IMPACT OF MULTIPLE-ENZYME MIXTURE ON PERFORMANCE OF BROILERS FED CORN-SOYBEAN MEAL DIETS

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SUMMARY

This study aimed to investigate effects of supplementing corn-soybean meal diets of broilers with enzyme mixture (*Phytabex plus*) on growth performance, slaughter traits and blood metabolites. A total of 150 one day old Avian broiler chicks (sex-mixed) were subjected to a 5 weeks dietary experiment. Chicks were randomly divided into 5 experimental groups [basal diets supplemented with 0, 100, 150, 200 and 200 g/ ton *Phytabex plus* , during starter (0-3 weeks) and 0, 100, 150, 200 and 100 g/ ton *Phytabex plus* , during grower (4-5 weeks)]. Each treatment comprised 3 replicates (10 chicks per replicate). Results indicated that, chicks fed diet supplemented with 100 g/ ton *Phytabex plus* (T2) had significantly heavier live body weight (LBW) by (4.11 (T1), 9.39 (T3), 4.98 (T4) and 4.83% (T5) than other treatments. Feed conversion ratio (FCR) was 1.86, 1.95, 1.99, 1.90 and 1.95 for birds fed diet supplemented with different levels of *Phytabex plus* (T1: T5) respectively. In addition, birds fed diet supplemented with 150 g/ ton *Phytabex plus* (T3) recorded higher dressing percentage and ready to cook at 5 weeks of age compared to other groups. Moreover, enzyme supplementation significantly increased plasma total protein and globulin while, total cholesterol and alanine transaminase (ALT) were insignificantly affected by dietary treatments. Economic traits during the trial period were decreased for chicks fed any of experimental diets as compared with those fed the control diet. It is clear from the present study that using *Phytabex plus* at 100 g/ ton improved LBW and at 150 g/ ton improved percentage of dressed weight and total edible parts and there was no negative effect on liver but favorable effects were noticed on some blood parameters, while there was no economical benefit upon using *Phytabex plus* .

Keywords: *corn-soybean meal, enzyme mixture and broiler performance*

INTRODUCTION

Feeding enzymes to poultry is one of the major nutrition advances in the last fifty years. The main potential of enzyme addition to feed appears for digestion of substances that an animal is intrinsically incapable of digesting (Cheeke, 1991). These enzymes can open up to the complex feed cell walls, allowing the animals own enzymes to digest the enclosed nutrients. These complexes are only a fraction of the polysaccharides present in the digesta and are made up of a number of different components. (Austin *et al*., 1999). High digesta viscosity can lead to reduced feed intake, slower digesta passage rate and impaired nutrient digestion (Naqvi and Nadeem, 2004). It is well known that exogenous enzymes have been shown to improve performance and nutrient digestibility when added to poultry diets containing cereals, such as barley (El-Faham and Ibrahim, 2003); wheat (Kalmendal and Tauson, 2012), and to those containing rye (Lázaro *et al*., 2003). However, it has been reported also that multi-enzyme products improve bird's productivity (El-Faham and Ibrahim, 2004) and digestibility of corn and soybean meal, which induce less viscosity of digesta for broilers (Olukosi *et al*., 2007). The impact of many commercial enzyme products have been well stated, but there is still some vagueness in their mode of action (Bedford, 2002). Moreover, several reports indicated that using an enzyme cocktail (Zado), has beneficial effects on broiler productivity when birds fed a corn-soybean meal (SBM) based diet, which are reflected on economic benefits for producers. (Safaa, 2013). Also, Kocher *et al*. (2003) reported that using an enzyme cocktail containing pectinase, amylase and protease in corn-SBM-based diets for chicks resulted in improved performance. In addition, Kalmendal and Tauson (2012) observed that the combination of xylanase and serine protease improved FCR, compared with the control diet but, LBW and feed intake were not affected by enzyme addition. Moreover, Gracia *et al*., (2003) demonstrated that amylase was a critical enzyme to improve the nutritional value of corn-based broiler diets, improving body weight gain (BWG) and FCR by 4 to 9% compared with an un-supplemented control diet. On the other hand, Barekatain *et al*. (2013) observed that the addition of xylanase and protease to broiler corn-SBM based diets up to 21 days of age did not result in further improvement in productive performance represented by body weight gain, feed intake and FCR. Moreover, Kocher *et al*. (2002) reported that addition of enzymes' complex from 4 to 38 days of age had no effect on BWG or FCR of broilers fed on a corn-SBM diet.

Therefore, the aim of this study was to evaluate the impact of commercial enzymes' complex (*Phytabex plus*) supplementation to broiler fed corn-SBM based diets on productive performance, carcass characteristics and blood metabolites.

MATERIALS AND METHODS

This study was conducted at Poultry Experimental Unit, Agricultural Experiment and Research Station at Shalakan, Faculty of Agriculture, Ain Shams University, Egypt.

Birds and Diets

A total of 150 Avian broiler chicks (mixed sex) at one-day old with an initial body weight ranged between 44.0 and 47.0 g were obtained from a local commercial hatchery. Chicks were then divided randomly into 5 treatments [basal diet supplemented with *Phytabex plus* at (0, 100, 150, 200 and 200 g/ ton in starter basal diet) and (0, 100, 150, 200 and 100 g/ ton in grower basal diets)]. The chicks were weighed individually and randomly allocated to 5 dietary treatments groups, each group contained 30 chicks which were allotted into 3 replicates, and each replicate contained 10 chicks. Basal starter (0-3 wks) and grower (4-5 wks) diets were formulated according to the nutritional recommendation of NRC (1994) for broilers, their composition and calculated analysis are shown in Table (1). *Phytabex plus* is a

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

Ingredients	Dietary Treatments	
	Starter (0-3 Weeks)	Grower (4-5 Weeks)
Corn (grains)	54.50	57.50
Soybean meal (44%)	33.00	28.00
Corn gluten meal (62%)	6.20	6.20
Soybean oil	2.00	4.00
Mono-calcium phosphate	1.80	1.80
Calcium carbonate	1.60	1.60
Premix	0.30	0.30
Salt (NaCl)	0.20	0.20
Methionine HA	0.20	0.20
HCL Lysine	0.20	0.20
Total	100	100
Chemical composition		
Crude protein %	23.00	21.05
ME Kcal/ Kg diet	2986	3168
Ca%	1.02	1.00
AP%	0.50	0.49
Lysine %	1.29	1.16
Methionine + Cystein %	0.95	0.90
Price/ Ton (L.E.)	3827	3808
Composition of commercial multi enzymes (*Phytabex Plus*): Each 1 Kg contains		
Xylanase 10000000 IU	α-Amylase 100000	Cellulase 500000 IU
Acid Protease 2000000 IU	β-Glucanase 500000 IU	Food-grade corn starch carrier up
Phytase 5500000 IU	β-Mannanase 800000 IU	to 1 Kg

Methionine HA: Methionine Hydroxy-Analogue, ME: metabolizable energy, AP: Available phosphorus.
Each 3 Kg of the premix contains: Vitamins: A: 12000000 IU; Vit. D3 2000000 IU; E: 10000 mg; K3: 2000 mg; B1:1000 mg; B2: 5000 mg; B6:1500 mg; B12: 10 mg; Biotin: 50 mg; Coline 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.

dry stabilized preparation manufactured by ENBio-Tech Co., LTD, China, it is a multi-enzyme preparation, each 1 Kg contains (Xylanase, Cellulase, B-Glucanase, B-Mannanase, Phytase, Acid protease, α-Amylase and corn starch food grade (carrier) (Table, 1). Chicks in all treatments were reared under similar hygienic and managerial conditions. They were housed in well ventilated brooding pens from one-day up to 5 wks of age, wheat straw was used as a litter, and feed and water were provided ad-libitum throughout the experimental period.

Parameters Measured

Live body weight (LBW) and feed consumption (FC) for each replicate for all treatments were recorded, then were averaged and expressed in grams per chick throughout the experimental periods. Body weight gain (BWG) and feed conversion ratio (FCR) were also calculated during the same periods. Production Index (PI) was calculated according to North (1981).

At the end of 5 wks of age, three chicks from each treatment were randomly taken for slaughter. The birds were then immediately eviscerated by removing of head, feathers, lungs, feet and gastro-intestinal tract. The carcass parameters including weights of abdominal fat, liver, gizzard and heart were recorded. These weights were expressed in terms of percentage of live weight.

During slaughter, individual blood samples were taken from birds within each treatment and collected into dry clean centrifuge tubes containing drops of heparin and centrifuged for 15 min (3000 rpm) to obtain plasma. Plasma samples were stored at -20°C in a deep freezer until the time of chemical determination. Quantitative determination of blood included the following: Total protein (according to Gornall *et al*., 1949), albumin (method as described by Doumas *et al*., 1971), globulin (determined by subtraction particular value of albumin from corresponding value of total protein), total cholesterol (enzymatic colorimetric method described by Richmond, 1973), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined according to the method of Reitman and Frankel (1957). All biochemical parameters of blood were calorimetrically diagnosing kits (produced by Bio-Diagnostics Company, Egypt).

Feeding economic efficiency was carried out according to the prices of feed ingredients, enzyme preparation and LBW during experimental time. A production cost analysis and economic evaluation was carried out according to methods described by North (1981) and Emmert (2000).

Statistical Analysis

Statistical analysis was conducted using the General Linear Model (GLM) procedure of SAS (2004). Means were compared using Duncan's Multiple Range Test (Duncan, 1955) where the level of significance was set at minimum ($P \leq 0.05$).

The statistical model was:

$Y_{ij} = \mu + T_i + e_{ij}$

<u>*Where:*</u> Y_{ij} = an observation; μ = overall mean

T_i = effect of treatment; e_{ij} = random error

RESULTS AND DISCUSSION

Growth performance

Results of Table (2) showed that live body weight (LBW) was significantly affected due to enzyme supplementation during starter and grower stages. Bird’s LBW was significantly increased by 7.12% for chicks fed (T2) diet than those fed the control (T1) diet at 3 wks of age, whereas was insignificantly increased by 4.29% at 5 wks of age. On the other hand, chicks fed (T2) diet had heavier LBW by 9.39, 4.98 and 4.83% than those fed (T3), (T4) or (T5) diet respectively at 5 wks of age. Daily weight gain (DWG) showed the same trend since chicks fed (T2) diet during all stages (0-3, 4-5 and 0-5 wks) reflected significantly the highest DWG compared with other treatments. However, during starter period (0-3 wks), chicks gained (33.15 vs. 30.81 g.), while during grower period (4-5 wks), chick gained (55.97 vs. 55.01 g.) and during whole experimental period (0-5 wks) chicks gained (42.28 vs. 40.49 g) compared with the control group (T1). Moreover, feeding (T2) diet gave higher DWG compared to (T3), (T4) or (T5) diets being 38.19, 40.11 and 40.18 g, respectively, however, these differences failed to be significant. Similar observations were reported by other investigators, Shirmohammad and Mehri (2011) who reported that addition of enzyme preparation to broiler diet improved BWG significantly. Also, Osman *et al*. (2007) and Pourreza *et al*. (2007) reported that broiler chicks fed diets supplemented with enzymatic growth promoters (Ronozyme) achieved the highest LBW and BWG at 6 wks. In addition, Greenwood *et al*. (2002) showed that using a mixture of xylanase, protease and amylase enzymes with corn-soybean broiler starter diet improved LBW at 14 and 42 days of age. Data in Table (2) indicated that daily feed consumption (DFC) per chick (g/ day) was significantly increased by feeding (T2) diet compared with those fed control (T1) diet and other dietary treatments (T3, T4 or T5). Increment of feed consumption was more pronounced during the grower period (4-5 wks) being 11.59%, while it was only 6.93% during the starter period (0-3 wks). Increased DFC (g/ d) could be related to the fact that broiler chicks consume more feed to meet energy requirements moreover broiler chicks require more dietary energy to maximize growth during short rearing periods (Al-Homidan, 2003). These results are in agreement with findings of Khan *et al*. (2006) and Pourreza *et al*. (2007) who concluded that dietary enzyme supplementation increased feed intake. In contrast, Zakaria *et al*. (2010) showed that enzyme supplementation had no significant effect on feed intake of birds. Feed conversion ratio (FCR) showed that, chicks fed control (T1) diet were more efficient in converting their feed into gain compared with those fed other (T2: T5) diets, and differences were significant except for (T4) diet. The best FCR was detected for chicks fed the control (T1) diet (1.86) or (T4) diet (1.90). On the other hand, the worst FCR were found in chicks fed (T3) diet (1.99), which could be due to the lowest DWG. These finding are in contrast with those obtained by Youssef *et al*. (2011) and Onu *et al*. (2011) who found that enzyme supplementation improved FCR of broilers. Similarly, Hassanein (2011) reported that FCR was significantly improved by supplementing enzyme preparation to bird's diet.

Table (2): Effect of different dietary treatments on productive performance.

Item	Dietary Treatments					
	1	2	3	4	5	Sig.
Live body weight (g)						
3 weeks	690.83^{b} ±1.82	740.00^{a} ±21.93	720.07^{ab} ±0.92	736.03^{a} ±1.90	742.33^{a} ±8.85	*
5 weeks	1461.00^{ab} ±8.08	1523.63^{a} ±13.06	1380.50^{b} ±12.41	1447.78^{ab} ±35.95	1450.00^{ab} ±49.07	*
Daily weight gain (g)						
0–3 weeks	30.81^{b} ±0.08	33.15^{a} ±1.04	32.20^{ab} ±0.04	32.96^{a} ±0.08	33.26^{a} ±0.42	*
4–5 weeks	55.01^{a} ±0.44	55.97^{a} ±0.63	47.17^{b} ±0.82	50.84^{ab} ±2.43	50.54^{ab} ±2.87	*
0–5 weeks	40.49^{ab} ±0.23	42.28^{a} ±0.37	38.19^{b} ±0.35	40.11^{ab} ±1.02	40.18^{ab} ±1.40	*
Daily feed consumption (g)						
0–3 weeks	50.40^{c} ±0.05	53.89^{ab}±0.91	53.08^{b} ±0.22	52.61^{b} ±0.24	54.77^{a} ±0.25	**
4–5 weeks	112.75^{b} ±1.96	125.82^{a}±2.73	110.55^{b} ±2.69	111.67^{b} ±4.38	113.94^{b} ±1.66	*
0–5 weeks	75.34^{b} ±0.75	82.66^{a}±1.64	76.07^{b} ±1.21	76.23^{b} ±1.61	78.44^{b} ±0.81	**
Feed conversion ratio (g feed/ g gain)						
0–3 weeks	1.63^{ab} ±0.01	1.63^{ab} ±0.02	1.65^{a} ±0.01	1.60^{b} ±0.01	1.64^{ab} ±0.01	*
4–5 weeks	2.02^{b} ±0.05	2.25^{a} ±0.07	2.34^{a} ±0.01	2.20^{ab} ±0.01	2.26^{a} ±0.09	*
0–5 weeks	1.86^{c} ±0.01	1.95^{ab} ±0.02	1.99^{a} ±0.01	1.90^{bc} ±0.01	1.95^{ab} ±0.04	*

*a, b, c Means within the same row with different superscripts are significantly different. Sig. = Significance ** (P≤0.01), * (P≤0.05). NS = Non Significant.*

Impact of *Phytabex plus* supplementation (T2: T5) to corn-soybean meal based diets on protein conversion ratio (PCR) and caloric conversion ratio (CCR) are shown in Table (3). Level of *Phytabex plus* was significantly effective on PCR and CCR during stages of 0-3, 4-5 and 0-5 weeks of age. It is clear that, chicks fed (T1) diets (control group) had better PCR and CCR during all periods, while, chicks fed (T3) diets had worst PCR and CCR values during all periods and theses differences were significant. These findings are in contrast with those obtained by Zhou *et al*. (2009), who concluded that enzyme preparation containing a mixture of xylanase, protease and amylase enzymes resulted in improvements in ME value when added to broiler corn-soybean diets in starter, grower and finisher phases. Several studies had demonstrated some beneficial effect on ME and non-starch polysaccharides digestibility of soybean meal diets, depending on enzyme preparation used (Meng *et al*., 2005; Awad *et al*., 2013).

Table (3): Effect of different dietary treatments on protein conversion ratio and caloric conversion ratio.

Item	Dietary Treatments					
	1	2	3	4	5	Sig.
PCR: Protein conversion ratio (g protein/ g gain)						
0–3 weeks	0.37^{ab}±0.01	0.37^{ab}±0.01	0. 38^{a}±0.01	0.36^{b}±0.01	0.37^{ab}±0.01	*
4–5 weeks	0.43^{b}±0.01	0.47^{a}±0.01	0.49^{a}±0.01	0.46^{ab}±0.01	0.47^{a}±0.02	*
0–5 weeks	0.40^{c}±0.01	0.42^{ab}±0.01	0.43^{a}±0.01	0.41^{bc}±0.01	0.43^{ab}±0.01	**
CCR: Calorie conversion ratio (1000 Kcal/ g gain)						
0–3 weeks	49.09^{ab}±0.19	48.83^{ab}±0.71	49.47^{a}±0.14	47.90^{b}±0.35	49.42^{a}±0.39	*
4–5 weeks	65.24^{b}±0.60	71.62^{a}±2.36	74.59^{a}±0.52	70.00^{ab}±0.60	72.12^{a}±3.06	*
0–5 weeks	57.17^{c}±0.21	60.22^{ab}±0.82	62.03^{a}±0.33	58.95^{bc}±0.47	60.77^{ab}±1.72	*

*a, b, c Means within the same row with different superscripts are significantly different. Sig. = Significance ** (P≤0.01), * (P≤0.05).*

Carcass characteristics

Table (4) shows the effect of *Phytabex plus* supplementation on carcass characteristics for chicks slaughtered at 5 wks of age. Dressing, ready to cook and gizzard percentages were significantly affected.

Table (4): Effect of different dietary treatments on carcass characteristics.

Item	Dietary Treatments					
Carcass Characteristics	1	2	3	4	5	Sig.
Live Body weight (g)	1486.67 ±20.48	1499.33 ±14.44	1438.33 ±37.23	1571.67 ±80.06	1573.33 ±39.40	NS
Carcass weight (g)	1051.33 ±12.97	1038.00 ±5.77	1035.67 ±20.57	1095.67 ±82.19	1126.00 ±32.86	NS
Dressing %	70.72^{abc}±0.62	69.23^{c}±0.56	72.01^{a}±0.89	69.65^{bc}±0.41	71.53^{ab}±0.57	*
Abdominal Fat %	0.88 ±0.26	1.14 ±0.17	1.40 ±0.38	1.13 ±0.25	1.44 ±0.05	NS
Liver %	2.14±0.11	2.33±0.13	2.49±0.07	2.29±0.17	2.02±0.21	NS
Gizzard %	1.74^{a}±0.13	1.31^{b}±0.10	1.27^{b}±0.07	1.49^{ab}±0.07	1.44^{ab}±0.07	*
Heart %	0.43±0.04	0.44±0.03	0.49±0.01	0.47±0.05	0.52±0.07	NS
Giblets %*	4.32±0.21	4.09±0.11	4.25±0.01	4.25±0.15	3.99±0.25	NS
Ready to Cook % #	75.04^{ab} ±0.63	73.33^{b} ±0.67	76.26^{a} ±0.88	73.91^{b} ±0.42	75.52^{ab} ±0.76	*
Lymphoid Organs %						
Spleen %	0.12±0.01	0.10±0.02	0.09±0.02	0.10±0.02	0.11±0.02	NS
Thymus %	0.23±0.04	0.27±0.02	0.15±0.05	0.12±0.05	0.20±0.07	NS
Bursa %	0.13±0.05	0.07±0.01	0.12±0.03	0.07±0.01	0.11±0.03	NS

*a, b Means within the same row with different superscripts are significantly different. Sig. = Significance ** (P≤0.01), * (P≤0.05). NS = Non Significant.*
** Giblets = Liver + Gizzard + Heart, # Ready to Cook = (Carcass weight + Giblets weight)*

The corresponding values of dressing percentages ranged between 69.23% (T2) and 72.01% (T3), while ready to cook percentages ranged between 73.32% (T2) and 76.26% (T3), while gizzard percentages ranged between 1.27% (T3) and 1.74% (T1). Conversely, no significant effects were observed for relative weights of other internal organs (liver, heart, spleen, thymus and bursa) in response to dietary treatments. That means no adverse effects noticed on birds fed different levels of enzyme. Although abdominal fat parameter had no significant differences among all treatment groups, different levels of *Phytabex plus* (T2: T5) had higher values compared to control group (1.14, 1.40, 1.13, 1.44 and 0.88) respectively. These results were similar to those of Jamroz *et al*. (1996) and Wang *et al*. (2005) who observed that exogenous dietary enzyme supplementation significantly increased meat yield of broiler. In contrary, Saleh *et al*. (2005) and Zakaria *et al*. (2010) reported that dressing percent, heart, gizzard and abdominal fat were not significantly affected due to dietary enzyme supplementation.

Blood parameters

Table (5) shows the effect of *Phytabex plus* supplementation in broiler diets on some metabolic functions. The data revealed that chicks fed (T2: T5) diets recorded higher values of total protein (TP) and globulin (G) and lower albumin/ globulin (A/G) ratio, and these values were significantly different. Change in plasma TP and G as affected by dietary treatments might be due to role of enzymes in improving digestibility of protein, fiber and organic matter (Table, 5). These effects were significant on albumin level which was decreased with (T2) group in comparison to control (T1). However, it is known that plasma albumin is a very strong predictor of bird's health. On the other hand, plasma globulin is an indicator of immune response and source of gamma globulins (antibodies). Plasma globulin was significantly increased by adding *Phytabex plus* to chick's diets. Although there are significant differences among treatments in A/G ratio values, and groups (T2: T5) recorded better ratios compared to control (T1) and that means that dietary treatments have improved immunity of chicks. Shehab *et al*.

Table (5): Effect of different dietary treatments on some blood plasma parameters, 35 days.

Item	Dietary Treatments					
	1	2	3	4	5	Sig
Total Protein (g/ dl)	5.84^{b} ±0.33	6.14^{ab} ±0.64	6.70^{ab} ±0.13	7.51^{a} ±0.76	6.84^{ab} ±0.21	*
Albumin (g/ dl)	4.30^{a} ±0.15	3.66^{b} ±0.06	4.20^{a} ±0.06	4.22^{a} ±0.14	4.33^{a} ±0.12	**
Globulin (g/ dl)	1.54^{b} ±0.18	2.47^{ab} ±0.58	2.50^{ab} ±0.07	3.29^{a} ±0.62	2.50^{ab} ±0.08	*
A/ G ratio #	2.85^{a} ±0.24	1.66^{b} ±0.39	1.68^{b} ±0.02	1.36^{b} ±0.22	1.73^{b} ±0.01	**
Cholesterol (mg/ dl)	196.50 ±8.94	201.00 ±37.52	197.50 ±22.23	212.00 ±21.93	188.50 ±1.44	NS
AST (RFU/ dl)	31.15^{b} ±0.25	24.23^{b} ±4.05	32.17^{b} ±0.47	57.71^{a} ±7.60	31.55^{b} ±9.93	*
ALT (RFU/ dl)	46.02 ±0.72	42.84 ±9.33	52.50 ±3.42	38.11 ±5.36	53.38 ±3.59	NS

*a, b, c Means within the same row with different superscripts are significantly different. Sig. = Significance ** (P≤0.01), * (P≤0.05). NS = Non Significant.*
 # A/ G ratio (Albumin/ Globulin ratio)

(2012) reported that blood serum total protein and liver enzymes (AST) of quails were not significantly affected by feeding dietary Kemzyme. Liver function of broiler chicks as determined by AST and ALT activities was not affected significantly by adding *Phytabex plus* , except for (T4) with AST. Both AST and ALT showed changes and opposite trends with (T4) diet, where AST significantly increased (31.15 vs. 57.71 RFU/ dl) and ALT insignificantly decreased (46.02 vs. 38.11 RFU/ dl) than those fed control (T1) diet. These results are in agreement with those of Abd El-Fattah *et al*. (2003) and Ibrahim and Saleh (2005). It is well known that values of both AST and ALT are used to detect liver and heart functions (Smith *et al*. 1998). While, their increase than normal values in blood indicates an impairment in these vital organs. Thus, it can be concluded that using *Phytabex plus* except for (T4) had no adverse effects on liver functions as confirmed by insignificant alterations in AST and ALT values. Regarding lipid metabolites, results indicated that chicks fed (T2: T5) diets showed insignificant differences in cholesterol concentrations compared with those fed control (T1) diet. Plasma cholesterol ranged between 188.5 and 212.0 mg/ dl. Chicks fed (T4) diets gave higher cholesterol figure while, chicks fed (T5) diet recorded lower figure with insignificant differences. These results are disagreement with findings of Elmenawey *et al*. (2010) who found that Kemzyme did not significantly affect plasma AST concentration. These results agreed with those revealed by Sturkie (2000) who reported that the concentration of Avian plasma lipids are influenced by the physical and nutritional status of birds and plasma cholesterol levels of birds are strongly affected by heredity, nutrition, age, sex and environmental conditions. The obtained results are in disagreement with those reported by several investigators (El-Faham and Ibrahim, 2004; Abou El-Wafa *et al*., 2002; Salem *et al*., 2008) which concluded that significant increase in plasma total cholesterol was observed when enzyme preparations were added to corn-soybean broilers diets.

Economic efficiency

Data of economic efficiency carried out during the experimental period are listed in Table (6). Economic efficiency was decreased by 12, 26, 10 and 17% for broiler chicks fed (T2, T3, T4 and T5 respectively) diets as compared to those fed control (T1) diet. This result might be due to increased feed intake, feed cost and decreased net return. Chicks fed control (T1) diet had the best economic efficiency and relative economic efficiency values being 29.54 and 100% respectively. Whereas, chicks fed (T3) diet had lower values, being 21.81 and 74%, respectively. Khattak *et al*. (2006) reported that, responses to enzymes might be affected by many factors including type and amount cereals in the diet, spectrum and concentration of enzymes used, type and age of animal and type of gut microflora present with physiology of the bird or other possible reasons. The obtained results are in disagreement with those reported by Elnagar (2012) who concluded that enzymes supplementation to broiler diets gave better relative economic efficiency without adverse effects on productive performance or carcass traits of broiler until 6 weeks of age.

Table (6): Effect of different dietary treatments on economic traits.

Economic Traits	Dietary Treatments				
	1	2	3	4	5
Average feed intake (Kg)	2.63±0.02	2.89±0.03	2.66±0.04	2.67±0.05	2.75±0.02
Live body weight (Kg)	1.46±0.01	1.52±0.04	1.38±0.01	1.45±0.03	1.45±0.04
Feed cost (LE)	9.66±0.09	10.72±0.12	9.81±0.15	9.86±0.20	10.14±0.10
Total cost (LE) #	14.66±0.09	15.72±0.21	14.81±0.15	14.86±0.20	15.14±0.10
Total return (LE)*	19.72±0.10	20.56±0.17	18.64±0.16	19.55±0.48	19.57±0.66
Net return (LE)	5.06±0.56	4.85±0.03	3.82±0.01	4.68±0.27	4.43±0.55
Economic efficiency	34.48±0.13	30.85±0.64	25.80±0.19	31.47±1.43	29.21±3.47
Relative economic efficiency	100.00 ±0.00	89.48 ±1.88	74.82 ±0.56	91.24 ±4.15	84.72 ±10.07
Performance index [1]	78.52±0.09	77.95±0.19	69.31±0.12	76.18±2.23	74.35±4.33
Production efficiency factor [2]	179.42 ±25.68	163.44 ±26.11	191.42 ±3.37	168.10 ±25.84	199.23 ±19.73

 # Total Cost = (Feed Cost + price of one-day live chicks + incidental costs);
** According to local price of Kg LBW which was 13.50 L.E.; 1: North (1981); 2: Emmert (2000)*

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تأثير إضافة المستحضرات الإنزيمية على الأداء الإنتاجى لبدارى التسمين المغذاة على عليقة (ذرة – كسب فول صويا)

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أجريت دراسة للتعرف على تأثير إضافة المستحضر الإنزيمى (*Phytabex plus*) إلى عليقة قاعدية (ذرة - كسب فول الصويا) على الأداء الإنتاجى وصفات الذبيحة وبعض صفات الدم لبدارى التسمين. استخدم فى التجربة 150 كتكوت غير مجنس عمر يوم حتى 5 أسابيع من سلالة Avian. قسمت الكتاكيت عشوائياً إلى 5 معاملات تجريبية حيث [العليقة القاعدية أضيف إليها 0، 100، 150، 200 و 200 جم/ طن *Phytabex plus* خلال فترة البادئ (صفر - 3 أسبوع) و 0، 100، 150، 200 و 100 جم / طن *Phytabex plus* خلال فترة النامى (4 - 5 أسبوع)].

كل معاملة غذائية احتوت على 3 مكررات (10 كتكوت بكل مكرر). أوضحت النتائج أن الكتاكيت المغذاة على عليقة قاعدية مضاف إليها 100 جم /طن *Phytabex plus* سجلت أعلى وزن حى عند عمر 5 أسابيع وذلك بزيادة قدرها 4,11 (T1) و 9,39 (T3)، 4,98 (T4) و4,83% (T5) بالمقارنة بالمعاملات المختلفة. معامل التحويل الغذائى سجل 1,86، 1,95، 1,99، 1,90 و 1,95 للطيور المغذاة على علائق بها مستويات مختلفة من *Phytabex plus* (T1: T5) على الترتيب. سجلت الطيور المغذاة على 150 جم/ طن *Phytabex plus* (T3) أعلى قيم معنوية لنسبة الذبيحة والأجزاء الكلية المأكولة. إضافة المستحضر الإنزيمى إلى علائق بدارى التسمين أثر بشكل معنوى على بروتين وجلوبيولين بلازما الدم بينما لم يؤثر على الكوليسترول و ALT. إضافة المستحضر الإنزيمى إلى علائق بدرى التسمين خفض بصورة واضحة العائد الاقتصادى بالمقارنة بمعاملة الكنترول. أنخفضت قيم المقاييس الإقتصادية خلال فترة الدراسة للطيور المغذاة أى من العلائق التجريبية بالمقارنة بمثيلاتها المغذاة عليقة كونترول.

يتضح من هذه الدراسة أن إضافة المستحضر الإنزيمى *Phytabex plus* بمعدل 100 جم/ طن أدى إلى تحسن وزن الجسم وبمعدل 150 جم/ طن أدى إلى تحسن % للذبيحة و% للأجزاء المأكولة ولم يؤثر سلبيا على الكبد بل أدى إلى تحسن بعض قياسا الدم، بينما لم يكن لإضافة المستحضر الإنزيمى أى عائد اقتصادى.