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INFLUENCE OF STRAIN AND DIETARY LEVEL OF ENZYME-COCKTAIL ON PRODUCTIVE PERFORMANCE, BLOOD PARAMETERS AND LYMPHOID ORGANS OF BROILER

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ABSTRACT

The present experiment was designed to study effects of broiler strain and dietary level of enzyme cocktail (PhytaBex® Plus), on productive performance, some blood plasma parameters and lymphoid organs. A total of 270 one-day old broiler chicks (135 *Avian* chicks and 135 *Cobb* chicks) were distributed over six experimental groups according to a (2 x 3) factorial design. There were three different experimental diets presented to chicks within each strain as; T1: fed basal diet (BD); T2: BD + PhytaBex® Plus (100 g/ ton) and T3: fed BD + PhytaBex® Plus (200 g/ ton). Live body weight (LBW) and daily weight gain (DWG) during starter phase showed that chicks of *Cobb* strain recorded significantly higher LBW and DWG compared to chicks of *Avian* strain, whereas, birds fed T2 or T3 diets had heavier LBW and recorded higher DWG compared to those fed T1 diet. Strain, enzyme level and their interactions, had no significant effects on final LBW or DWG during grower phase. Values of daily feed intake (DFI) during starter phase showed that chicks of *Cobb* strain recorded significantly higher DFI compared to chicks of *Avian* strain, while, birds fed T2 or T3 diets consumed more feed than those fed T1 diet. Additionally, DFI during grower phase presented no significant differences between strains, whereas enzyme level had significantly decreased DFI of birds fed T1 diet compared to birds fed T2 or T3 diets. Values of feed conversion ratio (FCR) during starter or grower periods, indicated no significant differences between strains, enzyme levels or their interactions. Enzyme level had no significant effect on all of blood plasma parameters, except for plasma cholesterol, while strain had a significant effect on most of blood plasma parameters except for plasma albumin and cholesterol. Relative weights of lymphoid organs were not significantly affected by strain, dietary enzyme level or their interactions.

Finally, it could be suggested that addition of enzyme cocktail PhytaBex® Plus in diets of *Cobb* or *Avian* broiler strains, had some favorable effects on productive performance, with no harmful effects on bird's immunity or blood plasma traits.

Keywords: strain, enzyme-cocktail, broilers performance, blood plasma, lymphoid organs.

INTRODUCTION

The addition of exogenous enzymes to broiler diets has been recently renowned because of both economic and ecological issues. And, it is intended to encourage superior utilization of feed nutrients, in order to lessen feed needed to produce certain amount of animal protein and fewer nutrients misplaced in bird's excreta (Kalmendal and Tauson, 2012). Commercial enzyme additives would be sorted into single enzymes, mix of mono module enzymes and fermentation products from natural microorganism strains expressing a variety of enzyme activities (Freitas *et al.*, 2011). Exogenous enzymes have been used widely to enhance nutritive value of wheat and rye-based diets because of high insoluble non-starch polysaccharides found in these feedstuffs which induce high digesta viscosity (Mathlouthi *et al.*, 2002; Lázaro *et al.*, 2003). Additionally, it was reported that enzyme cocktail feed additives improve bird's productivity (Saleh *et al.*, 2005) and digestibility of corn-soybean meal based diets, which in turn, induces less viscosity of ingested feed for broilers (Zanella *et al.*, 1999; Gracia *et al.*, 2003; Olukosi *et al.*, 2007; Cowieson and Ravindran, 2008). The effectiveness of commercial enzyme preparations has been well stated, but, unfortunately there is little information about their mode of action (Bedford, 2002). Numerous reports pointed out that dietary enzymes improve nutrients' digestibility in broilers (Gracia *et al.*, 2003; Cowieson and Ravindran, 2008; Kalmendal and Tauson, 2012). In addition, Gao *et al.* (2007) suggested that dietary enzymes speed up development of immune organs. These authors assumed that progress of nutrient digestibility might be revealed in developing immunity and adapted profile of blood metabolites particularly, if these enzymes are originated from anaerobic bacterium (Safaa *et al.*, 2010).

In regard to broiler productive performance, Kocher *et al.* (2003) reported that using an enzyme cocktail in corn-soybean meal-based diets resulted in improved performance. Also, Cowieson *et al.* (2006) indicated that exogenous enzymes can be used successfully in a low nutrient density diet formulated to maintain performance of birds. In addition, Cowieson and Ravindran (2008) stated that supplementing corn-soybean meal-based diets with an enzyme product, improved body weight gain and feed efficiency compared to un-supplemented diets, with no effect on feed intake. Mode of action of enzymes in corn-based diets has been linked to improved starch digestibility associated with amplification of endogenous alpha-amylase or improved digestion of resistant starches, better access to cell contents by means of reduction of cell wall integrity, alteration of the intestinal microbial community, improved protein solubility and digestibility. In addition, Kalmendal and Tauson (2012) observed that using a blend of enzymes improved feed conversion ratio, compared to control diet with no effect on body weight and feed intake. Moreover, Gracia *et al.* (2003) confirmed that amylase was a critical enzyme to improve nutritional value of corn-based broiler diets, improving body weight gain and feed conversion ratio compared to un-supplemented diet. In the same way, Remus *et al.* (2005) presented effects of enzymes mixture on ileal digestibility of amino acids for broiler and found a 2% better digestibility. However, these effects were dependent on amino acid. Similarly, dietary enzyme supplementation was employed to increase availability of starch, protein and other nutrients that are entrapped by cell wall structures or viscous polymers that are resistant to digestion by host enzymes (Frigard *et al.,* 1994).

Studies of Safaa, (2013) indicated that broiler diets supplemented with exogenous enzymes increased protein and globulin levels in blood plasma, which might supported by enhancement of immune organs. Similarly, Gao *et al.*(2007) suggested that enzyme supplementation, to wheat-based diets enhanced the humoral immune response. In regard to plasma lipid components, enzyme addition to broiler diets reduced cholesterol level in plasma (Safaa , 2013), suggesting that enzyme supplementation might play a role in lipid metabolism. However, Onilude and Oso (1999) reported that supplementation of enzyme mixture to broiler fiber-containing diets reduced blood lipid metabolites including plasma cholesterol level. Also, Cowieson *et al.* (2013) reported that phytase addition to broiler diets reduced cholesterol level in blood plasma of chickens fed positive control diet but, increased cholesterol level in blood plasma of chickens fed negative control diet. In contrast, Sarica *et al.* (2005) reported that enzyme supplementation in broiler diets based on wheat-corn-soybean meal did not affect cholesterol content in plasma. Frigard *et al.* (1994) noted a higher serum cholesterol level in broilers fed rye-corn-soybean meal based diet supplemented with commercial enzyme than those of birds fed un-supplemented diet, which was attributed to elimination of dietary fiber effect on reducing serum cholesterol by enzyme supplementation. Gao *et al.* (2007) observed that enzyme supplementation to wheat-based diets had significantly increased relative weight of spleen which was attributed to better feed digestion, enhanced absorption of nutrients and regulated metabolic hormones in response to addition of enzyme, which in turn, would present a positive effect on humoral immune response based on plasma globulin level.

PhytaBex® Plus is one of many available enzyme-cocktail feed additives which contains enzymes of: xylanase, cellulase, β-glucanase, β-mannanase, phytase, acid protease and α-amylase. PhytaBex® Plus is accepted to be used in poultry diets, but little information is available regarding relationship between PhytaBex® Plus as a feed additive and broiler chicken strain. The objective of the present study was to investigate effects of strain (*Avian* or *Cobb*) and dietary level of enzymes on productive performance, blood constituents and lymphoid organs of broilers.

MATERIALS AND METHODS

Experimental Diets and Birds

Two hundred seventy, day old broiler chicks were used in the present experiment, 135 chicks of *Avian* strain and 135 chicks of *Cobb* strain, and distributed over six experimental groups. There were three experimental diets presented to chicks within each strain as; T1: fed basal diet (BD), T2: BD + PhytaBex® Plus (100 g/ ton) and T3: fed BD + PhytaBex® Plus (200 g/ ton). Six experimental groups in 3 replicate each, having 15 chicks per replicate. Birds were distributed in a (2 x 3) factorial design. They were reared under the same environmental, managerial and hygienic conditions from one-day old till 5 weeks of age. Feed ingredients and chemical composition of experimental diets is summarized in Table (1). Composition of enzyme cocktail PhytaBex® Plus used for dietary treatments is reviewed in Table (2). The feed and water were provided continuously for birds *ad libitum*. Basal diets were formulated to provide nutrient requirements according to NRC (1994). Experimental design is summarized in Table (3) where prices of diets are also presented.

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

Ingredients	Basal Diets	
	Starter (0-21 Days)	Grower (22-35 Days)
Corn (grains)	55.00	58.00
Soybean meal (44%)	33.00	28.00
Poultry by-product meal (58%)	6.60	6.60
Soybean oil	2.00	4.00
Di-calcium phosphate	1.50	1.50
Calcium carbonate	1.00	1.00
Premix	0.30	0.30
NaCl (Salt)	0.20	0.20
Methionine HA	0.20	0.20
L-Lysine HCl	0.20	0.20
Total	100	100
Chemical composition		
Crude protein %	23.16	21.21
ME Kcal/ Kg diet	2966	3149
Calcium %	1.01	1.00
Available phosphorus %	0.50	0.50
Lysine %	1.43	1.31
Methionine & cystein %	0.92	0.87
Price/ Ton (L.E.)	4017	3998

Each 3 Kg of the 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; 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.

Table (2): Composition of each 1 Kg of enzyme-cocktail PhytaBex® Plus.

Items (Enzymes)	Weight (g)	Units
Xylanase	100	10,000,000 IU
Cellulase	100	500,000 IU
β-Glucanase	50	500,000 IU
β-Mannanase	40	800,000 IU
Phytase	220	5,500,000 FTU
Acid Protease	60	2,000,000 IU
α-Amylase	60	100,000 IU
All the above components were mixed with food-grade corn starch up to 1 Kg		

g: gram, IU: international units and FTU: Phytase units

Growth performance

Chicks were individually weighed weekly till the age of 5 weeks and their live body weight (LBW) were recorded to the nearest gram. The average daily weight gain (DWG) (g/ bird/ day) was calculated by subtracting the average of initial body weight of the birds in a certain stage from the final one in the same stage. Care was taken to collect the residual feed from feed troughs and then weighed. Daily feed intake (DFI) (g/ bird/ day) was calculated by subtracting residual feed from offered feed. Feed conversion ratio (FCR) (g feed/ g gain) was also recorded weekly. All parameters of productive performance were calculated during both starter (0-3 weeks) and grower (4-5) phases.

Table (3): Experimental design and diets.

Strain	**Avian**			**Cobb**		
Dietary Treatment	**1**	**2**	**3**	**1**	**2**	**3**
Starter (0-21 days)						
Additives P-B Plus: PhytaBex® Plus	-	P-B Plus 100 g/Ton	P-B Plus 200 g/Ton	-	P-B Plus 100 g/Ton	P-B Plus 200 g/Ton
Price/ Ton (L.E.)	4017	4037	4057	4017	4037	4057
Grower (22-35 days)						
Additives P-B Plus: PhytaBex® Plus	-	P-B Plus 100 g/Ton	P-B Plus 200 g/Ton	-	P-B Plus 100 g/Ton	P-B Plus 200 g/Ton
Price/ Ton (L.E.)	3998	4018	4038	3998	4018	4038

Blood plasma

Blood samples were collected at 35 day of age from the slaughtered chicks into heparinized Wassermann plastic tubes. Plasma samples were obtained after centrifuging of blood samples at 4000 r.p.m for 10 min. The plasma samples were stored in a deep freezer at -20º C until blood biochemistry analyses were done. Quantitative determination of blood plasma included the following: Total protein according to (Gornall *et al.*, 1949), albumin (Doumas *et al.*, 1971), globulin (determined by subtraction particular value of albumin from corresponding value of total protein), total cholesterol with 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 blood plasma parameters were determined using commercial diagnosing kits.

Lymphoid organs

At 5 weeks of age, 18 birds (3 birds from each group) were randomly taken and slaughtered for autopsy. Spleen, bursa of Fabricius and all thymic lobes were removed from the autopsied birds. Each organ was cleaned from adhering tissues and weighed using digital electronic balance. The weight of each organ was recorded to the nearest two decimal points. Relative organ weights were calculated as percentages of the corresponding live body weights.

Mortality number

Accumulative mortality number (Table, 8) was calculated by subtracting number of live birds at the end of the experimental period from number of live birds at the beginning for each treatment.

Ambient temperature and relative humidity

Values of ambient temperature (Figure, 1) and relative humidity (Figure, 2) of the poultry house were recorded throughout the trial period on a daily basis using high and low ended thermo hygrometer.

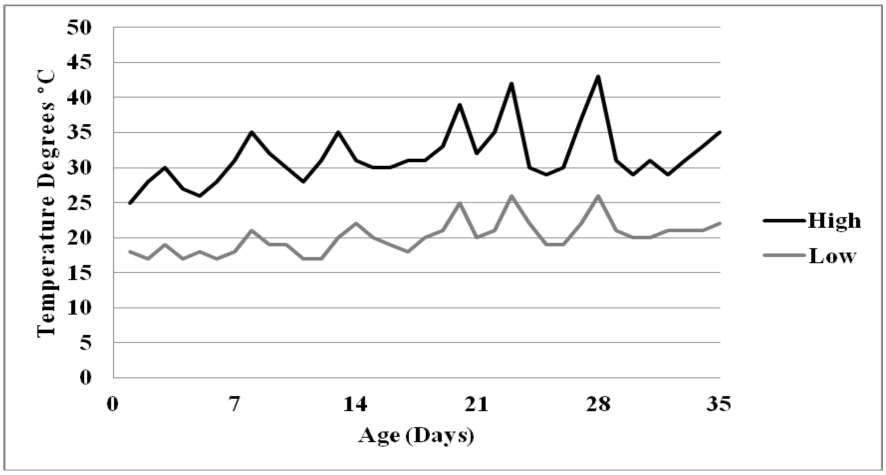

Figure (1): Ambient temperature throughout experimental period.

Statistical analysis

Data obtained were subjected to statistical analysis using the procedure of two-way analysis of variance with strain and enzyme and their interaction using the general linear model (GLM) procedure of SAS (2004) according to the following model;

$$Y_{ijk} = \mu + S_i + T_j + (S*T)_{ij} + e_{ijk}$$

Where:

Y_{ijk}= Trait measured	T_j = Enzymes effect (level of PhytaBex®)
μ = Overall mean	$(S*T)_{ij}$= Interaction between strain & enzyme
S_i = Strain effect (i= 1, 2)	e_{ijk} = Experimental error

When significant differences among means were found, means were separated using Duncan's multiple range tests (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance

Table (4) and Table (5) present effect of strain, dietary enzyme level and their interactions on productive performance of broilers at starter and grower phases, respectively. Results of Table (4) indicate that LBW at 3 weeks of age was significantly affected by strain, enzyme level and their interactions. Chicks of *Cobb* strain were significantly heavier than chicks of *Avian* strain, while, birds fed T2 or T3 diets had heavier LBW compared to those fed T1 diet. LBW values of birds at 5 weeks of age (Table, 5) had no significant differences between strains, enzyme levels and their interactions. These results agree with those of Deif (2008) who reported that, there were no significant differences between LBW values of broilers of *Hubbard* and *Cobb* strains at marketing age. In addition, Marcato *et al.* (2009) found parallel growth rates for broilers of *Cobb* and *Ross* strains at 35 days old.

DWG during starter phase (Table, 4) was significantly affected by strain, enzyme level and their interactions. Chicks of *Cobb* strain recorded significantly higher DWG compared to chicks of *Avian* strain, while, birds fed T2 or T3 diets gained more body weight than those fed T1 diet. DWG values of birds during grower phase (Table, 5) had no significant differences between strains, enzyme levels or their interactions. Data presented in Table (4) show that strain, enzyme level and their interactions had significantly affected DFI during starter phase. Chicks of *Cobb* strain recorded significantly higher DFI compared to chicks of *Avian* strain, while, birds fed T2 or T3 diets consumed more feed than those fed T1 diet. DFI values of birds during grower phase (Table, 5) had no significant differences between strains, whereas enzyme levels had significantly affected DFI of birds fed T1 diet to be lower than that of birds fed T2 or T3 diets. These results were in disagreement with Al-Rishan (2006) who stated that feed consumption was not significantly affected by studied strains *(Hubbard*, *Ross* or *Arbor Acres)*. Values of FCR during starter (Table, 4), or grower (Table, 5) indicated no significant differences between strains, enzyme levels and their interactions. Results of productive performance are in conformity with several studies that reported no improvement in FCR when broiler diets were supplemented with enzyme cocktail (Kocher *et al.*, 2002; Meng *et al.*, 2006; Walk *et al.*, 2011; Barekatain *et al.*, 2013). On the other hand, some reports indicated that dietary enzyme cocktail have beneficial effects on broiler productivity (Kocher *et al.*, 2003; Cowieson *et al.*, 2006; Safaa, 2013).

Table (4): Effect of starter dietary treatments on productive performance.

Items	Strain (S)	Dietary Treatment (T) 1	2	3	Overall
Live body weight (LBW) (at 3 weeks)	Avian	663.00±1.35	663.33±0.96	652.00±0.58	659.44[b]
	Cobb	676.67±0.19	702.93±9.08	714.07±0.96	697.89[a]
	Overall	669.83[b]	683.13[a]	683.03[a]	
Daily weight gain (DWG) (0–3 weeks)	Avian	29.49±0.06	29.50±0.05	28.96±0.03	29.32[b]
	Cobb	30.16±0.01	31.41±0.43	31.94±0.05	31.17[a]
	Overall	29.83[b]	30.46[a]	30.45[a]	
Daily feed intake (DFI) (0–3 weeks)	Avian	46.47±1.11	47.94±0.01	49.46±0.59	47.96[a]
	Cobb	51.07±0.02	53.39±0.75	52.93±0.08	52.47[a]
	Overall	48.77[b]	50.67[a]	51.20[a]	
Feed conversion ratio (FCR) (0–3 weeks)	Avian	1.58±0.04	1.63±0.01	1.71±0.02	1.64
	Cobb	1.69±0.01	1.70±0.05	1.66±0.01	1.68
	Overall	1.64	1.66	1.68	

Probability			
Trait	S	T	S*T
LBW	0.0001	0.01	0.0001
DWG	0.0001	0.01	0.0001
DFI	0.0001	0.004	NS
FCR	NS	NS	0.03

Means within the same row or column with different superscripts are significantly different. NS = Non Significant.

Table (5): Effect of grower dietary treatments on productive performance.

Items	Strain (S)	Dietary Treatment (T) 1	2	3	Overall
Live body weight (LBW) (at 5 weeks)	Avian	1385.1±4.1	1317.0±102.1	1374.7±42.3	1358.9
	Cobb	1337.5±10.1	1380.5±3.7	1453.1±1.8	1390.3
	Overall	1361.3	1348.7	1413.9	
Daily weight gain (DWG) (3–5 weeks)	Avian	51.58±0.20	46.69±7.23	51.62±3.06	49.96
	Cobb	47.20±0.71	48.40±0.38	52.79±0.20	49.46
	Overall	49.39	47.55	52.21	
Daily feed intake (DFI) (3–5 weeks)	Avian	114.94± 0.01	116.67±5.90	111.46±0.34	114.36
	Cobb	102.21±0.72	111.59±1.45	119.74±0.11	111.18
	Overall	108.58[b]	114.13[a]	115.60[a]	
Feed conversion ratio (FCR) (3–5 weeks)	Avian	2.23±0.05	2.67±0.56	2.18±0.14	2.36
	Cobb	2.17±0.02	2.31±0.05	2.27±0.01	2.25
	Overall	2.20	2.49	2.22	

Probability			
Trait	S	T	S*T
LBW	NS	NS	NS
DWG	NS	NS	NS
DFI	NS	0.05	0.01
FCR	NS	NS	NS

Means within the same row or column with different superscripts are significantly different. NS = Non Significant.

Blood plasma parameters

Data presented in Table (6) show blood plasma parameters at 5 wks of age of broilers as affected by strain, dietary enzyme level and their interactions which ranged within normal ranges for broilers (Del Bianchi *et al.*, 2005; Meluzzi *et al.*, 1992). Plasma total protein and globulin were increased in chicks of *Cobb* strain compared to those of *Avian* strain. While effect of enzyme level on plasma total protein or globulin remained insignificant. On the other hand, values of plasma albumin showed no significant differences between strains, enzyme levels and their interactions. These results are in disagreement with Safaa (2013) who reported that enzyme supplementation had significantly increased plasma total protein and globulin. Values of albumin/globulin (A/G) ratio showed that chicks of *Avian* strain recorded significantly higher values of A/G ratio compared to chicks of *Cobb* strain. While effect of enzyme level on plasma A/G ratio remained insignificant. Conversely, plasma cholesterol level significantly increased with birds fed T3 diet compared to those fed T1 or T2 diets, while, strain had no significant effect on plasma cholesterol. These results are in disagreement with Onilude and Oso (1999) who reported that dietary enzyme supplement had significantly decreased plasma cholesterol of broilers. In contrast, Sarica *et al.* (2005) reported that dietary enzyme supplementation did not affect plasma cholesterol. Values of AST and ALT indicated that strain had only affected plasma level of AST while, level of enzyme had no significant effect on AST and ALT. These results agree with those of Safaa (2013) who reported that enzyme supplementation had no significant effect on both plasma AST and plasma ALT.

Table (6): Effect of dietary treatments on blood parameters at 5 weeks.

Items	Strain (S)	Dietary Treatment (T) 1	2	3	Overall
Total Protein (g/ dl)	Avian	6.59±0.29	7.35±0.46	6.61±0.19	6.85[b]
	Cobb	7.83±0.27	7.21±0.12	7.87±0.34	7.64[a]
	Overall	7.21	7.28	7.24	
Albumen (g/ dl)	Avian	4.20±0.33	4.40±0.30	4.11±0.03	4.23
	Cobb	4.03±0.10	3.87±0.02	3.70±0.30	3.87
	Overall	4.11	4.14	3.91	
Globulin (g/ dl)	Avian	2.39±0.04	2.95±0.16	2.50±0.20	2.61[b]
	Cobb	3.80±0.17	3.34±0.02	4.16±0.10	3.77[a]
	Overall	3.10	3.14	3.33	
A/G Ratio	Avian	1.76±0.17	1.49±0.02	1.66±0.13	1.64[a]
	Cobb	1.06±0.02	1.16±0.06	0.89±0.07	1.04[b]
	Overall	1.41	1.33	1.28	
Cholesterol (mg/ dl)	Avian	185.67±6.64	145.00±12.12	198.00±2.89	176.22
	Cobb	158.00±12.70	184.00±5.77	211.33±21.95	184.44
	Overall	171.83[b]	164.50[b]	204.67[a]	
AST (IU/L)	Avian	49.83±9.66	58.66±6.41	39.32±3.62	49.27[a]
	Cobb	43.53±0.09	33.85±0.06	33.88±0.01	37.08[b]
	Overall	46.68	46.25	36.60	
ALT (IU/L)	Avian	46.68±0.42	42.37±9.69	47.16±0.21	45.40
	Cobb	43.49±8.80	58.44±0.12	47.41±11.17	49.78
	Overall	45.09	50.41	47.29	

Probability			
Trait	S	T	S*T
Total Protein	0.01	NS	NS
Albumen	NS	NS	NS
Globulin	0.0001	NS	0.001
A/G Ratio	0.0001	NS	NS
Cholesterol	NS	0.01	0.05
AST	0.01	NS	NS
ALT	NS	NS	NS

Means within the same row or column with different superscripts are significantly different. NS = Non Significant.

Lymphoid organs

Data concerning effect of strain, dietary enzyme level and their interactions on relative weight of lymphoid organs, are presented in Table (7). Results show that, relative weights of lymphoid organs (spleen, thymus and bursa) were not significantly affected by strain, dietary enzyme level or their interactions. Conversely, Safaa (2013) reported that relative weights of spleen and bursa at 42 days of age, were significantly increased by enzyme supplementation suggesting that dietary treatments accelerated development of immune organs.

Ambient temperature and relative humidity

Values of mortality number within different groups of birds during the grower period (21 - 35 days), are presented in Table (8). It is clear from these data that number of mortality for different groups of birds comes about irrespective of experimental treatments. Moreover, all of death cases had occurred without any symptoms of a particular disease, but it seems to be related to a relatively undesirable rearing conditions, only during the grower stage, especially for ambient temperature and relative humidity. Data of relative humidity (Figure, 2) seemed to be homogeneous throughout the experimental period of five weeks. On the other hand, values of ambient temperature during the fourth and fifth weeks (Figure, 1), appeared to have severe waves of a marked rise in temperature (41° C at 28 days of age), that is higher than average that broilers can tolerate, and exceeded bird's ability to deal with heat stress. Consequently, all mortality occurrence took place within the last two weeks of age.

Table (7): Effect of dietary treatments on lymphoid organs weight.

Items	Strain (S)	Dietary Treatment (T)			Overall
		1	2	3	
Spleen %	Avian	0.13±0.02	0.12±0.04	0.19±0.07	0.15
	Cobb	0.11±0.04	0.22±0.05	0.17±0.03	0.17
	Overall	0.12	0.17	0.18	
Thymus %	Avian	0.19±0.07	0.23±0.07	0.30±0.09	0.24
	Cobb	0.19±0.08	0.24±0.04	0.29±0.01	0.24
	Overall	0.19	0.24	0.30	
Bursa %	Avian	0.12±0.03	0.09±0.02	0.10±0.03	0.10
	Cobb	0.10±0.02	0.08±0.02	0.08±0.02	0.09
	Overall	0.11	0.09	0.09	

Probability			
Trait	S	T	S*T
Spleen %	NS	NS	NS
Thymus %	NS	NS	NS
Bursa %	NS	NS	NS

Means within the same row or column with different superscripts are significantly different. NS = Non Significant.

Table (8): Mortality number during grower period (21-35 days).

Items	Strain (S)	Dietary Treatment (T)			Total
		1	2	3	
Mortality number	Avian	16	12	8	36
	Cobb	2	0	9	11
	Total	18	12	17	47

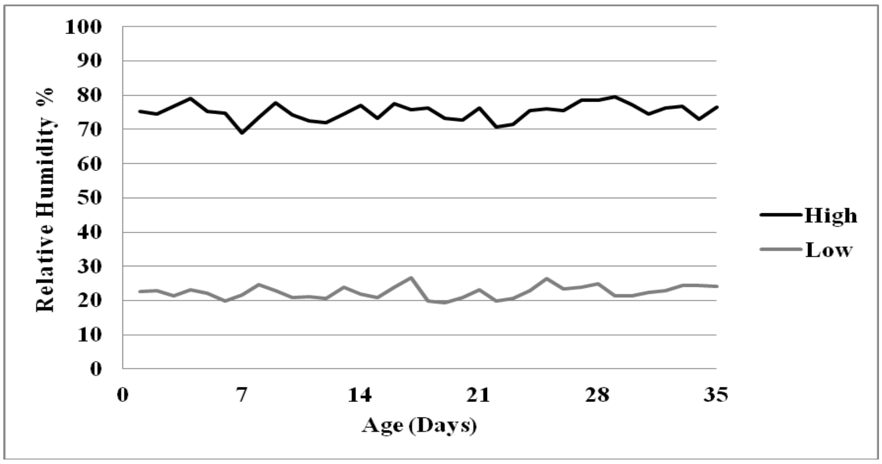

Figure (2): Relative humidity throughout experimental period.

CONCLUSION

In conclusion, it may be suggested that incorporation of enzyme cocktail PhytaBex® Plus in diets of *Cobb* or *Avian* broiler strains, had some beneficial effects on productive performance, with no negative effects on blood plasma parameters. Besides, using that enzyme feed additive had no harmful effect on immunity of birds as revealed by lymphoid organs relative weights.

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تأثير السلالة ومستوى العلف من كوكتيل إنزيمى على الآداء الإنتاجى، صفات الدم و الأعضاء اللمفاوية لدجاج اللحم

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صممت هذه التجربة لدراسة تأثير كل من سلالة دجاج اللحم ومستوى العلف من كوكتيل انزيمى PhytaBex® Plus على الأداء الإنتاجي، وبعض مقاييس بلازما الدم والأعضاء اللمفاوية. تم توزيع عدد 270 كتكوت تسمين عمر يوم واحد (135 كتكوت *Avian* و 135 كتكوت *Cobb*) على ستة مجموعات تجريبية وفقا لتصميم عاملى (3 x 2). إستخدمت ثلاثة علائق تجريبية مختلفة قدمت للدجاج داخل بكل سلالة؛ T1: غذيت عليقة قاعدية (BD)، T2: غذيت BD + PhytaBex® Plus بمعدل 100جم / طن وT3: غذيت غذيتBD + PhytaBex® Plus بمعدل 200جم / طن. مقاييس وزن الجسم والوزن المكتسب اليومى خلال فترة البادىء أوضحت أن كتاكيت سلالة *Cobb* سجلت وزن جسم ووزن مكتسب يومى أعلى معنويا من كتاكيت سلالة *Avian*، فى حين أن الطيور المغذاة عليقة T2 أو T3 سجلت وزن جسم أثقل ووزن مكتسب أعلى بالمقارنة بالطيور المغذاة عليقة T1. لم يظهر تأثير معنوى لكل من السلالة، مستوى الإنزيم أو التداخل بينهما على وزن الجسم النهائى أو وزن الجسم المكتسب خلال فترة النامى. العلف المستهلك اليومى خلال فترة البادىء أوضحت أن كتاكيت سلالة *Cobb* سجلت علف مستهلك يومى أعلى معنويا من كتاكيت سلالة *Avian* فى حين أن الطيور المغذاة عليقة T2 أو T3 سجلت علف مستهلك يومى أعلى بالمقارنة بالطيور المغذاة عليقة T1. العلف المستهلك اليومى خلال فترة لم يظهر فروق معنوية بين السلالات، إتضح تأثير مستوى الإنزيم فى خفض العلف المستهلك اليومى للطيور المغذاة عليقة T1 بالمقارنة بالطيور المغذاة عليقة T2 أو T3. قيم معامل التحويل الغذائى خلال فترة البادىء أو النامى لم تُظهِر فروق معنوية بين السلالات، مستويات الإنزيم أو التداخلات بينهما. لم يظهر تأثير معنوى لمستوى الإنزيم على كل مقاييس بلازما الدم بإستثناء كوليستيرول البلازما، فى حين أن السلالة كان لها تأثير معنوى على معظم مقاييس بلازما الدم بإستثناء ألبيومين وكوليستيرول البلازما. الأوزان النسبية للأعضاء الليمفاوية لم تتأثر معنويا بالسلالة، مستوى الإنزيم أو التداخل بينهما.

أخيرا، يمكن أن يُقتَرح إضافة كوكتيل انزيمى PhytaBex® Plus في علائق سلالات دجاج اللحم *Avian* أو *Cobb*، لما له من بعض التأثيرات الإيجابية على الأداء الإنتاجي، مع عدم وجود تأثير ضار على المناعة أو صفات بلازما الدم لطيور التسمين.