EFFECT OF DIFFERENT LEVELS OF OPTIZYME AND PHYTASE ENZYMES AND THEIR INTERACTIONS ON THE PERFORMANCE OF BROILER CHICKENS FED CORN/SOYBEAN MEAL: 2. TIBIA CHARACTERISTICS AND CALCIUM AND PHOSPHORUS RETENTION EFFICIENCY

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SUMMARRY

A total of 180 unsexed 1-day old IR broiler chicks were randomly distributed into 6 treatments of 3 replicates each (10 birds each) in experiment for 5 weeks of age. A factorial design (3×2) was used in which there were three levels of multienzymes, optizyme (0, 250, 500 mg/kg diet) and two levels of phytase enzyme (0, 1500 FTU/kg diet). The results showed that broiler chicks fed on either 250 or 500 mg/kg diet of optizyme alone or plus 1500 FTU/kg diet had significantly improved body weight gain (BWG) compared to control group. Tibia ash and phosphorous percentages were increased significantly ($P<0.05$) in broilers fed diets contained 250 mg/kg diet optizyme. Phosphorus retention efficiency percentages were increased significantly ($P<0.05$) in broilers fed diets contained 250 mg/kg diet optizyme alone or 250 mg/kg diet optizyme plus 1500 FTU/kg diet phytase. It could be concluded that the level of 250 or 500 mg / kg diet optizyme and 1500 FTU/kg diet phytase is effective for increasing absorption and bioavailability of phosphorus, which could decrease excretion of phosphorous and, therefore, environmental pollution. In addition, feeding broilers with these treated feeds might improve body weight gain.

Keywords: *Performance response, tibia, calcium and phosphorus retention efficiency and broiler chickens.*

INTRODUCTION

Poultry industry is becoming increasingly receptive to the use of exogenous enzymes supplementation. Enzyme supplementation to the poultry rations has a positive effect on feeds digestibility and leads to better productivity and performance.

Numerous studies have shown that supplementation of exogenous enzymes in wheat, barley, sorghum or triticale-based rations can improve performance of poultry to a level compared to that obtained by corn-soya-based rations. Naturally, the gastrointestinal tract of poultry produces enzymes to aid the digestion of nutrients (Abd El-Hack *et al.,* 2017).

Nowadays, phytase is utilized extensively to improve animal feeds utilization and economic of livestock farming due to many potential, such as overcome anti-nutritional factors such as phytic acid, improve digestion, and gut ecology and thus enhancing the use of nutrients for meat and egg production, reduce environmental pollution and increase profits due to nutrient equivalency value (Enshasy *et al*. 2018 and Attia *et al*. 2020). Phytase mainly improved phytate phosphorus utilization, particularly of high phytic acids diets

and enhanced the use of protein/amino acids, energy, phosphorous calcium and several trace minerals (Enshasy *et al.,* 2018)

However, the birds do not have enough enzymes to digest adequate fiber and need some commercial exogenous enzymes in the diets to improve the digestion. Enzyme is a biological catalyst composed of proteins, amino acids with minerals and vitamins.

The advantages of using commercial enzymes in poultry feeds include improved productive performance and feed utilization, minimized environmental pollution due to reduced nutrient of manure. Therefore, the objective of the present study was to investigate effect of exogenous enzymes on Performance response, tibia characteristics, and calcium and phosphorus retention efficiency.

MATERIALS AND METHODS

The present study was carried out at the Poultry Research Farm, Poultry Production Dept., Faculty of Agriculture, South Valley University, Qena. EGYPT.

Management and experimental design:

A total of 180 (IR) broiler chicks (one day old) were randomly divided into 6 treatments. Each treatment was divided into 3 replicates of 10 each. The birds were reared at 34°C temperature as standard brooding temperature and then, gradually reduced to reach 24°C at the end of the experiment. A light schedule used was 23 h of light during the entire period of the experiment, and the level of relative humidity ranged from 55 to 60%. The enzyme was supplemented in addition to the diet and was not included in the nutrient matrix. Birds were fed on starting commercial diet (Table 1) containing (23% crude protein, ME, 3000 Kcal. /Kg)

Table (1): Feed ingredients and chemical analyses of basal diets:

Ingredients, %	0 – 2 weeks Starter	3 – 5weeks Grower
Corn (grains)	54.00	59.20
Soybean Meal (44%)	32.85	28.00
Corn Gluten Meal (62%)	6.50	6.00
Soybean Oil	2.70	2.50
Di-Calcium Phosphate	1.46	1.52
Limestone	1.51	1.80
Premix	0.30	0.30
Salt (NaCl)	0.30	0.30
DL-Methionine	0.28	0.28
L-Lysine HCL	0.10	0.10
Total	100	100
Chemical analysis (Calculated)		
Crude Protein %	23.18	21.20
ME Kcal/ Kg diet	3009	3040
Calcium %	1.10	0.93
Available Phosphorus %	0.42	0.42
Lysine %	1.19	1.07
Methionine & Cysteine %	1.06	1.01

Each 3 Kg of premix contains: Vitamins: A: 12000000 IU; D3 2000000 IU; E: 10000 mg; K3: 2000 mg; B1:1000 mg; B2: 5000 mg; B6:1500 mg; B12: 10 mg; Biotin: 50 mg; Choline chloride: 250000 mg; Pantothenic acid: 10000 mg; Nicotinic acid: 30000 mg; Folic acid: 1000 mg; Minerals: Mn: 60000 mg; Zn: 50000 mg; Fe: 30000 mg; Cu: 10000 mg; I: 1000 mg; Se: 100 mg and Co: 100 mg.

from one day old to2weeks of age and growing commercial diet containing (21% crude protein, ME, 3000 Kcal. /Kg) from 3 to 5 weeks of age(marketing), diets were formulated according to the Nutrient Recommendations for poultry (NRC, 1994).

Experimental design:

The chickens were fed three levels of Optizyme enzyme (0, 250 and 500 mg/kg diet and two levels of Phytase enzyme supplementation (0 and 1500 FTU/kg diet). One FTU of Phytase enzyme activity (FTU) is defined as the activity of 0.030 µg of Phytase. Optizyme is a commercial multienzyme consist of multienzymes product containing proteases, amyloglucosidase, xylanase, β-glucanase, cellulases and hemicellulases, (Product of Optivite International LTD). One unit (FTU) is equal to the enzyme activity that liberates 1 µmol or tho-phosphate from 5.1 mmol of sodium phytin per minute at 37º C and pH 5.5.(Marketed by BASF, Germany). The experimental treatments were as follows: **T1** (0 mg/kg diet optizyme and 0 FTU/kg diet phytase); **T2** (0 mg/kg diet optizyme and 1500 FTU/kg diet phytase); **T3** (250 mg/kg diet optizyme and 0 FTU/kg diet phytase); **T4** (250 mg/kg diet optizyme and 1500 FTU/kg diet phytase); **T5** (500 mg/kg diet optizyme and 0 FTU/kg diet phytase); **T6** (500 mg/kg diet optizyme and 1500 FTU/kg diet phytase).

Broilers in each replicate were weighed (g) as a group replicate and feed consumption was also weighed weekly till 5 wks of age. Body weight gain (BWG) (g/chick) and feed conversion (FCR, g feed/g gain) were calculated from one day old to marketing age.

At 35 days of age, a random sample of 3 growing birds from each replicate were slaughtered after 8 h fasting according to the Islamic method using a sharp knife and cutting into the jugular vein, carotid artery and windpipe, processed. Left tibia was removed and cleaned from adhering flesh, dried under 110 C for 12 hr, left to cool, weighed and then calculated as relative to live body weight. Tibia diameters were measured using a caliper. According to Rezaeipour *et al.,* (2014) the (WLI) weight/length index was calculated by dividing bone weight (in mg) by its length (in mm). In order to determine the minerals concentrations, the tibiae were kept frozen in plastic bags at −20°C to maintain wetness until analysis. Then, frozen tibiae were thawed by leaving them in plastic bags at room temperature for 1 h and oven-dried at 105°C for 12 h. Subsequently, samples were then grinded in a mill, weighed and put in a muffle furnace overnight at 550° C for 3 h. The ash was used to quantify calcium and phosphorous amount in the tibia. The calcium and phosphorous contents (% of ash) were measured by atomic absorption and spectrophotometer methods, respectively. Tibia ash was determined according to AOAC (1990).

To determine calcium and phosphorus retention efficiency %, a separate experiment during the period from 36 to 38 days of age (for 3 days) was carried out, the three replicates from each treatment were set for total collection method. Chicks were fed on their corresponding experimental diets for 72 h, in which feed consumption and excreta voided, were accurately determined. The excreta was collected for each replicate, cleaned from feathers and feed then weighed, dried in a forced air oven at 70º C for 36 h. Samples were then finally ground and placed in screw-top glass jars until analyses. Calcium and phosphorus in feed and excreta were measured by methods of AOAC (1990).The percentage of calcium and phosphorus efficiency was determined based on its retention (Graña *et al*. (2013) in broiler chickens fed corn/soybean meal.

Calcium and phosphorus retention (g/bird) was calculated as nutrient intake (g/bird) minus nutrient excretion (g/bird). Nutrient retention (%) indicates the percentage of nutrient retained by the bird as a function of nutrient intake, and it was calculated as follows:

$$\textbf{Nutrient retention } (\%) = \frac{\textbf{nutrient retention (g/bird)}}{\textbf{nutrient intake (g/bird}} \times \mathbf{100}$$

Statistical analysis:

The data were statistically analyzed by factorial design (3 x 2), three levels of optizymes and two levels of phytase enzymes using ANOVA and General Linear Models (GLM) Procedure of SAS software (SAS, 2009). Duncan'smultiple range tests (Duncan 1955) was used to determine differences among means when treatment effects were significant. Significant differences were considered to exist when ($P<0.05$).

The mathematical model was as follows:

$$Yijk= \mu+ Oi+ Pj+ (OV)ij+ Eijk$$

Where: Yijk = any observation; μ= the population mean. Oi= optizyme levels effect (i = 1, 2 and 3).; Pj= Phytase levels effect (j = 1 and 2); (OP)ij= Interaction of optizyme levels× phytase levels. Eijk= Experimental error.

RESULTS AND DISCUSSIONS

Performance response:

The results of body weight response (body weight, BW., body weight gain, BWG., feed intake, FI and feed conversion ratio ,FCR) as affected by treatments at 5 weeks of age are presented in Table (2). BWG for birds fed either 250 or 500 mg/kg diet optizyme enzyme had a significantly (P≤0.05) higher BWG than control group. The obtained results are in agreement with Kalantar *et al.* (2015) and Zeng *et al.* (2015) who mentioned that enzyme supplemented wheat and barley diets with multienzymes to significant (P<0.05) increased BW gain compared to without enzymes. Supplementation with multi-enzyme tended to improve the nutritive value of corn-soybean diet in broiler chicks (Shirmohammad and Mehri, 2011). The obtained results are in disagreement with Al-harthi *et al.* (2020) who found that phytase supplementation improved BWG in broiler chickens enhanced broiler body weight gain and performance (Scholey *et al.*, 2018 and Broch *et al.*, 2018).

BWG of broiler chicks fed 250 or 500 mg optizyme with 1500 FTU phytase achieved the highest BWG than control groups. The interactions between phytase and optizyme (Table 2) showed that the groups (O×P1), (O1×P), (O1×P1), (O2×P), (O2×P1) had higher BWG than control group (.(O×P). Study conducted by Moss *et al.* (2017) showed that protease supplementation alone increased weight gains of poultry, but in combination with phytase decrease weight gain.

No significant effects due treatments at all on feed intake (Table 2). The obtained results are in agreement with Abudabos (2012) who found that at 10 day, no significant differences in FI were found due to enzyme supplementation.

No significant effects due treatments at all on FCR were detected. Similar trends were showed with Min *et al.* (2011) who showed that using enzyme mixture containing pectinase (provided by 200g/tone feed) to diets of broilers contained lower 40 kcal/kg ME could not improve FCR. Rutherfurd *et al.* (2012) reported that no effect of phytase supplementation on feed efficiency of broilers fed low avPdiets.

In the present study phytase or optizyme or interaction have not been shown increase either on feed intake or feed conversion. However, some authors mentioned conflict results (Bradbury *et al*.; 2017 and Moss *et al*, 2017), that Phytase present in the feed ingredients themselves has been shown to increase daily feed consumption which proportionally increases body weight gain as well as the growth-rate of poultry. El-Ghamry *et al.* (2005) found that phytase without or with multienzymes mixture improved growth and FCR significantly compared to their negative control. They also found that the combination of phytase plus multienzymes yield better results than phytase alone.

Tibia characteristics:

The results of tibia dry weigh, length (L), Diameter (D), weight length index (WLI), Ash %, and phosphorus % as affected by treatments at 35 days (from one day old to 5 weeks of age) are presented in Table 3. The results showed non significant (P≤0.05) differences due to optizyme addition for all Tibia characteristics, except of Ash %, and Phosphorus %. Birds fed to 250 mg/kg diet optizyme enzyme level had significant (P≤0.05) higher ash and phosphorus % than those in 500 mg/kg diet optizyme enzyme. However, birds fed on 500 mg/kg diet optizyme enzyme level supplementation had significant (P≤0.05) lower ash % than those control and 250 mg optizyme enzyme level supplementation. Birds fed the control diets (free optizyme enzyme supplementation) had an intermediate values. Similar trends with enzymes that affected bone characteristics were reported. The addition of enzymes to the diet positively affects mineral absorption in the intestine (Thomas and Ravindran, 2010).

No significant (P≤0.05) differences for all tibia characteristics due to phytase addition were reported. The obtained results are in agreement with Rama Rao *et al.* (2014) who reported that phosphorus contents in the

Table (2): Effect of treatments on performance response (g/bird) of broiler chickens.

Treatment	5 wks of age			
	Final BW (g)	BWG (g)	FI (g)	FCR
Optizyme levels (mg/kg)				
0 (O)	1664.08±55^{b}	1622.08±55^{b}	2607.48±71	1.61±0.04
250 (O1)	1697.77±45^{a}	1655.77±45^{a}	2721.09±71	1.64±0.03
500 (O2)	1700.70±30^{a}	1658.70±30^{a}	2693.99±30	1.62±0.02
Phytase levels (FTU/kg)				
0 (P)	1693.68±37	1651.68±37	2676.21±53	1.62±0.02
1500 (P1)	1681.35±35	1639.35±35	2672.16±29	1.63±0.03
Interactions				
O×P	1616.59±76^{c}	1574.59±76^{b}	2605.30±145	1.65±0.04
O×P1	1711.56±83^{a}	1669.56±83^{a}	2609.70±53	1.56±0.07
O1×P	1727.32±74^{a}	1685.32±74 ^{a}	2707.30±88	1.61±0.03
O1×P1	1668.21±60^{b}	1626.21±60 ^{a}	2734.80±15	1.68±0.05
O2×P	1737.14±27^{a}	1695.14±27 ^{a}	2716.00±14	1.60±0.03
O2×P1	1664.26±52^{b}	1622.26±52 ^{a}	2672.00±62	1.65±0.04

$^{a-c}$ Means in the same columns with different superscript are significant different (P≤0.05).
BW=body weight., BWG=body weight gain., FI=feed intake., FCR=Feed conversion ratio.

Table (3): Effect of treatments on tibia characteristics of broiler chickens.

Treatment	Tibia characteristics					
	Tibia dry weight (g)	Length (cm)	Diameter (cm)	WLI (mg/mm)	Ash (%)	Phosphorus (%)
Optizyme levels (mg/kg)						
0 (O)	5.25±0.30	8.83±0.22	0.66±0.05	59.45±3.29	46.67±0.43^{a}	15.31±0.9^{ab}
250 (O1)	5.20±0.15	8.53±.013	0.63±0.04	60.96±2.26	46.98±0.92^{a}	18.34±0.6^{a}
500 (O2)	5.90±0.27	8.66±0.13	0.70±0.04	68.13±3.71	43.91±0.67^{b}	14.59±1^{b}
Phytase levels (FTU/kg)						
0 (P)	5.34±0.24	8.61±0.10	0.65±0.02	62.02±3.13	45.00±0.46	17.41±0.95
1500 (P1)	5.56±0.19	8.74±0.16	0.67±0.04	63.62±2.52	46.71±0.83	14.75±0.98
Interactions						
O×P	4.89±0.43	8.40±0.20^{b}	0.60±0.05	59.95±3.17	45.93±0.1^{bc}	16.51±1^{ab}
O×P1	5.62±0.35	9.26±0.14^{a}	0.73±0.08	58.21±6.61	47.41±0.6^{ab}	14.12±1^{b}
O1×P	5.06±0.17	8.70±0.15^{ab}	0.63±0.03	58.16±2.88	45.27±0.4^{bc}	19.49±0.6^{a}
O1×P1	5.34±0.26	8.36±0.18^{b}	0.63±0.08	63.87±3.38	48.69±1^{a}	17.19±0.5^{ab}
O2×P	6.09±0.32	8.73±0.21^{ab}	0.73±0.03	69.76±7.55	43.79±1^{c}	16.25±2a^{b}
O2×P1	5.71±0.48	8.60±0.20^{b}	0.66±0.08	66.39±3.30	44.02±1^{c}	12.93±2^{b}

$^{a-c}$Means in the same columns with different superscript are significant different (P≤0.05).

WLI= Weight length Index (mg/mm). Tibia calcium % was avoid.

bones of broilers were not affected by supplementation of NSP-hydrolysing enzymes to guar meal- based diets. Walk *et al.* (2013) reported that super doses of phytase supplementation in low-P diet in 0- to 21-dayold broiler did not alter tibia ash percentage..

The present results concerning with phytase addition are in disagreement with Scholey *et al.* (2018), who reported that phytase had bone mineralization in broiler chickens.. Previous researchers also reported the efficacy of phytase on bone mineralization in poultry (Bradbury *et al*., 2017. The benefit of phytase supplementation was greater in younger than older chicken (Li *et al.*, 2018).

Manobhavan *et al.* (2015) who found that super doses of phytase (at 2500 FTU and 5000 FTU/kg) on low-phosphorus diet improved bone minerals such as calcium (Ca) and phosphorus (P).

The interactions between optizymes and phytase had significant (P<0.05) effects on length, ash% and phosphorus%. The birds in group (O1XP1) had the highest value in ash%. However, group (O1X P) had the highest value in tibia phosphorus %.

Length was significantly (P≤0.05) the highest in birds reared in group (OXP1) than others groups. No published reviews are available on the interaction between optizyme and phytase enzymes supplementation in broiler feeds.

Calcium retention efficiency:

The data of Table (4) revealed non-significant (P≤0.05) differences due to the optizyme enzyme for all calcium retention efficiency traits, except of Ca excreta %. Birds fed on (O) mg/kg diet optizyme enzyme level had significant (P≤0.05) the lowest Ca excreta % compared to 250 mg/kg and 500 mg/kg optizyme.

Concerning with Phytase enzyme, the results showed no significant (P≤0.05) differences for calcium retention efficiency. Ca excreta % was significantly (P≤0.05) the lowest in birds reared in groups (O×P) then (O×P_1) compared to others groups. Englmaierová *et al.* (2017) reported non-significant increase in ileal digestibility of Ca due to phytase supplementation to the diets. Kiarie *et al.* (2014) reported that the addition of enzymes to wheat-based diets did not affect calcium retention in broilers.

Reversely, the obtained results are in disagreement with Moss *et al.* (2018), who reported an improve in illeal digestibility performance of calcium, in broiler chicken diets. Mushtaq *et al.* (2009) found that the enzyme significant increased retention of excreta calcium, compared to without enzyme. Diet supplemented with enzyme had a positive effect on nutrient absorption of birds fed diets containing sunflower meal (SFM). Pure enzyme supplementation increased the retention of calcium in birds, which helps in better utilization of alternate feed ingredients (Ramesh and Chandrasekaran, 2011).

Phosphorus retention efficiency:

The data of Table (5) revealed significant (P≤0.05) differences due to the optizyme enzyme for P %, P/feed and P retention%. .Birds fed on 500 mg/kg diet optizyme enzyme level supplementation had a significant (P≤0.05) the lowest P % and P/feed compared to those in control group (0) mg/kg and 250 mg/kg diet optizyme enzyme level supplementation. Birds fed on 250 mg/kg diet optizyme enzyme level had significant (P≤0.05) the highest P retention efficiency% than those in 250 mg/kg diet optizyme enzyme level.

Table (4): Effect of treatments on calcium retention efficiency of broiler chickens.

Treatment	Calcium retention efficiency						
	Dry feed	Ca (%)	Ca/feed	Dry Excreta	Ca excreta (%)	Ca/excreta	Ca retention %
Optizyme levels (mg)							
0 (O)	135.56±13	0.93±0.00	1.26±0.12	22.13±1.89	1.82±0.18^{b}	0.39±0.03	69.04±3.82
250 (O1)	150.83±13	0.93±0.00	1.40±0.12	18.11±1.90	2.70±0.23^{a}	0.47±0.04	66.42±2.05
500 (O2)	125.88±9	0.93±0.00	1.17±0.08	18.44±2.24	2.76±0.26^{a}	0.49±0.06	58.11±4.24
Phytase levels (FTU)							
0 (P)	131.76±10	0.93±0.00	1.22±0.09	18.99±1.84	2.41±0.25	0.43±0.04	64.75±3.31
1500 (P1)	143.08±10	0.93±0.00	1.33±0.09	20.13±1.56	2.45±0.22	0.47±0.03	64.66±3.04
Interactions							
O×P	129.36±23	0.93±0.00	1.20±0.21	22.16±3.17	1.71±0.21^{b}	0.37±0.06	69.16±6.05
O×P1	141.76±19	0.93±0.00	1.31±0.18	22.11±2.81	1.94±0.34^{b}	0.41±0.02	68.70±6.04
O1×P	146.66±14	0.93±0.00	1.36±0.13	19.00±3.42	2.34±0.16^{ab}	0.43±0.07	68.38±3.21
O1×P1	154.99±26	0.93±0.00	1.44±0.24	17.22±2.37	3.06±0.34^{a}	0.51±0.04	64.58±2.35
O2×P	119.26±18	0.93±0.00	1.10±0.17	15.83±3.02	3.18±0.37^{a}	0.49±0.09	55.45±5.52
O2×P1	132.49±5	0.93±0.00	1.23±0.05	21.05±3.04	2.35±0.15^{ab}	0.50±0.09	59.34±7.38

$^{a-b}$ *Means in the same columns with different superscript are significant different (P≤0.05).*

Concerning with Phytase enzyme, the results showed no significant (P≤0.05) differences on phosphorus retention efficiency traits. The obtained results are in disagreement with Moss *et al*. (2018) and Kim et al., (2017) who mentioned that phytase improved the p retention in broiler chickens. Ghosh *et al.* (2016) found that supplementation of phytase in the diets of laying hens has been shown to improve the availability of phytate P. Manobhavan *et al*. (2016) found that super doses of phytase (at 2500 FTU and 5000 FTU/kg) on low-phosphorus diet improved ileal digestibility phosphorus. El-Sherbiny *et al*. (2010) reported that phytase

when reduced in broiler diets increased dietary P utilization and P excretion in broiler chickens. In addition, Motawe *et al*. (2012) reported that phytase supplementation significantly (P<0.05) decreased P excretion

Concerning with the interactions, there were significant effect on P % in feed intake and P phosphorus retention efficiency. P % was significant (P≤0.05) lowest in birds reared in group ($O_2 \times P_1$) compared to others groups. However, birds in the group O×P had the highest P % compared to others groups.

Table (5): Effect of treatments on phosphorus retention efficiency of broiler chickens.

Treatment	Phosphorus retention efficiency%						
	Dry feed	P (%)	P/feed	Dry Excreta	P excreta (%)	P/excreta	P retention %
Optizyme levels (mg)							
0 (O)	135.56±13	0.84±0.01^{a}	1.13±0.11^{a}	61.98±5	0.65±0.00	0.40±0.03	64.17±1^{ab}
250 (O1)	150.83±13	0.77±0.01^{b}	1.17±0.10^{a}	50.71±5	0.65±0.00	0.32±0.03	71.60±2^{a}
500 (O2)	125.88±9	0.65±0.03^{c}	0.82±0.06^{b}	51.64±6	0.65±0.00	0.33±0.04	59.10±4^{b}
Phytase levels (FTU)							
0 (P)	131.76±10	0.79±0.02	1.05±0.09	53.19±5	0.65±0.00	0.34±0.03	67.07±1
1500 (P1)	143.08±10	0.71±0.03	1.03±0.09	56.36±4	0.65±0.00	0.36±0.03	62.84±3
Interactions							
O×P	129.36±23	0.86±0.00^{a}	1.11±0.20	62.05±8	0.65±0.00	0.40±0.05	63.22±2^{ab}
O×P1	141.76±19	0.82±0.00^{b}	1.16±0.16	61.91±7	0.65±0.00	0.40±0.05	65.13±3^{a}
O1×P	146.66±14	0.81±0.00^{c}	1.19±0.12	53.20±9	0.65±0.00	0.34±0.06	71.15±4^{a}
O1×P1	154.99±26	0.74±0.00^{d}	1.15±0.19	48.22±6	0.65±0.00	0.31±0.04	72.05±4^{a}
O2×P	119.26±18	0.72±0.00^{e}	0.85±0.13	44.33±8	0.65±0.00	0.28±0.05	66.84±1^{a}
O2×P1	132.49±5	0.59±0.00^{f}	0.78±0.03	58.95±8	0.78±0.00	0.38±0.05	51.36±5^{b}

$^{a-b}$*Means in the same columns with different superscript are significant different (P≤0.05).*

Phosphorus retention efficiency was significantly (P≤0.05) the lowest in birds reared in groups ($O_2 \times P_1$) compared to others groups.

CONCLUSION

Supplementation of commercial enzymes can increase the nutritive value of feed ingredients and diets as well as allow greater flexibility in diet formulation. It has also a potential effect on mitigation of the environmental pollution by reducing the excretion of some elements such as nitrogen and phosphorus in poultry manure. Based on the results of the present study, it can be concluded that the level of 250 or 500 mg/kg diet multienzyme optizyme and 1500 FTU/kg diet phytase is effective for increasing absorption and bioavailability of phosphorus, which could decrease excretion of phosphorous and, therefore, environmental pollution. In addition, feeding broilers with those treated feeds might improve body weight gain.

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تأثير مستويات مختلفة من إنزيمات الأوبتزيم والفيتيز والتداخل بينهما على معدل آداء دجاج اللحم المغذى على عليقة الذرة/ كسب فول الصويا :2 . استجابة وزن الجسم ، خصائص عظم الساق وكفاءة الاحتفاظ بالكالسيوم والفوسفور

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تم إستخدام 180 كتكوت تسمين IR عمر يوم واحد تم توزيعها بشكل عشوائي في 6 معاملات3 مكررات لكل معاملة (10 طيور لكل مكررة) في التجربة لمدة 5 أسابيع من العمر. تم إستخدام تصميم عاملي (3 × 2) حيث كان هناك ثلاثة مستويات من الإنزيمات المتعددة ، الأوبتزيم هى (صفر و 250 و 500 ملليجرام/كجم عليقة) ومستويين من إنزيم الفيتيز (صفر و 1500 وحدة دولية/ كجم عليقة). أوضحت النتائج أن كتاكيت اللحم التى تم تغذيتها إما 250 أو 500 ملليجرام/كجم من الأوبتزيم بمفرده أو مع 1500 وحدة دولية/كجم عليقة قد حسن الزيادة فى وزن الجسم بشكل ملحوظ (BWG) مقارنة بمجوعة الكنترول. ازدادت نسب رماد الساق والفوسفور بشكل معنوي ($P < 0.05$) في دجاج التسمين الذي يحتوي على 250 ملليجرام/كجم.. كما ازدادت النسب المئوية لكفاءة الإحتفاظ بالفسفور بشكل ملحوظ ($P < 0.05$) في الطيور التي تم تغذيتها على العليقة التى تحتوي إما على 250 ملليجرام/كجم عليقة من مخلوط الأوبتزيم وحده أو 250 ملليجرام/كجم عليقة من مخلوط الأوبتزيم بالإضافة إلى اننزيم الفيتيز بمعدل 1500 وحدة دولية/كجم عليقة. يمكن إستنتاج أن مستوى 250 أو 500 ملليجرام/كجم عليقة من الأوبتزيم بالإضافة إلى 1500 وحدة دولية من الفيتيز/كجم عليقة فعال لزيادة الإمتصاص والتوافر الحيوي للفسفور ، مما قد يقلل من إفراز الفوسفور ، وبالتالي التلوث البيئي. بالإضافة إلى ذلك ، فإن تغذية الطيور بهذه الأعلاف المعالجة قد تحسن من زيادة وزن الجسم.