± 25.14
Body weight gain (g/bird)	583 a ± 13.56	546.2 ab ± 24.99	488 b ± 16.21	567.2 a ± 23.52	526.6 ab ± 25.14
Feed intake (g/bird)	907 ± 22.99	909 ± 44.48	867 ± 20.12	905 ± 41.01	858 ± 48.45
FCR	1.555 d ± 0.019	1.663 b ± 0.012	1.728 a ± 0.022	1.595 cd ± 0.024	1.626 bc ± 0.025
(0-37) days of age:					
Body weight (g/bird)	1693.7a ± 34.75	1489.2 b ± 57.73	1426.8 b ± 29.03	1660.8 a ± 75.64	1536.5 ab ± 67.96
Body weight gain (g/bird)	1650.1 a ± 33.83	1444.5 b ± 56.92	1381.4 b ± 28.11	1617.4 a ± 74.78	1491.5 ab ± 67.25
Feed intake (g/bird)	3263 ± 81.46	3026 ± 118.99	3015 ± 71.05	3279 ± 163.20	3134 ± 157.01
FCR	1.977 c ± 0.024	2.095 b ± 0.008	2.183 a ± 0.025	2.026 c ± 0.009	2.099 b ± 0.020
(0-49) days of age:					
Body weight (g/bird)	2664.4 a ± 47.00	2391.5 b ± 90.00	2315.2 b ± 42.03	2646.2 a ± 96.47	2495.1 ab ± 74.52
Body weight gain (g/bird)	2620.8 a ± 47.00	2346.8 b ± 90.00	2269.8 b ± 41.15	2602.8 a ± 96.47	2450.1 ab ± 74.52
Feed intake (g/bird)	5481 ± 94.84	5218 ± 206.70	5227 ± 70.89	5534 ± 192.29	5422 ± 187.88
FCR	2.092 c ± 0.012	2.223 b ± 0.009	2.304 a ± 0.020	2.127 c ± 0.007	2.211 b ± 0.019

*** Phy = 500 FTU Phytase/ kg diet.**

Means within the same row with different superscripts are significantly different at P<0.05.

In the entire growing period (0-49 days of age) compared to those fed control diets, the birds fed energy-deficient diets without phytase (diets 2 and 3) had decreased ($P<0.05$) body weight up to 10.2 and 13.1% and impaired ($P< 0.05$) feed conversion ratio by 6.3 and 10.2 %, respectively.

The inclusion of 500 FTU phytase/kg diet improved body weight and feed conversion ratio at 21, 37 and 49 days of age, for birds fed diets reformulated by phytase supplementation (diets 4 and 5, respectively). Overall body weight was improved (up to 10.7 and 7.8%) and feed conversion ratio (up to 4.3 and 4.0 %) for birds fed energy-deficient diets reformulated by phytase (diets 4 and 5) in comparison with those fed deficient-energy diets (diets 2 and 3) without phytase.

The observed performance responses may reflect the improvement in AME by phytase supplementation. Kies *et al.* (2001) reported that, AME increased when 500 FTU/kg was included in the diets. Namkung and Leeson (1999) showed increased in AME content of the corn-soy diet from 11.87 MJ/kg in control group to 12.15 MJ/kg with 1200 FTU phytase/kg diet. As reported by Ravindran *et al.* (2001) the improved performance may reflect the release of P, available amino acids, and energy by the added phytase. Kies *et al.* (2001) reported that inclusion of phytase in diets not limited in available phosphorus content results in improvement in weight gain and feed conversion ratio this might be due to an improvement in utilization of energy, probably by an increase in digestibility or metabolizability of energy. It is necessary to notice that feed consumption was not affected significantly ($P>0.05$) at any stage by levels of ME or addition of phytase.

Energy utilization (MEU) and energy efficiency (MEE):

The effect of ME level and phytase supplementation on energy utilization (MEU) and energy efficiency (MEE) are presented in Table (3). Data of the main effects indicated that the decrease of ME content in the experimental diets, decreased energy intake and depressed MEU (the amount of energy required to produce one gram of body weight gain), MEE (the amount of body weight gain per 1000 Kcal ME) and relative MEE at different experimental stages (21, 37 and 49 days of age). However, phytase supplementation to the low energy diets (diets 4 and 5) improved MEU, MEE and relative MEE compared to the birds fed energy-deficient diets (2 and 3) and nearly to those fed control diet (diet 1).

Concerning body weight gain, the birds fed diets containing different levels of low ME diets without phytase supplementation (diets 2 and 3) had decreased body weight gain at 21, 37 and 49 days of age (Table 3).

The more pronounced of decreasing body weight gain were observed during grower period (22-37 days of age) to represent 15.8 and 16.3% for chicks fed low energy diets (2) and (3), respectively. Compared with those fed low energy diets (diets 2and 3), phytase supplemented diets (4 and 5) increased body weight gain during different experimental periods. The best improvement in body weight gain was achieved during grower period (22-37 days of age) to be 16.9 and 8.0% compared with those fed low energy diets (2 and 3) without phytase and was the same as those fed control diets.

Table (3): The effect of dietary treatments on metabolizable energy utilization (MEU) and metabolizable energy efficiency (MEE).

Item	Treatments				
	Control Diet (1)	-75 Kcal Diet (2)	-150 Kcal Diet (3)	-75 Kcal + phy* Diet (4)	-150 Kcal + phy* Diet (5)
0-21 days of age					
Body weight gain (g/bird)	583 a ± 13.56	546 ab ± 24.99	488 b ± 16.21	567 a ± 23.52	527 ab ± 25.14
Feed intake (g/bird)	907 ± 22.99	909 ± 44.48	867 ± 20.12	905 ± 41.01	858 ± 48.45
Energy intake (kcal/bird)	2808 a ± 72.08	2750 ab ± 134.60	2565 b ± 59.33	2738 ab ± 124.04	2530 ab ± 140.21
MEU	4.82 b ± 0.06	5.0[illegible] a ± 0.04	5.10 a ± 0.06	4.83 b ± 0.07	4.80 b ± 0.07
MEE	207.80 a ± 2.60	198.90 b ± 1.45	196.40 b ± 2.48	207.60 a ± 2.98	208.80 a ± 3.14
Relative MEE	100	95.72	94.51	99.90	100.48
22-37 days of age:					
Body weight gain (g/bird)	1067 a ± 24.50	898 b ± 48.08	893 b ± 39.64	1050 a ± 57.48	965 ab ± 54.40
Feed intake (g/bird)	2357 ± 65.85	2117 ± 104.32	2149 ± 80.03	2374 ± 132.38	2276 ± 138.13
Energy intake (kcal/bird)	7542 a ± 210.67	6616 ab ± 326.02	6554 b ± 244.09	7419 ab ± 413.68	6941 ab ± 421.13
MEU	7.07 b ± 0.14	7.38 a ± 0.07	7.35 a ± 0.09	7.06 b ± 0.04	7.18 ab ± 0.06
MEE	141.80 a ± 2.69	135.60 b ± 1.23	136.15 b ± 1.60	141.60 a ± 0.79	139.30 ab ± 1.20
Relative MEE	100	95.63	96.02	99.86	98.23
38-49 days of age:					
Body weight gain (g/bird)	971 ab ± 20.39	902 ab ± 51.05	888 b ± 27.57	985 a ± 29.25	959 ab ± 18.07
Feed intake (g/bird)	2217 ± 37.65	2192 ± 112.80	2211 ± 45.59	2255 ± 59.79	2288 ± 51.64
Energy intake (kcal/bird)	7096 ± 121	6833 ± 358	6745 ± 139	7020 ± 180	6832 ± 91
MEU	7.32 ab ± 0.07	7.59 a ± 0.12	7.62 a ± 0.12	7.13 b ± 0.07	7.14 b ± 0.10
MEE	136.80 ab ± 1.29	131.90 b ± 2.04	131.80 ab ± 2.39	140.30 a ± 1.18	140.30 a ± 1.96
Relative MEE	100	96.42	96.35	102.56	102.56
0-49 days of age:					
Body weight gain (g/bird)	2621 a ± 47.00	2347 b ± 90.00	2270 b ± 41.15	2603 a ± 96.47	2450 ab ± 74.52
Feed intake (g/bird)	5481 ± 94.84	5218 ± 206.70	5227 ± 70.89	5534 ± 192.29	5422 ± 187.88
Energy intake (kcal/bird)	17450 a ± 302	16200 ab ± 647	15860 b ± 216	17180 ab ± 618	16300 ab ± 536
MEU	6.66 b ± 0.04	6.90a ± 0.03	6.99 a ± 0.05	6.60 b ± 0.02	6.65 b ± 0.05
MEE	150.30 a ± 0.88	144.90 b ± 0.59	143.10 b ± 1.15	151.50 a ± 0.50	150.40 a ± 1.11
Relative MEE	100	96.41	95.21	100.79	100.06

*** Phy = 500 FTU Phytase/ kg diet.**

Means within the same row with different superscripts are significantly different at P<0.05.

It seems that phytase supplementation could decrease the deleterious effect of energy deficient diets for broiler especially during the grower period (22-37 days of age). Moreover, chicks may require extra levels of phytase especially during finisher period. Ravindran *et al.* (1999a) with broiler diet based on wheat and sorghum found that the AME content was improved from 13.06 MJ/kg up to 13.35 MJ/kg in-group supplemented with 500 FTU/kg. The strong improvement of AME was achieved by increasing phytase supplementation to 750 FTU, being 13.51 MJ/kg. The magnitude of response to added phytase was related to the levels of ME and phytase supplementation. The greatest response occurred at 2950 to 3100 kcal ME/kg with 500 FTU/kg phytase supplementation. Ravindran *et al.* (2001) observed significant improvements in AME with phytase addition.

The effect of phytase in improving the growth performance or AME of chicks fed low or deficient-energy diets may be due to improvement in starch digestibility or amylase activity. Phytic acid negatively correlated with blood glucose response, which infers that phytate reduces carbohydrate digestibility, or inhibit amylase activity (Yoon *et al.*, 1983). This probably inhibit the activity of pancreatic α-amylase in addition to salivary α-amylase, so, the reduced digestion of starch by these enzymes may by a deleterious factor in diet high in cereal grains, legumes and oil seeds (Keuckles and Betschsrt, 1987).

Carcass Characteristics:

Neither different ME levels nor phytase supplementation had an influence on the carcass or other parameters percentage (Table 4).

Table (4): The effect of dietary treatments on carcass characteristics of broiler chicks.

Items	Control Diet (1)	-75 Kcal Diet (2)	-150 Kcal Diet (3)	-75 Kcal + phy* Diet (4)	-150 Kcal + phy* Diet (5)	S**
LBW of the slaughtered sample (g/bird)	2709	2394	2408	2287	2477	-
Carcass %	79.19 ± 0.27	79.03 ± 0.12	79.30 ± 0.15	79.45 ± 0.25	79.53 ± 0.05	NS
Liver %	1.77 ± 0.03	1.78 ± 0.03	1.73 ± 0.01	1.70 ± 0.04	1.71 ± 0.01	NS
Gizzard %	1.37 ± 0.04	1.40 ± 0.07	1.34 ± 0.02	1.40 ± 0.02	1.32 ± 0.01	NS
Heart %	0.53 ± 0.02	0.53 ± 0.01	0.51 ± 0.01	0.54 ± 0.01	0.51 ± 0.01	NS
Giblets %	3.66 ± 0.07	3.70 ± 0.09	3.58 ± 0.03	3.64 ± 0.07	3.54 ± 0.01	NS
Total edible parts%	82.85 ± 0.26	82.73 ± 0.19	82.89 ± 0.18	83.09 ± 0.31	83.06 ± 0.05	NS
Abdominal fat%	2.34 ± 0.03	2.28 ± 0.02	2.29 ± 0.03	2.31 ± 0.02	2.28 ± 0.04	NS
Breast meat %	18.12 ± 0.07	18.13 ± 0.16	18.18 ± 0.18	18.10 ± 0.05	18.14 ± 0.14	NS
Thighs meat %	16.32 ± 0.12	16.25 ± 0.14	16.24 ± 0.09	16.29 ± 0.15	16.29 ± 0.06	NS

* Phy = 500 FTU Phytase/ kg diet. ** Significance.

The results of carcass characteristics indicated that phytase supplementation did not significantly affect carcass percentage. These results agree with the finding of Scheideler and Ferket (2000) who reported that phytase supplementation had no effect on total carcass yield

Tibia Measurements:

The results of DTW, TL, TW, TBS and tibia content of ash, Ca and P. at 49 days of age are shown in Table (5). The different dietary treatments had no significant effect on tibia measurements. The absence of significant influe ıce of energy-deficient phytase supplementation on tibia measurement indicated that the diets contained adequate amounts of nonphytate P to support bone mineralization and that the observed performance response were independent on P effects of the enzyme. Ravandran *et al.* (2001) confirmed this conclusion.

The statue of bones especially, leg bones (tibia and femur) may have a direct impact on the quality of the poultry meat produced (Orban *et al.*, 1999).

Table (5) The effect of dietary treatments on tibia measurements (dry tibia weight (DTW), tibia length (TL), tibia width (TW) and tibia breaking strength (TBS) of broiler chicks.

Items	Control Diet (1)	-75 Kcal Diet (2)	-150 Kcal Diet (3)	-75 Kcal + phy* Diet (4)	-150 Kcal + phy* Diet (5)	S**
DTW	10.8 ±0.75	10.4 ±0.58	10.9 ±0.29	11.0 ±0.12	11.4 ±0.77	NS
TL	9.5 ±0.50	9.9 ± 0.38	9.3 ± 0.29	9.7 ±0.20	9.4 ± 0.40	NS
TW	0.86 ±0.04	0.88 ±0.03	0.93 ±0.04	0.91 ±0.04	0.88 ±0.02	NS
TBS	15.1 ±0.38	15.2 ±0.13	15.8 ±0.11	15.2 ±0.14	15.6 ±0.27	NS
Ash %	45.3 ±0.58	45.5 ±0.24	44.6 ±0.09	45.0 ±0.11	45.6 ±0.23	NS
Ca% of ash	14.0 ±0.09	14.2 ±0.22	14.1 ±0.18	14.5 ±0.[illegible]	14.7 ±0.17	NS
P % 0f ash	34.3 ±0.61	34.8 ±0.37	35.0 ±0.19	34.9 ±0.32	35.4 ±0.31	NS

*** Phy = 500 FTU Phytase/ kg diet.**
**** Significance.**

Economic efficiency:

Simple calculations of economic efficiency for broiler chicks fed the experimental diets are shown in Table (6). Feeding energy-deficient diets (2 and 3) decreased total feed cost, total income, net revenue and economic efficiency values compared to the control diets. However, the addition of 500 FTU phytase/kg diet (diets 4 and 5) improved the economic values than energy-deficient diets. These results are due to the improvement of broiler performance fed energy-deficient diets reformulated by phytase.

In conclusion, the effect of phytase supplementation on metabolizable energy, which is the most costly nutrient in poultry feed, is of high importance to the nutrients as well as for the least-cost-formulations. Reformulating energy-deficient diets with 500 FTU phytase/kg restored BWG lost when the energy-deficient diets had been fed. Moreover, Phytase supplementation to plant protein diets could alleviate the adverse effect of energy-deficient diets.

Table (6): The effect of dietary treatments on economic efficiency (EE) of broiler chicks.

Item	Treatments				
	Control Diet (1)	-75 Kcal Diet (2)	-150 Kcal Diet (3)	-75 Kcal + phy* Diet (4)	-150 Kcal + phy* Diet (5)
Feed intake (g/bird):					
Starter	907	909	867	905	858
Grower	2357	2117	2149	2374	2276
Finisher	2217	2192	2211	2255	2288
Feed price (L.E/kg):					
Starter	1.493	1.450	1.407	1.463	1.420
Grower	1.420	1.376	1.333	1.389	1.346
Finisher	1.344	1.298	1.268	1.311	1.281
Feed cost (L.E/bird):					
Starter	1.354	1.318	1.220	1.324	1.218
Grower	3.346	2.913	2.864	3.298	3.063
Finisher	2.979	2.844	2.804	2.955	2.931
Total	7.679	7.075	6.888	7.577	7.212
LBW (g/bird)	2664.4	2391.5	2315.2	2646.2	2495.1
Feed cost /kg LBW (L.E)	2.882	2.958	2.975	2.863	2.890
Total income (L.E/bird)	15.986	14.349	13.891	15.877	14.971
Net revenue (L.E/bird)	8.307	7.279	7.003	8.300	7.759
EE	1.082	1.028	1.017	1.095	1.76
Relative EE	100	95.01	93.99	101.2	99.45

*** Phy = 500 FTU Phytase/ kg diet.**

REFERENCES

A.O.A.C. (1990).Official Methods of Analysis. Association of Official Analytical Chemists, Washington, DC.

Coelho, M.B. and E.T. Kornegay (1996). Phytase in Animal Nutrition and Waste Management, Basf corp., Mt. Olive, N.S.

Farrell, D.S. and E. A. Martin (1998). Improving the nutritive value of rice bran in poultry diets.III the addition of inorganic phosphorus and a phytase to duck diets. Br. Poult. Sci., 39: 600 – 611.

Hatten, L.F., D. R.Ingram and S.T. Pittman (2001). .Effect of phytase on production parameters and nutrient availability in broilers and laying hens. J. Appl. Poult. Res. 10: 274 – 278.

Keuckles, B. E. and A. A. Betschsrt (1987). Effect of phytate and other myo - inositol phosphate esters P on alpha-amylase digestion of starch. j. Food Sci. 52: 714 – 721.

Kies, A.K., K.H.F.Van Hemert and W.C. Sauer (2001). Effect of phytase on protein and amino acid digestibility and energy utilization. World's Poult. Sci. J., 57:110-126.

Ledoux, D. R., J. D. Firman, J. N. Broomhrad and Y. C. Li. (1999). Effect of microbial phytase on apparent ileal digestibility of amino acids in turkey poults fed a corn-soybean meal diet formulated in an ideal protein basis. Poultry Science, 78 (suppl.1).

Murai, A., T. Kobayashi, T. Okada and J. Okumura (2002). Improvement of growth and nutritive value in chicks with non-genetically modified phytase product from Aspergillus niger. Br. Poult. Sci., 43 (5 Suppl) 687-695.

Namkung, H., and S.Leeson (1999). Effect of phytase enzyme on dietary nitrogen-corrected apparent metabolizable energy and the ileal digestibility of nitrogen and amino acids in broiler chicks. Poultry Science, 78:1317-1319.

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

Orban, J. I., O. Adeola, and R. stroshine (1999). Microbial phytase in finisher diets of white pekin duck: Effect on growth performance, plasma phosphorus concentration and leg bone characteristics. Poultry Science, 78: 366-377.

Ravindran, V., S. Cabahug, G. Ravindran and W. L. Bryden (1999a). Influence of microbial phytase on apparent Ileal amino acid digestibility of feedstuffs for broilers. Poultry Science, 78: 699 – 706

Ravindran, V. S. Cabahug, P. H. Selle and W. L. Bryden (2000). Response of broiler chickens to microbial phytase supplementation as influenced by dietary phytic acid and non-phytate phosphorus levels. II: Effect on apparent metabolizable energy, nutrient digestibility and nutrient retention. Br. Poult. Sci., 41: 266 – 274.

Ravindran, V., P. H. Selle and W. L. Bryden. (1999b). Effect of phytase supplementation, individually and in combination with glycanase on nutritive value of wheat and barley. Poultry Science,78:2047-2054.

Ravindran, V., P.H. Selle, G. Ravindran, P.C.H. More, A.K. Kies and W.L.Bryden (2001). Microbial phytase improving performance, apparent metabolizable energy, and Ileal amino acid digestibility of broilers fed a lysine-deficient diet. Poultry Science, 80:338-344.

Rojas S. W. and J. L. Scott (1969). Factors affecting the nutritive value of cottonseed meals as protein source for chick diets. Poultry Science, 48: 819 – 835.

Samejima, M. (1990).Principal component analysis of measurement in the skeleton of red jungle fowl and 12 breeds of domestic fowls. Jap. Poult.Sci. 27:142-161.

Scheideler, S. E. and P.R. Ferket (2000).Phytase in broiler ration: effect on carcass yields and incidence of tibial dyschondroplasia. Appl. Poult.. Rese, 9:468-475.

Sebastian, S., S. P. Touchburn, E.R. Chavez and P. C. Lague (1997). Apparent digestibility of protein and amino acids in broiler chickens fed a corn-soybean diet supplementation with microbial phytase. Poultry Science, 76:1760-1769.

Selle, P. H., V. Ravindran, P. H. Piltolo and W . L. Bryden (1999). An evaluation of microbial phytase in sorghum-based broiler diets. Proc. Aust. Symp. 11: 97-100.

SX "Statistix" (1992). Statistix version 4 user's manual, NH analytical software, St. Paul, MN.

Viveros, A. A., A. Brenes, I. Arija and C. Centeno (2002). E ffects of microbial phytase supplementation on mineral utilization and serum enzyme activities in broiler checks fed different levels of phosphorus. Poultry Science, 81: 1172 – 1183.

Yi, Z., E.T.Kornegay, V. Ravindran and D.M. D. Enbow (1996). Improving phytate phosphorus availability in corn and Soybean meal for broilers using microbial phytase and calculation of phosphorus equivalency values for phytase. Poultry Science, 75: 240-249.

Yoon, J. H., L. U. Thompson and D. J. A. Jenkins (1983). The effect of phytic acid on *in vitro* rate of starch digestibility and blood glucose response. A M. J Clin. Nutr. 38: 835 – 852.

تاثير إضافة إنزيم الفيتيز إلى العلائق المنخفضة فى الطاقة على الأداء الإنتاجى لكتاكيت اللحم

عمرو حسين عبد الجواد[١] – علاء الدين عبد السلام حميد[٢] – مسعد محمد على المنيرى[١]

١ – قسم الإنتاج الحيوانى – المركز القومى للبحوث – الدقى – القاهرة – مصر

٢ – قسم إنتاج الدواجن – كلية الزراعة – جامعة عين شمس – القاهرة – مصر

أجريت تجربة لدراسة تأثير إضافة إنزيم الفيتيز إلى علائق بها نقص فى محتواها من الطاقة القابلة للتمثيل وذلك على الأداء الإنتاجى وكفاءة استخدام الطاقة وصفات الذبيحة وبعض قياسات عظمة الساق لكتاكيت اللحم. استخدم ١٧٥ كتكوت عمر يوم واحد موزعة على خمس مجموعات كل منها تحتوى على ٣٥ طائرا (٧ مكررات بكل مجموعة). تم تركيب علائق مجموعة المقارنة بحيث تكون محتوية على ٢٣% بروتين خام ، ٣١٠٠ كيلو كالورى طاقة قابلة للتمثيل خلال مرحلة البادئ (من ٠-٢١ يوما) وتحتوى على ٢٠% بروتين خام ، ٣٢٠٠ كيلو كالورى طاقة خلال فترة النامى (٢٢-٣٧ يوما) وفى مرحلة الناهى تحتوى على ١٨,٥% بروتين خام ، ٣٢٠٠ كيلو كالورى طاقة. أما طيور المجموعتين الثانية والثالثة فقد تم تغذيتهم على علائق مشابهة لطيور مجموعة المقارنة ولكن محتواها من الطاقة القابلة للتمثيل منخفض بمقدار ٧٥،١٥٠ كيلو كالورى على التوالى. وفى المجموعتين الرابعة والخامسة تم تقديم علائق المجموعتين الثانية والثالثة بعد إضافة إنزيم الفيتيز إليهما بمعدل ٥٠٠ وحدة/كجم عليقة.

أوضحت نتائج هذه الدراسة ما يلى:

١. انخفض وزن الجسم معنويا وتدنى معامل التحويل الغذائى للطيور التى تم تغذيتها على علائق منخفضة فى محتواها من الطاقة فى حين انخفضت كفاءة الاستفادة من الطاقة عن مجموعة المقارنة وذلك فى المجموعات المغذاة على علائق منخفضة فى محتواها من الطاقة.

٢. إضافة إنزيم الفيتيز إلى العلائق المنخفضة فى الطاقة يزيد معنويا وزن الجسم ويحسن كل من معامل التحويل الغذائى وكفاءة الاستفادة من الطاقة.

٣. لم تتأثر صفات الذبيحة وكذا قياسات عظمة الساق باختلاف المعاملات الغذائية.

يستخلص من هذه الدراسة أنه يمكن إضافة إنزيم الفيتيز بمعدل ٥٠٠ وحدة/كجم من العلائق المنخفضة فى محتواها من الطاقة بمعدل ٧٥ إلى ١٥٠ كيلو كالورى عن الاحتياجات المثلى لتلافى التأثير المعاكس لهذه العلائق.