THE EFFECT OF DIFFERENT LEVELS OF OPTIZYME AND PHYTASE ENZYMES AND THEIR INTERACTIONS ON THE PERFORMANCE OF BROILER CHICKENS FED CORN/SOYBEAN MEAL: 1-BROILER PERFORMANCE, CARCASS TRAITS, BLOOD CONSTITUENTS AND NITROGEN RETENTION EFFICIENCY

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SUMMARY

The present study was carried out at the Poultry Research Farm, Poultry Production Dept., Faculty of Agriculture, South Valley University., Qena to investigate the effect of optizyme, phytase enzymes supplementations and their interactions on the performance of broiler chickens fed corn/soybean meal. includes 1. broiler performance, some carcass traits, some blood constituents and nitrogen retention efficiency%. The experimental design was 3×2 factorial design, three Optizyme enzyme levels (0, 250 and 500 µg/kg) and two Phytase enzyme levels (0 and 1500 FTU/kg). The results showed that the level of 250 or 500 mg optizyme and 1500 FTU phytase improved body weight gain (BWG) at end of the experiment, feed consumption (FC) from one day old to three wks of age, numerically dressed percentage, elevating blood plasma alkaline phosphatase, triglycerides, calcium and enhanced nitrogen retention efficiency. The results concluded that the optizyme level (250 or 500 mg) and 1500 FTU phytase enhanced the performance of IR broiler chickens in the criteria studied.

Keywords: *Performance, optizyme, phytase, nitrogen retention, carcass and broiler.*

INTRODUCTION

Poultry excreta contain significant N, Ca, P, Cu, Mn, and Zn levels, which contribute to environmental pollution, particularly of water sources (Payne, 1998 and Paterson, 2002). Poultry nutritionists have sought alternatives to formulate more efficient feeds, reducing production costs and environmental pollution. The use of nutritional strategies, such as formulation diets addition of enzymes and organic trace minerals, has helped to reduce the impact of the excretion of potentially polluting elements in the environment (Ferket *et al*., 2002)

Poultry industry in developing countries is facing some challenges due to high costs of conventional feed ingredients like yellow corn and soybean meal which are mainly used in poultry rations (Abd El-Hack *et al.,* 2015; Alagawany and Attia, 2015). There are several benefits obtained from the use of enzymes that can enhance intestinal health. The benefits of using enzymes in diets for monogastric gives enhanced growth performance and feed conversion, causes reduced environmental problems due to reduced output of nitrogen excretion, increases accuracy and flexibility in least-cost feed formulations and improved wellbeing of animals (Nikam *et al.,* 2016). In corn and soybean meal-based diets, enzyme supplementation might improve energy availability and inhibit anti-nutritional agents (Doskovic *et al.,* 2013; Latham *et al.,* 2016). Several studies have detected an improvement in performance of broilers with enzyme supplementation of fed corn and soybean-based diets (Flores *et al.,* 2016). Recently, considerable interest has been shown the use of phytase as a feed additive, as it not only increases the availability of phosphate in feed but also reduces environmental pollution (Pariza and Cook, 2010). Phytate and phytate-bound phosphorus (P) is invariably present in practical poultry diets which limits nitrogen (N) and phosphorus P (P) bioavailability and poses ecological problems as excreted N and P pollutes the environment. Phytate-degrading feed enzymes or phytases have been included in broiler diets for more than 20 years primarily to liberate phytate-bound P and to harness the ‘extra-phosphoric’ effects as phytase has shown to improve protein and energy utilization (Selle and Ravindran,2007). The effects of phytase supplementation of maize-, sorghum- and wheat-based broiler diets were previously investigated (Liu *et al.,* 2014). Although phytase is supplemented primarily to liberate P from phytate and hence is a necessary additive in diets that are deficient in P and Ca, phytase has been beneficial as well in diets that are formulated to be adequate in P (Adeola and Cowieson, 2011). The supplementation of phytase in the diets of laying hens has been shown to improve the availability of phytate P and other minerals including Ca, Mn and Zn (Jalal and Scheideler, 2001 and Ghosh *et al.,* 2016. Microbial phytases supplementation improved the phosphate utilization from phytate phosphorus, reduced P excretion, and subsequently decreased phosphate pollution (Jondreville *et al.,* 2007; Lalpanmawia *et al.,* 2014). Farran *et al.* (2010) reported that supplementation of 0.1% (Avizyme) 1100 (xylanase and β-glucanase 300 U/g) to barley-based finisher diets improved weight gains. The objective of the study was to investigate the effect of optizyme, phytase enzyme supplementations and their interactions on the performance of broiler chickens fed corn/soybean meal. includes 1. broiler performance, carcass traits, blood constituents and nitrogen retention efficiency.

MATERIALS AND METHODS

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

Birds and management:

A total number of 180 Broiler chickens, one day old "IR Breed" were obtained from commercial hatchery, weighted to the nearest gram. All chickens were randomly divided into six treatments, three replicates each (10 birds each) and housed in 18 pens. The chicks were weighed as individual replicate; Experimental pens were equipped with ventilation, gas heating systems and electrical heaters to provide the required temperature. The light and dark cycles were obtained by using three light type programs, controlled by automatic timer and dimer for each. Feed and water were available ***ad libitum*** and all the other conditions were the same during the experimental period. The chickens fed three levels of Optizyme enzyme and two levels for Phytase enzyme supplementation in diets.The birds were reared at 34°C temperature as standard brooding temperature and then, gradually reduced to reach 26 °C at the end of the experiment. Birds were fed on starting commercial diet (Table 1) containing (23% crude protein, ME, 3000 Kcal. /Kg) from 1 to 3 weeks 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 experimental design was 3×2 factorial design, three Optizyme enzyme levels (0, 250 and 500 µg/kg) and two Phytase enzyme levels (0 and 1500 FTU/kg). One FTU of Phytase enzyme activity is defined as the activity of 0.030 µg of Phytase. The design was expressed in the diagram as follows:

Treatment 1 (T 1): Chicks were fed to Optizyme enzyme level (0 µg) and level Phytase (0 FTU) as a control group.
Treatment 2 (T2): Chicks were fed to Optizyme enzyme level (0 µg) and level Phytase (1500 FTU) each.
Treatment 3(T3): Chicks were fed to Optizyme enzyme level (250 µg) and level Phytase (0 FTU) each.
Treatment 4 (T4): Chicks were fed to Optizyme enzyme level (250 µg) and level Phytase (1500 FTU) each.
Treatment 5 (T5): Chicks were fed to Optizyme enzyme level (500 µg) and level Phytase (0 FTU) each.
Treatment 6 (T6): Chicks were fed to Optizyme enzyme level (500 µg) and level Phytase (1500 FTU) each.

All replicates were weighed individually from one day to 5wks of age by using the nearest gram weekly during the period. Feed consumption (FC) for each replicate was weekly recorded till the end of the experiment. Body weight gains (BWG) were calculated weekly and then calculated as daily body weight gain (DBWG) according to the following equation during the period from one day old to 3, 3 to 5, and one day old to5 weeks of age. Feed to gain ratio (F: G ratio) was calculated for the period from

One day old-3 , 3-5 , and One day old-5 weeks of age. At 5 wks of age, a random sample of 3 growing birds from each replicate was taken to study carcass traits. They were individually weighed and slaughtered by cutting the neck near the first cervical vertebra and then blooded freely for 10 minutes. The birds were weighed after slaughtering and the following measurements were recorded: carcass weight, giblets. Edible viscera weight, carcass cut-up parts were recorded, and dressing percentage was calculated.

At the 5 wks of age, during carcass traits were recorded, Blood samples were collected directly into heparinized sterile tubes. For the plasma analysis, samples were centrifuged at 3000 rpm for 15 min to isolate the plasma. The plasma was collected and stored at −20°C (for up to 2 days) until analyzed. The plasma analyzed for total protein (Gornall *et al*., 1949); albumin (Doumas *et al*., 1971); Globulin is calculated by the difference. Also, Albumen / globulin ratio was calculated. Cholesterol (Richmond, 1973 and Allen *et al*., 1974); Calcium (Gindler and King 1972); phosphorus (El-Merzabani *et al.*, 1977); Triglycerides (Fassati 1982) and the activities of alkaline phosphatase (ALP) enzymes were assayed in serum by the method of (Belfield and Goldberg 1971)

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

Ingredient, %	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.

Determination of nitrogen retention efficiency:

To test Nitrogen efficiency % determination, a separate experiment during the period from 36 to 38 days of age (for 3 days) was carried out, the three replicate from each treatment were set for total collection method (Attia, 1986). 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. Nitrogen in feed and excreta were measured by AOAC method (1990). The percentage of nitrogen efficiency was determined based on its retention in broiler chickens fed corn/soybean meal.

Nutrient 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:

Nutrient retention (%) = [nutrient retention (g/bird) / nutrient intake (g/bird)]*100 (Graña *et al*., (2013).

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) procedure (Version 9.2). Duncan's multiple range tests according to 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 used was:

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

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

Body weight (BW), Body weight gain (BWG), feed consumption (FC) and feed conversion ratio (FCR):

The results of BW, BWG, FC and FCR as affected by Optizyme, Phytase enzyme levels and their interactions from one day old to 5 weeks of age are presented in Tables 2, 3, 4 and 5 respectively. Concerning body wight, the birds fed to 500 mg optizyme enzyme had a significantly ($P\leq0.05$) the highest BW than those in control group or 250 mg optizyme level at 2 and 5 weeks of age. The same trend was obtained with 1500 FTU of phytase. BW of broiler chicks fed 250 or 500 mg optizyme with 1500 FTU phytase achieved higher BW than control groups. The multi-enzyme (3 different enzyme combinations: xylanase, glucanase, protease, and amylase) supplements to broiler diets showed no improvement in BW (Shalash *et al.*, 2009). Abou El-Wafa *et al*. (2002) reported that a significant improvement in BW in broilers fed diet supplemented with avizyme. The obtained results are in disagreement with Attia *et al*., (2003) who reported that the addition of exogenous enzyme Optizyme (Optivite, Retford, UK) in dehulled sunflower meal levels (5%, 10%, or 15%) showed no effect in birds. Also, Douglas *et al.* (2000) showed no change in growth performance of birds fed low energy corn-SBM diets supplemented with Avizyme 1500 though increases in ileal.

Table (2): Body weights of broiler chickens (g/bird) at different weeks of age as affected by Optizyme and phytase enzyme levels and their interactions.

Treatment	Age (weeks)					
	One day	One week	Two week	Three week	Four week	Five week
Optizyme levels (mg)						
0 (O)	42.00	163.38±2	384.93±11[b]	763.83±18	1259.24±29	1664.08±55[b]
250 (O1)	42.00	163.83±2	411.86±6[a]	781.62±11	1279.96±25	1697.77±45[a]
500 (O2)	42.00	160.86±4	409.44±5[a]	784.00±10	1267.28±21	1700.70±30[a]
Phytase levels (FTU)						
0 (P)	42.00	164.60±2	390.24±7[b]	770.16±11	1269.78±18	1693.68±37
1500 (P1)	42.00	160.78±2	413.92±5[a]	782.80±11	1267.87±22	1681.35±35
Interaction						
O×P	42.00	165.42±1	360.11±7[b]	734.00±10	1216.52±6	1616.59±76[c]
O×P1	42.00	161.34±5	409.75±9[a]	793.66±28	1301.96±52	1711.56±83[a]
O1×P	42.00	161.72±4	400.60±9[a]	783.91±22	1296.65±44	1727.32±74[a]
O1×P1	42.00	165.94±1	423.13±6[a]	779.33±8	1263.26±29	1668.21±60[b]
O2×P	42.00	166.65±7	410.00±3[a]	792.59±7	1296.16±15	1737.14±27[a]
O2×P1	42.00	155.07±2	408.88±10 [a]	775.40±20	1238.39±38	1664.26±52[b]

Means in the same columns with different superscript are significant different ($P\leq0.05$)

Table (3): Body weight gains (g/bird) of broiler chickens as affected by Optizyme and Phytase enzyme levels and their interactions.

Treatment	Body weight gain(g /bird)		
	Gain from one day old -3wks of age	Gain from3-5 wks of age	Gain from one day old to 5 wks of age
Optizyme levels (mg)			
0 (O)	721.83±18	900.25±48	1622.08±55[b]
250 (O1)	739.62±11	916.15±41	1655.77±45[a]
500 (O2)	742.00±10	916.71±26	1658.70±30[a]
Phytase levels (FTU)			
0 (P)	728.16±11	923.52±32	1651.68±37
1500 (P1)	740.80±11	898.55±31	1639.35±35
Interaction			
O×P	692.00±10	882.59±85	1574.59±76[b]
O×P1	75166±28	917.90±59	1669.56±83[a]
O1×P	741.91±22	943.42±54	1685.32±74 [a]
O1×P1	737.33±8	888.88±68	1626.21±60 [a]
O2×P	750.59±7	944.55±21	1695.14±27 [a]
O2×P1	733.40±20	888.86±47	1622.26±52 [a]

Means in the same columns with different superscript are significant different ($P \leq 0.05$)

Table (4): Feed consumptions (g/bird) of broiler chickens as affected by Optizyme and phytase enzyme levels and their interactions.

Treatment	Feed consumption (g/bird)		
	FC from one day old to 3 wks of age	FC from 3-5 wks of age	FC from one day old to 5 wks of age
Optizyme levels (mg)			
0 (O)	926.83±22	1680.65±74	2607.48±71
250 (O1)	993.00±14	1728.09±35	2721.09±71
500 (O2)	996.83±8	1697.15±25	2693.99±30
Phytase levels (FTU)			
0 (P)	944.78±17 [b]	1731.43±50	2676.21±53
1500 (P1)	999.67±10 [a]	1672.50±24	2672.16±29
Interaction			
O×P	866.67±0.76[b]	1738.60±146	2605.30±145
O×P1	987.00±4[a]	1622.70±48	2609.70±53
O1×P	983.33±12[a]	1724.00±76	2707.30±88
O1×P1	1002.67±27[a]	1732.20±12	2734.80±15
O2×P	984.33±3[a]	1731.60±10	2716.00±14
O2×P1	1009.33±15[a]	1662.70±46	2672.00±62

[a – b]*Means in the same columns with different superscript are significant different ($P \leq 0.05$)*

No significantly differences due to the Optizyme, phytase enzyme supplementation or their interactions in BWG within the periods from one day old to 3 wks and 3-5 weeks of age. However, the BWG from one day old to 5 wks of age was affected significantly by optizyme levels and the interactions only. Birds fed the supplemented control diet with optizyme had higher BWG than those control groups. The same trend was obtained with 1500 FTU of phytase. BW of broiler chicks fed 250 or 500 mg optizyme with 1500 FTU phytase achieved higher BW than control groups. Several studies have detected an improvement in performance of broilers with enzyme supplementation of fed corn and soybean-based diets (Kiarie *et al*., 2014 and Flores *et al*., 2016). Hassan *et al.* (2011) showed that addition of phytase 375 U/Kg to the basal diet (deficient in lysine (90% of the requirements)) significantly improved BWG. Farran *et al.,* (2010) reported that supplementation of 0.1% (Avizyme) 1100 (xylanase and β-glucanase 300 U/g) to barley-based finisher diets improved weight gains. Yuan *et al.* (2008) observed that the average BWG were significantly improved for the birds fed the diets supplemented with 180 mg/kg and 360 mg/kg enzyme complex compared to those of the basal diet (control) and 720 mg/kg enzyme complex Abd El-Hakim and Abd El-Samme (2004) found that phytase supplementation at 750 U/kg to broiler diets from 7 to 42 d of age during summer season improved BWG. El-Nagmy *et al*. (2004) found that phytase supplementation (0, 400, 800 U/kg) improved BWG of broiler chickens fed diets containing two levels of protein (23/21% and 20/18% CP) during the growing/finishing period.

No significantly differences due to the Optizyme, phytase enzyme supplementation or their interactions in FC within the periods from 3-5 and from one day old to 5 wks of age. However, the FC from one day old to 3 wks of age was affected significantly by phytase levels and the interactions only. Birds fed the supplemented control diet with phytase had higher FC than those control groups. The same trend was obtained with 1500 FTU of phytase. FC of broiler chicks fed 250 or 500 mg optizyme with 1500 FTU phytase achieved higher FC than control groups. Similar trend was obtained with Abudabos (2010 and 2012) who reported that at 10 day, no significant differences in FC due to enzyme supplementation. Motawe *et al*., (2012) showed that phytase supplementation FI was not affected by phytase supplementation at starter/grower period. Edwin et al., (2004), Hanna et al., (2008) and Cowieson and Ravindran (2008) a reported no effect of exogenous enzyme supplementation on feed intake in broilers. Attia *et al*. (2006) reported that Avizyme decreased ($P<0.05$) FI (3.0%). Enzyme supplementation had no significant influence on feed consumption (Scheideler *et al*., 2005), The addition of enzymes to the experimental diets did not significantly affect FC of chicks.

No significantly differences due to the Optizyme, phytase enzyme supplementation or their interactions in FCR within the periods from one day old to 3 wks and 3-5 weeks of age. Although, numerically the FCR of birds fed the supplemented highest levels of both optizyme and phytase had the best FCR than those control groups. The obtained results concerning multienzymes are in agreement with that reported by Scheideler *et al*., (2005) , and Mohamed *et al*. (2005) and Soliman (1997) who reported that enzyme supplementation had no significant influence on feed conversion and also, did not significantly improve feed conversion at days 14 and 35 (Zeng *et al*., 2015), during the breeding period.

Table (5): Feed conversion ratio (g feed/g gain) of broiler chickens as affected by Optizyme and Phytase enzyme levels and their interactions.

Treatment	Feed conversion ratio (g feed/g gain)		
	FCR3-0	FCR 5-3	FCR 5-0
Optizyme levels (mg)			
0 (O)	1.31±0.02	2.93±0.11	1.63±0.04
250 (O1)	1.37±0.03	3.00±0.11	1.66±0.03
500 (O2)	1.37±0.02	2.95±0.7	1.64±0.02
Phytase levels (FTU)			
0 (P)	1.32±0.02	2.92±0.06	1.64±0.02
1500 (P1)	1.38±0.02	3.01±0.09	1.65±0.03
Interaction			
O×P	1.28±0.02	2.99±0.18	1.67±0.04
O×P1	1.34±0.05	2.87±0.16	1.59±0.07
O1×P	1.35±0.03	2.88±0.08	1.62±0.03
O1×P1	1.39±0.05	3.12±0.20	1.70±0.05
O2×P	1.34±0.01	2.88±0.07	1.62±0.03
O2×P1	1.40±0.04	3.02±0.13	1.67±0.04

Means in the same columns with different superscript are significant different (P≤0.05)

Carcass characteristics:

Date presented in Table (6) showed that blood, feather, femur, breast, giblets, carcass and dressed percentages relative to BW were no significantly affected by Optizyme, Phytase enzyme levels and their interactions. Regarding Optizyme enzyme effects, the results showed that not significantly effects due to Optizyme enzyme on carcass characteristics. On the other hand, there was significant interaction effect between Optizyme and Phytase enzyme levels on femur percentage relative to BW. Birds in the groups 6 had significantly lowest femur percentage ($P\leq0.05$) than other groups. Numerically dressed percentage achieved the highest value in group fed 250 mg optizyme and 1500 FTU phytase (Table 5). The obtained results are in agreement with that reported by El-Serwy *et al.*, (2012) and Fathey, (2012) who reported that enzyme supplementation to experimental diets had no significant effect on carcass traits of broilers.). Cardoso *et al.*, (2011) and Carvalho *et al.*, (2009) using enzyme complexes in diets for broilers, observed no change in breast and leg yields and abdominal fat. Salem *et al.* (2008) reported that dietary avizyme supplementation had no significant effect on most of carcass traits studied (heart, liver, empty gizzard, abdominal fat, and thymus) relative weights. The carcass weight, carcass yield, and the relative weight of the abdominal fat were significantly (P<0.05) increased by enzyme addition, but relative weight of the breast, legs, liver, and gizzard as percentage of live weight were not (Shirzadi *et al.*, 2009). Attia (2003) found that phytase supplementation at 600 U/kg to duckling diets containing different levels of lysine or methionine, did not affect carcass yield. Salem *et al.* (2003) found that phytase at 600 U/kg in broiler diets containing different levels of P had no effect on carcass yield at 4 wk of age, however it increased carcass yield at 7 wk of age. Also, Yonemochi *et al.* (2003) found that supplementation of 500 U of phytase/kg diet for broiler chick's decreased significantly abdominal fat deposition compared to the negative control fed nPP- inadequate diet. Abd El-Samee (2002) reported that phytase supplementation at 750 U/kg to broiler diets did not significantly affect carcass characteristics and meat analysis of 7 wk of age broiler chicks. Qota *et al.* (2002) found that phytase addition at 500 U/kg to broiler diets contained 10% linseed cake did not significantly affect dressing, liver, gizzard, heart, giblets, and pancreas percentages, as well as meat physical characteristics such as pH value; tenderness, WHC and color intensity. Phytase increased percentage CP of meat, while it decreased fat and DM content of meat.

Table (6): Carcass characteristics (%) of broiler chickens as affected by Optizyme and Phytase enzyme levels and their interactions.

Treatment	Carcass characteristics (%)						
	Blood	Feather	Femur	Breast	Giblets	Carcass	Dressed
Optizyme levels (mg)							
0 (O)	3.3±0.3	7.9±0.6	15.0±0.1	18.3±1	4.2±0.1	75.2±0.5	79.4±0.5
250 (O1)	3.2±0.1	7.8±0.6	13.9±0.6	19.9±1	4.2±0.1	75.2±0.8	79.4±0.9
500 (O2)	2.7±0.2	7.3±0.8	13.6±0.8	20.9±0.4	4.3±0.1	75.3±0.7	79.6±0.6
Phytase levels (FTU)							
0 (P)	3.3±0.1	7.6±0.5	14.2±0.5	19.4±0.6	4.2±0.1	74.9±0.4	79.0±0.3
1500 (P1)	2.9±0.2	7.7±0.6	14.1±0.4	20.0±1.0	4.3±0.1	75.6±0.6	79.9±0.6
Interaction							
O×P	$3.6±0.1^{a}$	6.9±0.7	$15.1±0.2^{a}$	18.2±1	4.2±0.1	75.1±0.5	79.3±0.5
O×P1	$3.0±0.6^{ab}$	8.8±0.6	$15.0±0.1^{a}$	18.4±2	4.2±0.2	75.3±0.9	79.5±1.1
O1×P	$3.4±0.1^{ab}$	9.1±0.3	$12.8±0.5^{b}$	19.6±1	4.1±0.0	74.0±0.4	78.1±0.4
O1×P1	$3.1±0.2^{ab}$	6.5±0.5	$14.9±0.4^{a}$	20.3±2	4.4±0.1	76.4±1	80.8±1
O2×P	$2.9±0.1^{ab}$	6.8±0.3	$14.8±1^{a}$	20.5±0.5	4.3±0.1	75.5±0.7	79.8±0.6
O2×P1	$2.5±0.3^{b}$	7.8±1.6	$12.5±0.4^{b}$	21.4±0.6	4.3±0.2	75.1±1.4	79.4±1.3

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

On the other hand, the obtained results are in disagreement with (Hassan *et al*., (2011) who reported that the highest dressing percentage value was recorded for birds fed the high crude protein diet supplemented with avizyme and the highest abdominal fat percentage value was recorded for birds fed the low crude protein diet supplemented with avizyme**.**

Some blood constituents:

The results of blood constituents as affected by Optizyme, Phytase enzyme levels and their interactions are presented in Table (7). Concerning with the effect of Optizyme enzyme, the results showed that there were not significantly (P≤0.05) differences for all blood constituents, except of calcium and cholesterol levels. Birds fed to 500 mg optizyme enzyme level supplementation (O1) had a significantly (P≤0.05) the highest calcium level than those in 0 mg optizyme enzyme level supplementation. While those in 250 mg optizyme enzyme level supplementation had an intermediate value. Birds fed to 500 mg optizyme enzyme level supplementation had a significantly (P≤0.05) the highest cholesterol level compared to 0 mg and 250 mg optizyme enzyme levels supplementation. Salem *et al.* (2008) observed that inclusion the avizyme in the diet significantly (P ≤ 0.05) increased the concentration of plasma cholesterol by about 14.7% over the no supplemented diet. Moreover, enzyme addition increased serum total protein, cholesterol, calcium and phosphorus numerically (P>0.05). At 49 d of age, enzyme addition improved (P<0.01) serum total protein concentration by 3.9% for control group vs. 250g for multienzyme Bergazyme group (Abudabos, 2010).

Table (7): Plasma constituents of broiler chickens as affected by Optizyme and Phytase enzyme levels and their interactions.

Treatment	Blood constituents			
	Tot. Protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	A/G Ratio
Optizyme levels (mg)				
0 (O)	3.32±0.07	1.27±0.03	2.04±0.05	0.62±0.02
250 (O1)	3.45±0.13	1.25±0.03	2.20±0.12	0.57±0.03
500 (O2)	3.55±0.11	1.34±0.03	2.21±0.10	0.61±0.02
Phytase levels (FTU)				
0 (P)	3.49±0.11	1.32±0.01	2.17±0.11	0.62±0.02
1500 (P1)	3.39±0.06	1.26±0.04	2.12±0.03	0.59±0.01
Interaction				
O×P	3.35±0.13	1.34±0.02[ab]	2.00±0.10	0.67±0.02
O×P1	3.29±0.08	1.21±0.05[bc]	2.08±0.04	0.58±0.03
O1×P	3.59±0.25	1.30±0.01[abc]	2.28±0.25	0.59±0.06
O1×P1	3.32±0.12	1.19±0.07[c]	2.13±0.07	0.56±0.02
O2×P	3.55±0.23	1.31±0.04[abc]	2.23±0.22	0.59±0.05
O2×P1	3.55±0.07	1.38±0.03[a]	2.17±0.06	0.63±0.02

[a – c]Means in the same columns with different superscript are significant different (P≤0.05)

Table (7 cont.): Plasma constituents of broiler chickens as affected by Optizyme and Phytase enzyme levels and their interactions.

Treatment	Blood constituents				
	Calcium mg/dl	Phosphorus mg/dl	Triglycerides mg/dl	ALP U/L	Cholesterol (g/dl)
Optizyme levels (mg)					
0 (O)	9.70±0.04[b]	4.45±0.17	89.84±6	1209.42±319	139.00±3[b]
250 (O1)	9.76±0.02[ab]	4.53±0.15	90.51±3	812.64±128	131.00±2[b]
500 (O2)	9.86±0.02[a]	4.56±0.15	92.35±3	1475.99±232	159.00±4[a]
Phytase levels (FTU)					
0 (P)	9.78±0.03	4.57±0.13	93.60±2	1256.24±220	152.00±4[a]
1500 (P1)	9.76±0.03	4.46±0.11	88.20±4	1075.80±190	134.00±3[b]
Interaction					
O×P	9.75±0.06[ab]	4.76±0.23	101.90±5[a]	1033.53±464[ab]	149.00±0.00[b]
O×P1	9.66±0.05[b]	4.15±0.17	77.79±6[b]	1385.32±489[ab]	129.00±0.00[e]
O1×P	9.74±0.03[ab]	4.34±0.17	90.17±3[ab]	781.28±176[b]	137.00±0.00[d]
O1×P1	9.78±0.05[ab]	4.73±0.23	90.85±6[ab]	844.00±213[b]	125.00±0.00[f]
O2×P	9.87±0.06[a]	4.62±0.30	88.72±3[ab]	1953.90±189[a]	170.00±0.00[a]
O2×P1	9.85±0.01[a]	4.50±0.12	95.98±5[a]	998.08±251[ab]	148.00±0.00[c]

[a – f]Means in the same columns with different superscript are significant different (P≤0.05)

Concerning with Phytase enzyme, there were significantly (P≤0.05) differences were observed between the phytase levels and plasma cholesterol. Cholesterol of birds fed Phytase enzyme (1500 FTU) were higher than non-fed Phytase enzyme levels (0 FTU). There was an interactions effect between Optizyme enzyme and Phytase enzyme levels on albumin, calcium, triglycerides, alkaline phosphatase (ALP) and cholesterol. However, albumin was significantly (P≤0.05) the highest in birds reared in group 6 than other groups. However, birds in the group 4 had the lowest albumin than other groups. Plasma phosphorus% was not significantly affected by optizyme, phytase levels and their interactions.

Concerning with the interactions, cholesterol was significantly (P≤0.05) the highest in birds reared in groups 5 than other groups. While those in birds reared in groups 4 had lowest Cholesterol than other groups than other groups.

Calcium was significantly (P≤0.05) the highest in birds reared in groups 5 and 6 than other groups.

Triglyceride was significantly (P≤0.05) the highest in birds reared in groups 1 and 6 than in birds reared in group 2. However, birds in the groups 3, 4, and 5 had an intermediate value. ALP was significantly (P≤0.05) the highest in birds reared in groups 5 than other groups. Phytase supplementation tend to decrease significantly the activity of plasma content of alkaline phosphatase, (ALP) but plasma content of Ca and P was not significantly affected by phytase supplementation (Ghazalah and Alsaady, 2008).

Calcium was significantly (P≤0.05) the highest in birds reared in groups 5 and 6 than other groups. Similar trend was obtained with Abou-Ashour *et al.* (2011) who found that plasma Ca and P were increased at 6000 and 12000 U phytase/kg diet

The obtained results are in disagreement with Manobhavan *et al., (*2016) who showed that super doses of phytase (at 2500 FTU and 5000 FTU/kg) on low-phosphorus diet improved blood P levels.

The use of nutritional strategies, such as formulation diets addition of enzymes and organic trace minerals, has helped to reduce the impact of the excretion of potentially polluting elements in the environment (Ferket *et al.*, 2002) and helped to improve performance and nutrients retention efficiency.

Nitrogen retention efficiency:

The data presented in Table 8 reveal the total nitrogen in excreta at 42 days of age reveal that it were insignificantly affected by optizyme or phytase or their interactions. However, N retention% was significantly affected by optizyme levels, the level 250 mg optizyme achieved the highest value of N retention% but control group achieved the lowest value. Also, N retention % was significantly affected by the interaction between optizyme and phytase levels. The 250 mg optizyme and 1500 FTU phytase achieved the highest value of N retention%.

The diet containing phytase (Control+PHY) did not influence (p > 0.05) N intake, but it was better than the C diet because it reduced (p < 0.05) total N excretion (from 2.44 to 2.4%) and increased N retention (g/bird and %) from 45.3 to 51.64% (Table 8).

Table (8): Nitrogen retention (%) of broiler chickens as affected by Optizyme and Phytase l enzyme levels and their interactions.

Treatments	Nitrogen availability						
	Dry feed	N feed (%)	Total N/feed	Dry Excreta	N excreta (%)	Total N/excreta	N retention efficiency%
Optizyme levels (mg)							
0 (O)	135.56±13	3.37±0.01^{b}	4.57±0.46	61.98±5	4.27±0.28	2.63±0.27	41.30±5^{b}
250 (O1)	150.83±13	3.55±0.02^{a}	5.36±0.49	50.71±5	4.20±0.15	2.14±0.25	59.44±5^{a}
500 (O2)	125.88±9	3.56±0.03^{a}	4.49±0.34	51.64±6	4.88±0.27	2.49±0.30	44.65±4^{ab}
Phytase levels (FTU)							
0 (P)	131.76±10	3.46±0.01	4.56±0.36	53.19±5	4.63±0.23	2.44±0.25	45.30±5
1500 (P1)	143.08±10	3.53±0.04	5.05±0.36	56.36±4	4.26±0.18	2.40±0.20	51.64±4
Interaction							
O×P	129.36±23	3.41±0.00^{e}	4.41±0.79	62.05±8	4.87±0.19^{a}	3.01±0.44	30.77±2^{c}
O×P1	141.76±19	3.34±0.00^{f}	4.73±0.65	61.91±7	3.67±0.14^{b}	2.25±0.22	51.84±3^{ab}
O1×P	146.66±14	3.50±0.00^{c}	5.13±0.51	53.20±9	4.13±0.29^{ab}	2.20±0.44	56.70±9^{ab}
O1×P1	154.99±26	3.61±0.00^{b}	5.59±0.93	48.22±6	4.26±0.14^{ab}	2.07±0.33	62.19±6^{a}
O2×P	119.26±18	3.49±0.00^{d}	4.16±0.65	44.33±8	4.90±0.60^{a}	2.11±0.37	48.42±6^{abc}
O2×P1	132.49±5	3.64±0.00^{a}	4.82±0.20	58.95±8	4.86±0.12^{a}	2.87±0.42	40.89±7^{c}

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

These results are consistent with the findings of De Faria & Sakamoto (2008), who found that a feed containing a combination of these same nutritional strategies (Control+PHY) promoted lower N content in the excreta, but did not affect N retention. Phytase is also known for releasing amino acids chelated with phytate, thereby contributing to increase nitrogen retention and to reduce nitrogen excretion in poultry (Lan *et al.,* 2002; Viveiros *et al.,* 2002 and Rutherfurd *et al.,* 2004).

REFERENCES

AOAC (1990). Association of Official Analytical Chemists. Official methods of analysis. *Assoc Anal Chem*.

Abd El-Hack, M.E.; Alagawany, M. Farag, M.R. and K. Dhama (2015). Use of maize distiller's dried grains with solubles (DDGS) in laying hen diets: trends and advances. Asian J. Anim. Vet. Adv., 10: 690-707.

Abd El-Hakim, A.S. and M.O. Abd El-Samee, (2004). Effect of feeding systems and phytase supplementation on the performance of broiler chicks during summer season. Egypt. Poult Sci., 24(11): 297-310.

Abd El-Samee, M.O. (2002). Effect of different levels of crude protein, sulpher amino acid, microbial phytase and their interaction on broiler chicks performance. Egypt. Poult. Sci., 22: 999-1021.

Abou El-Wafa, S., AM.R Osman, A.G. Abdallah and N.A. Hataba (2002). Evaluation of some commercial enzymes in broiler diets based on corn or barleylsoy in combination with growth promoter. Egypt. Poult. Sci, 22:1023-1045.

Abou-Ashour, A. M. H., S. A. A. A. El-Rahman, G. A. Zanaty, Manal K. Abou-Elnaga (2011). Effect of phytase supplementation on phytate phosphorous utilization and related parameters in broiler chickens. Proceedings of the 4th Scientific Conference of Animal Wealth Research in the Middle East and North Africa, Foreign Agricultural Relations (FAR), Egypt, 3-5 October 2011. pp. 375-394.

Abudabos, A. (2010). Enzyme supplementation of corn-soybean meal diets improves performance in broiler chicken. Int. J. Poult. Sci., 9: 292-297.

Abudabos, A. M. (2012). Effect of enzyme supplementation to normal and low density broiler diets based on corn- soybean meal. Asian .J .Anim. Vet. Adv., 7:139-148.

Adeola, O. and A.J. Cowieson (2011). Board-invited review: opportuni- ties and challenges in using exogenous enzymes to improve nonruminant animal production. J. Anim. Sci. 89, 3189–3218.

Alagawany, M. and A.I. Attia (2015). Effects of feeding sugar beet pulp and Avizyme supplementation on performance, egg quality, nutrient digestion and nitrogen balance of laying Japanese quail. Avian Biol. Res., 8: 79-88.

Allen, N. K, and D. H. Baker (1974). Quantitative evaluation of nonspecific nitrogen sources for the growing chick. Poultry Sci. 53:258-264.

Attia, Y. A. (1986). Effect of different dietary levels of protein and energy in productive performance of white leghorn chickens.M. Sc. Thesis, Fac. Of vet. Med., Al-Azher Univ.

Attia, Y.A., M.A. Al-Harthi, and A.A., El-Deek (2003). Nutritive value of undehulled sunflower meal as affected by multienzyme supplementation to broiler diets. Arch. Geflugelk., 67: 97–106.

Attia, Y. A., Aggoor, F. A., Ismail, M. F. S., Qota M. A. and E.A., Shakmak (2006). Effect of energy level, rice by products and enzyme additions on growth performance and energy utilization of Japanese quail. XII European Poultry Conference, Verona 10-14 September 2006, Italy.

Cardoso, D. M., M. P. Maciel, D. P. Passos, F. V. Silva, S. T. Reis, and F. S. Aiura (2011). Efeito do uso de complexo enzimático em rações para frangos de corte. Archivos de Zootecnia, Córdoba, v. 60, n. 232, p. 1053- 1064.

Carvalho, J. C. C.; A. G. Bertechini, and E. J. Fassani (2009). Desempenho e características de carcaça de frangos de corte alimentados com dietas à base de milho e farelo de soja suplementada com complexos enzimáticos. Revista Brasileira de Zootecnia, Viçosa, MG, v. 38, n. 2, p. 292-298.

Cowieson, A. J. and V. Ravindran (2008). Effects of exogenous enzymes in maize-based diets varying in nutrient density for young broilers; gowth performance and digestibility of energy, minerals and amino acids. Br. Poult. Sci. 49:34-44.

De Faria DE, M.I. Sakamoto (2008). Estratégias nutricionais para reduzir a excreção de nutrientes em frangos de corte. 5th Simpósio sobre Manejo e Nutrição de Aves e Suínos; Cascavel, Paraná. Brasil. p.81-8.

Doskovic, V., S. Bogosavljević-Bosković, Z. Pavlovski, B. Milošević, Z. Škrbić, and S. Rakonjac (2013). Enzymes in broiler diets with special reference to protease. Journal World's Poultry Science, Savoy, v. 69, n. 2, p. 343-359.

Douglas, M. W., C. M. Parsons, and M. R. Bedford (2000). Effect of various soybean meal sources and avizyme on chick growth performance and ileal digestible energy. J. Appl. Poult. Res. 9:74-80.

Doumas, B. T., W. A. Watson, and H. G., Biggs (1971). Albumin standards and the measurement of serum albumin with bromcresol green. Clin Chim Acta., 1 :87-96.

Duncan, O. D., and B. Duncan (1955). A methodological analysis of segregation indexes. *American sociological review*, *20*(2), 210-217.

Edwin S C, K. Viswanathan, B. Mohan, and M R. Purushothaman (2004). Effect of supplementation of NSP hydrolyzing enzymes on growth performance of Japanese quails. Indian Journal of Poultry Science 39 (3):241-245.

El-Merzabani, M. M., A., Anwer-El-Aaser, and N. I. Zakhary (1977). A New Method for Determination of Inorganic Phosphorits in Serum without Deproteinization. *Clinical Chemistry and Laboratory Medicine*, *15*(1-12), 715-718.

El-Nagmy, K.Y., Abd El-Samee, M.O. and M.R.M., Ibrahim (2004). Effect of dietary plant protein and microbial phytase levels on performance of broiler chicks Egypt. Poult. Sci., 24 (1): 101-121.

El-Serwy, A. A., M.S. Shoeib, and I.A. Fathey (2012). Performance of broiler chicks fed mash or pelleted diets containing corn-with-cobs meal with or without enzyme supplementation. J. Animal and poultry prod., Mansoura Univ., Vol.3 (3): 137-155.

Farran, M. T., Barbour, G. W., Usayran, N. N., Darwish, A. H., Machlab, H. H., Hruby, M. and A. Vahe'M (2010). Performance and carcass quality of broiler chickens fed a corn-soybean meal diet containing graded barley levels without or with enzyme. *The journal of poultry science*, *47*(1), 34-40.

Fassati, P., l. Prencipe (1982) Triglycerides determination after enzymatic hydrolysis. *Clin. chem*, *28*, 2077.

Fathey I.A (2012). Nutritional studies on poultry. Ph. D. thesis, Faculty of Agriculture Mansoura University Egypt.

Ferket P.R., Van E. Heugten, Van TLTG. Kempen and R. Angel (2002). Nutritional estrategies to reduce environmental emissions from nonruminants. Journal of Animal Science;80(2):168-182.

Flores, C.; M. Williamns, J. Penazek, Y. Dersjan, A. Awat and J. T. Lee (2016). Direct-fed microbial and its combination with xylanase, amylase, and protease enzymes in comparison with AGPs on broiler growth performance and foot-pad lesion development. Journal of Applied Poultry Research, Champaign, v. 24, n. 3, p. 328-337.

Ghazalah, A.A. and M.A., Alsaady (2008). Effect of dietary metabolizable energy and microbial phytase levels on broiler performance, nutrients digestibility and minerals utilization. Egypt. Poult. Sci. Vol (28) (III): 815-832.

Ghosh, A., G. P., Mandal, A., Roy and A. K. Patra (2016). Effects of supplementation of manganese with or without phytase on growth performance, carcass traits, muscle and tibia composition, and immunity in broiler chickens. Livestock Science, 191, 80-85.

Gindler, M., and J. D. King (1972). Chemical method for determination of calcium in serum. Am. J. Clin. Path, 58, 376.

Gornall, A. C.; C. J. Baradawill and M. M. David (1949). Determination of serum proteins by means of the biuret reaction. J. Biol Chem., 177: 751-766.

Graña, A. L., F. D. C., Tavernari, G. R., Lelis, L. F. T., Albino, H. S., Rostagno and P. C. Gomes (2013). Evaluation of nutrient excretion and retention in broilers submitted to different nutritional strategies. *Brazilian Journal of Poultry Science*, *15*(2), 161-168.

Hanna, A. Z., H. Mohammad, A. R. Jalal and A. S. Jabrin (2008). Effect of exogenous enzymes on the growing performance of broiler chickens fed regular corn-soybean based diets and the economics of enzyme supplementation Pakistan Journal of Nutrition 7(4): 534-539.

Hassan, H.M.A., M.O. Abd-Elsamee, A.E. El-Sherbiny, A. Samy and A. Mohamed (2011). Effect of Protein Level and Avizyme Supplementation on Performance, Carcass Characteristics and Nitrogen Excretion of Broiler Chicks. American-Eurasian J. Agric. and Environ. Sci., 10 (4): 551-560.

Jalal, M. A., and S. E. Scheideler (2001). Effect of supplementation of two different sources of phytase on egg production parameters in laying hens and nutrient digestiblity. Poultry Science, 80(10), 1463-1471.

Jondreville, C., P. Lescoat, M. Magnin, D. Feuerstein, B. Gruenberg, and Y. Nys (2007). Sparing effect of microbial phytase on zinc supplementation in maize–soya-bean meal diets for chickens. Animal, 1(6), 804-811.

Kiarie, E., L. F. Romero and V. Ravindran (2014). Growth performance, nutrient utilization, and digest characteristics in broiler chickens fed corn or wheat diets without or with supplemental xylanase. Poultry Science, Savoy, v. 93, n. 10, p. 1186-1196.

Lalpanmawia, H., A. V. Elangovan, M. Sridhar, D. Shet, S. Ajith and D. T. Pal (2014). Efficacy of phytase on growth performance, nutrient utilization and bone mineralization in broiler chicken. Animal Feed Science and Technology, 192, 81-89.

Lan, G.Q,.; N. Abdullah, S. Jalaludin and Y.W. Ho (2002). Efficacy of supplementation of a phytase-producing bacterial culture on the performance and nutrient use of broiler chickens fed corn-soybean meal diets. Poultry Science, 81(10):1522-1532.

Latham, R. E.; M. P. Williams, C. Flores, H. V. Masey O'neill, T. W. York and J. T. Lee (2016). Impact of variable corn nutrient content, AME prediction, and xylanase inclusion on growth performance. Journal of Applied Poultry Research, Champaign, v. 25, p. 338- 351.

Liu, S.Y., D.J. Cadogan, A. Peron, H.H. Truong, P.H. Selle (2014). Effects of phytase supplementation on growth performance, nutrient utilisation and digestive dynamics of starch and protein in broiler chickens offered maize-, sorghum- and wheat-based diets. Anim. Feed Sci. Technol. 197, 164–175.

Manobhavan, M., A. V. Elangovan, M. D. Sridhar, Shet, S. Ajith, D. T. Pal and N. K. S. Gowda (2016). Effect of super dosing of phytase on growth performance, ileal digestibility and bone characteristics in broilers fed corn–soya-based diets. Journal of animal physiology and animal nutrition, 100(1), 93-100.

Mohamed, M. A. El-Sherbiny, A.E. Hammouda and H.M.A. Hassan,(2005). Addition of phytase and other enzyme preparation to low phosphorus-Low calcium broiler diets. Egypt. Poult. Sci., 25: 689-702.

Motawe, H. F. A., T. M. EL-Afifi, H. M. A. Hassan, and Y. A. Attia (2012). Addition of phytase to broiler diets contained different lysine levels. Egypt. Poult. Sci. Vol (32) (I): 117-130.

Newkirk, R. W., and H. L. Classen (2001). The non-mineral nutritional impact of phytate in canola meal fed to broiler chicks. Animal Feed Science and Technology, 91(3-4), 115-128.

Nikam, M. G., V. R. Reddy, and M. V. L. N. Raju (2016). Effect of dietary supplementation of Non Starch Polysaccharide hydrolyzing enzymes on broilers reared on Corn-Soya standard and basal diets. International Journal of Agricultural Science and Research, 6(3), 389-396.

NRC (1994). Nutrient Requirements of Poultry. 9th rev. ed. Natl. Acad. Press, Washington, DC, USA.

Pariza, M. W. and M. Cook. (2010). Determining the safety of enzymes used in animal feed. Reg. Toxicol. Pharmacol. 56:332–342.

Paterson P.H. (2002). Hen house ammonia: Environmental consequences and dietary strategies. Multi-state poultry meeting;; Pensilvânia, Pensilvânia. United State of America. p.12.

Payne V.W. (1998). Management, treatment and utilization of poultry litter with respect to environmental protection. Simpósio Internacional sobre Ambiência e Sistemas de Produção Avícola;; Concórdia, Santa Catarina. Brasil. p.182-193.

Qota, E. M. A., E A. Al-Ghamry, and G.M. El-Mallah (2002). Nutritive value of soaked linseed cake as affected by phytase, Biogen supplementation or formulating diets based on available amino acid on broiler performance. Egypt. Poult. Sci. 22:461-475.

Ravindran, V., W.L. Bryden and E.T. Kornegay (1995). Phytates: Occurrence, bioavailability and implications in poultry nutrition. Poult. Avian Biol. Rev. 6:125-143.

Richmond, N. (1973). Preparation and properties of a cholesterol oxidase from Nocardia sp and its application to the enzymatic Assay of total cholesterol in serum. Clinical Chemistry, 19: 1350-1356.

Rutherfurd S.M., T.H. Chung, P.C.H. Morel and P.J. Moughan (2004). Effect of microbial phytase on ileal digestibility of phytase phosphorus, total phosphorus, and amino acids in a low-phosphorus diet for broilers. Poultry Science;83(1):61- 68.

Salem, A. A., E. M. M. El-Anwer, E. M. M. Abo-Eita and M. M. M. Namra (2008). Productive and physiological performance of golden montazah male chickens as affected by feed restriction and avizyme supplementation. *Egypt Poult. Sci*, *28*, 1137-1164..

Salem, Fayza. M, H.A. El-Alaily, N.M. El- Medany and K. Abd El-Galil (2003). Improving phosphorus utilization in broiler chick diets to minimize phosphorus pollution. Egypt. Poult. Sci., 23(11): 201-218.

Scheideler, S.E., M.M. Beck and A. Abudabos (2005). Multiple-enzyme (Avizyme) supplementation of cornsoy-based layer diets. J. Appl. Poult. Res., 14:77-86.

Selle, P.H. and V. Ravindran (2007). Microbial phytase in poultry nutrition. Animal Feed Science and Technology 135, 1–41.

Shalash, S. M. M., El-Wafa, S. A., Sayed, M. A. M., El-Gabry, H. E., Ramadan, N. A. and M. S. Mohamed (2009). Nutritive value of distillers dried grains with soluble and broiler performance at starter period. *Int. J. Poult. Sci*, *8*, 783-787.

Shirzadi, H., H. Moravej and M. Shivazad (2009). Comparison of the effects of different kinds of NSP enzymes on the performance, water intake, litter moisture and jejunal digesta viscosity of broilers fed barley-based diet. Journal of Food, Agriculture & Environment 7:615-619.

Soliman, A.A. (1997). Evaluation of the productivity and performance of broiler breeder hens fed practical or vegetable diets containing high levels of barley and sunflower meal with multi-enzymes supplement during the pre-laying and laying periods. Ph.D. Thesis, Fac., of Agric., Alex. Univ., Egypt.

Viveiros A, A. Brenes, I.C. Arija and C. Centeno (2002). Effects of microbial phytase supplementation on mineral utilization and serum enzyme activities in broiler chicks fed different levels of phosphorus. Poult., Sci., 81(8):1172- 1183.

Yuan, J., J. Yao, F. Yang, X. Yang, X. Wan, J. Han, Y. Wang, X. Chen, Y. Liu, Z. Zhou, N. Zhou and X. Feng (2008). Effects of supplementing different levels of a commercial enzyme complex on performance, nutrient availability, enzyme activity and gut morphology of broilers. Asian-Aust. J. Anim. Sci. 21:692-700.

Zeng, Q; X. Huang, Y. Luo, X. Ding, S. Bai, J. Wang, Y. Xuan, Z. Su, Y. Liu and K. Zhang (2015). Effects of a multi-enzyme complex on growth performance, nutrient utilization and bone mineralization of meat duck. J. Anim. Sci. Biotechnol., 6: 12.

تأثير مستويات مختلفة من انزيمات الاوبتزيم والفيتيز والتداخل بينهما على معدل اداء دجاج اللحم المغذى على عليقة الذرة/كسب فول الصويا: 1- معدل اداء كتاكيت اللحم ، صفات الذبيحة ، صفات الدم والاستفادة الحيوية للنيتروجين

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أجريت الدراسة الحالية في مزرعة بحوث الدواجن ، قسم إنتاج الدواجن ، كلية الزراعة ، جامعة جنوب الوادي ، قنا لبحث تأثير إنزيمات الأوبتزيم ، ومكملات إنزيمات الفيتيز وتفاعلاتها على أداء دجاج التسمين الذي يغذى على الذرة / وجبة فول الصويا. يشمل 1. أداء اللاحم وبعض صفات الذبيحة وبعض مكونات الدم وكفاءة الإحتفاظ بالنيتروجين ٪. كان التصميم التجريبي 3 × 2 تصميمًا عامليًا ، وثلاثة مستويات من إنزيم الأوبتزيم (صفر ، 250 و 500 ميللجرام / كجم) ومستويين من إنزيم الفيتيز (صفر و 1500 وحدة دولية/ كجم أوضحت النتائج أن مستوى 250 أو 500 ميللجرام من إنزيم الأوبتزايم و 1500 وحدة دولية من إنزيم الفيتيز تحسن من زيادة وزن الجسم فى نهاية التجربة ، إستهلاك الأعلاف من يوم واحد إلى ثلاثة أسابيع من العمر ، النسبة المئوية للتصافى ، إرتفاع الفوسفاتيز القلوي لبلازما الدم ، والدهون الثلاثية ، والكالسيوم ، وزيادة كفاءة الاحتفاظ بالنيتروجين. وخلصت النتائج إلى أن مستوى الأوبتزيم (250 أو 500) و 1500 وحدة دولية من إنزيم الفيتيز قد عزز أداء دجاج التسمين من سلالة IR فى المعايير التي تمت دراستها.