THE RESPONSES OF GROWTH PERFORMANCE, DIGESTIBILITY AND BLOOD BIOCHEMISTRY OF CHICKENS TO THE DOSE AND ADMINISTRATION METHOD OF ENZYMES

A. S. El-Shafey [1]; Asmaa Sh. Elnaggar[1] and M. I. El-Kelawy[2]

[1]Department of Animal and Poultry Production, Faculty of Agriculture, Damanhour University, Egypt.
[2]Department of Poultry Production, Faculty of Agriculture, New Valley University, Egypt.

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SUMMARY

The aim of this study was to investigate the responses of growth performance, digestibility and blood biochemistry to the dose and administration method of enzymes. A total of 150 unsexed 1-d-old Arbor Acres broiler chickens were divided equally among 5 dietary treatments with 6 replicates per treatment and five chickens each. All experimental groups were fed the same basal diet and given 5 multienzyme treatments: The 1st group, the control group, did not receive multienzyme supplementations. The 2nd, 3rd, 4th and 5th groups were given multienzyme in water at 100 and 150% of the recommended dosage in drinking water given either continuously or intermittently methods, respectively. In the continuous method, the multienzyme is added to the water over the day. While, in intermittently method, the multienzyme is added to the water over the day followed by day off during the 1st through the 35th days of age. The addition of multienzyme either at 100 or 150% to water improves the growth performance and nutrient digestibility i.e. dry matter, crude protein and ether extract of broiler chickens compared with the control. However, 100% of multienzyme resulted in the best growth performance than that 150% multienzyme group. Intermittently administration exhibited significantly better growth performance and nutrient digestibility i.e. dry matter and NFE than those given multienzyme with continuously administration way. There were no significant effects of the multienzymes dose and the administration methods on carcass characteristics and blood biochemical constituents except triglycerides and creatinine. In conclusion, broilers received multienzymes at 100% intermittently in water exhibited significantly higher growth rate and significantly the best FCR. Production index was also the best of this group.

***Keywords**: Broilers, multienzyme, administration method and dose of enzyme.*

INTRODUCTION

The use of enzymes in corn soybean diets for broilers is essential as to overcome the anti-nutritional factors even in non-vicious grains and protease inhibitors as will, which might limit nutrient digestibility's in the gut (Slominski, 2011 and Yegani and Korver, 2013). Chicken broilers is still unable to take advantage of 400-450 kcal of energy per kilogram of diet because its non starch polysaccharides (NSP) content which impede digestion of nutrients by broilers due to the shortage or absence of digestive enzymes capable of the hydrolyze of NSP (Cowieson, 2010). The use of NSP enzymes may be desired to hydrolyze of the anti-nutritional of ingredients to attain the best performance and profit from these diets (Slominski, 2011). Enzymes supplementation in broiler diets increasing activities of digestive enzyme (Alagawany *et al*., 2017) and improved the endogenous enzyme production thus improves the absorption of nutrients by the chickens (Angel *et al*., 2011).

The usage of enzymes in the feeding of broilers has enhances feed digestibility, minimizing the anti-nutritional effects and promoting the productivity indexes (Attia *et al*., 2003 and Hooge *et al*., 2010), the digestibility rates (Fafiolu *et al*., 2015 and Zeng *et al*., 2015).And improved growth performance (Attia *et al*., 2014a; Fafiolu *et al*., 2015 and Williams *et al*., 2014and 2018), survival rate (Abdel-Hafeez *et al*., 2016), reduce the pollutant potential of excreta (Costa *et al*., 2008), improved the economic efficiency (Attia *et al*., 2008 and El-Serwy *et al*., 2012) and gut ecology (Cowieson, 2010 and Attia *et al*., 2014b). However, the effect of multienzyme counted on dietary composition and enzyme type (Attia; 2003; Abudabos, 2012 and Attia *et al*., 2014a). This study aimed to investigate the responses of growth performance, digestibility and blood biochemistry of broilers to the dose and administration method of enzymes.

MATERIALS AND METHODS

The study was carried out at the Al-Bostan Experimental Poultry Farm, Department of Animal and Poultry Production, Faculty of Agriculture, Damanhour University, Egypt.

Experimental design and dietary treatments:

One hundred and fifty-one-day-old Arbor Acres broiler chicks were randomly distributed into five treatment groups. Each treatment group consisted of six replicates of 5 unsexed birds each. All experimental groups were fed the same base diet and were given 5 multienzyme treatments: The 1st group, the control group, did not receive multienzyme supplementations. The 2nd, 3rd, 4th and 5th groups were given multienzymes in water at 100 and 150% from recommended dosage in drinking water given either continuous or intermittent methods, respectively. In the continuous method, the multienzyme is added to the water over the day. While in intermittent method, the multienzyme is added to the water over the day followed by day off during the 1st through the 35th days of age. The experimental diets were formulated to meet requirements of broiler chickens according to NRC (1994). The multienzyme (Galzym® produced by Textan company and imported by El Nehesi company, it is a combination of a group of exogenous and fibrolytic enzymes consisted of, cellulase:100000000 unit, xylanase 1500000 unit, lipase 6500 unit, alpha amylase 250000 unit, protease 400000 unit and Pectinase 30000 unit). The recommended dose of enzymes is 1ml/3L water. The composition of the experimental diets is presented in Table (1).

Table (1): Ingredients and chemical composition of the experimental basal diets fed during the experiment stages.

Item	Standard diets	
	Starter (1-21d)	Grower (22-35d)
Ingredients (g/kg)		
Yellow corn	512.3	518.1
Rye	0	50
Soybean meal (44% CP)	328	244
Dicalcium phosphate	18.00	16.00
Limestone	10.00	10.00
NaCl	3.00	4.50
Full fat soybean meal	100	130
Vit+min premix[1]	3.00	3.00
L-Lysine	1.00	1.90
DL-Methionine	2.00	2.50
Vegetable oil	22.70	20.00
Total	1000	1000
Calculated or determined composition (g/kg):		
Dry matter[2]	864	880
Crude protein(CP)	227	209
CP	221	210
ME (Kcal./Kg)[3]	3018	3055
Crude fat, [2]	61	65
Crude fibre[3]	40.2	37.2
Crude fibre, [2]	36.1	35.5
NFE, [3]	625	640
Calcium[3]	8.58	8.45
Available phosphate [3]	4.07	3.78
Methionine[3]	5.48	5.71
Methionine+cystine[3]	9.10	9.05
Lysine[3]	13.18	12.53
Ash, [2]	51.1	53.5

[1]Vit+Min mix. provides per kilogram of the diets: Vit. A, 12000 IU, vit. E (DL-α-tocopheryl acetate) 20 mg, menadione 2.3 mg, Vit. D3, 2200 ICU, riboflavin 5.5 mg, calcium pantothenate 12 mg, nicotinic acid 50 mg, Choline 250 mg, vit. B_{12} 10 μg, vit. B_6 3 mg, thiamine 3 mg, folic acid 1 mg, d-biotin 0.05 mg. Trace mineral (mg/kg of diets): Mn 80 Zn 60, Fe 35, Cu 8, selenium 0.1 mg. [2]Analyzed values. [3]Calculated values.

Animal housing and management: Chicks were raised in battery brooders. Each replicate was kept in a cage (30 × 35 × 45). Chicks had full access to feed and water during the experimental period. The housing temperature was 32°C during the 1st week and declined gradually by 2°C each week and was then stabilized at 25°C until slaughter. A light schedule was 23 h light until 7th day followed by 20 h light from 8th day to through the experimental period until 3 day before slaughter test (8-35 days of age).

***Experimental procedures and growth performance measurements*:** Broilers in each replicate were weighed (g) at 1, 21 and 35 d of age, and the body weight gain (BWG,g/chick) was calculated. Feed intake (FI) was recorded for each replicate (g/chick) and thereby feed conversion ratio (FCR, g feed/g gain) and survival rate (SR, 100 - mortality rate) during the periods from 1-21, 22-35 and 1-35 d of age were calculated.

Apparent digestibility of dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash was done according to (Aggoor *et al*., 2000). The DM, CP, EE, CF and ash of feeds and excrement were determined according to (AOAC, 2004) and expressed on DM basis.

Carcass characteristics measurements: At 35 d of age, six broiler chicks (3 males and 3 females) from each group were slaughtered after 8 hours fasting, processed and the weight of carcass and internal organs were taken and expressed as (%) of live body weight (LBW).

Blood sampling and laboratory analyses: At slaughtering, six blood samples per treatment were collected in clean non-heparinised tubes. The serum was separated by centrifugation at 1500 x g for 10 minutes at 4°C, and stored at -18°C until analysis. The serum profiles were determined using commercial diagnostic kits (Diamond Diagnostics Company, Cairo, Egypt). Glucose concentration (mg/dl) was measured according to Trinder (1969). Total protein (g/dl) was measured according to Henry *et al.* (1974), albumin (g/dl) was measured according to Doumas (1971), globulin (g/dl) was measured according to Coles (1974). The activities (µ/l) of the alanine aminotransferase (ALT) and aspartate aminotransferase (AST) enzymes were determined according to the method described by Reitman and Frankel (1957). In addition, serum samples were assigned for determination of creatinine and urea (Bartles *et al.,* 1972), triglycerides (Fossati and Prencipe, 1982), total cholesterol (Stein, 1986), high density lipo-protein, HDL (Lopez-Virella, 1977), while low density lipo-protein (LDL) was determined according to (Friedewald *et al.,* 1972).

Statistical analysis:

The statistical analysis was performed using a completely randomized design and all data collected were subjected to analysis using a two-way ANOVA procedure (Statistical Analysis System (SAS), 2002). The statistical model included the effects of the dose of the multienzymes (0, 100 and 150%), method of administration (continuously vs. intermittently) and their interactions according to the following model: $Y_{ijk} = \mu + D_i + AM_j + (D \times AM)_{ij} + e_{ijk}$

Where Y_{ijk} = observed value ; μ = overall mean ; D_i = doses effect; AM_j = administration method effect; $(D \times AM)_{ij}$ = interaction between the two effects; e = random error. Before analysis, all percentages were subjected to logarithmic transformation ($\log_{10}x+1$) to normalize data distribution. The differences among means were determined using Duncan's new multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth and Feed:

The effect of different dose of multienzyme given in water continuously or intermittently on the production performance of broiler chickens are summarized in Table (2). The results indicate that BWG during the periods from 1-21 and 1-35 days of age and FCR during all experimental periods were significantly affected by the dose of the enzyme, method of administration, and the interaction between them. The intermittent addition of multienzyme at 100% to water improves the BWG during the periods from 1-21 and 1-35 days of age and FCR during the periods from 1-21, 22-35 days of age and 1-35 days of age compared to other treatments. In addition, enzyme supplemented continuously at 100 and 150% as well as 100% intermittent increases BWG during the periods from 1-21 and 1-35 days of age and improved FCR during the periods from 1-21, 22-35 and 1-35 days of age compared to the control group. However, FI of broiler chickens during most of the experimental periods was insignificantly affected by the dose of the multienzyme, supplementation method and the interaction between the dose of the enzyme and the administration method except for enzyme supplemented continuously increased FI compared to the control group during the periods from 1-35 days of age.

Table (2): Effect of different dose of multienzymes given in water continuously or intermittently on growth performance in broiler chicks during the starter and growing-finishing periods[1].

Treatment effect	Body weight gain (g)			Feed intake (g)			Feed conversion ratio[2]		
	1-21 d	22-35d	1-35d	1-21 d	22-35d	1-35d	1-21 d	22-35d	1-35d
Effect of enzyme dose									
Control	567c	1108	1675c	898	2105	3003	1.58a	1.90a	1.79a
100%	711a	1184	1895a	1010	2065	3075	1.42c	1.74c	1.62c
150%	685b	1166	1851b	1017	2093	3110	1.48b	1.79b	1.68b
Effect of administration method									
Control	567c	1108	1675c	898	2105	3003[b]	1.58a	1.90a	1.79a
Con	686b	1163	1848b	1019	2104	3123[a]	1.48b	1.81b	1.68b
Int	710a	1188	1898a	1009	2054	3063[ab]	1.42c	1.73c	1.61c
Interaction between enzyme dose and administration method									
Control	567b	1108	1675c	898	2105	3003	1.58a	1.90a	1.79a
100% Con	686b	1159	1845b	1022	2102	3125	1.49b	1.81b	1.69b
100% Int	736a	1210	1946a	998	2028	3025	1.35c	1.67c	1.55c
150% Con	685b	1167	1851b	1014	2106	3120	1.48b	1.80b	1.68b
150% Int	685b	1166	1851b	1020	2081	3101	1.48b	1.78b	1.67b
RMSE	22.11	40.84	32.04	44.05	74.91	57.80	0.032	0.037	0.021
Probability level									
Dose	0.015	0.333	0.005	0.714	0.411	0.187	0.0004	0.0080	0.0001
Method	0.021	0.181	0.002	0.642	0.150	0.032	0.0004	0.0001	0.0001
Interaction	0.021	0.168	0.002	0.446	0.469	0.134	0.0004	0.0017	0.0001

Con=Continuous; Int= intermittently

[1]Number of observation =6 replicates per subgroup of each treatments.

[abc] Within columns (for each effect), means not sharing similar superscripts are significantly different at P = 0.05.

Apparent digestibility of nutrients and European production index:

Data concerning the effects of the dose of the enzyme and the administration method on the apparent digestibility of the nutrients of broiler chicks are shown in Table (3). Only the dose of the multienzyme had a significant effect on the digestibility of DM, CP and EE. The addition of multienzyme (100 or 150%) to water improves the digestibility of DM and CP of broiler chickens compared with the control, and 100% multienzyme had the best digestibility of DM and CP. However, there were no significant effects due to the dose of the multienzyme on the apparent digestibility of CF, NFE and ash. Furthermore, broilers received multienzymes intermittently exhibited significantly better digestibility of CP than those given multienzyme continuously and the control group. There were no significant effects from the administration method on the apparent digestibility of DM, EE, CF and ash.

The present study indicates that the addition of multienzyme 100% intermittently to water improves the growth performance of broiler chickens compared with the control. The positive effect of enzymes on growth performance of broilers was observed along with considerable increasing in nutrient digestibility i.e. NFE and ash of this group. In addition, intermittently administration was adequate which may resulted in considerable saving in cost of additives. The present results are agreement with those reported by Zeng *et al*. (2015) and Alagawany *et al*. (2017). These improvements could be attributed to the increased digestive enzyme activities (Alagawany *et al*., 2017). Furthermore, these improvements could be also attributed to the eliminating the adverse impacts of anti-nutritional compounds and enhancing the availability and absorption of nutrients through increasing the digestibility of the ingested diets thereby improving growth performance of broilers (Attia 2003; Kocher *et al*., 2015 and Abdel-Hafeez *et al*., 2016). In addition, multienzyme was found to improve energy utilization in corn-soybean meal and sorghum-soybean meal diets because the digestion of starch and cereal cell walls (Attia *et al*., 2003 and Attia *et al*., 2008). However, the effect of multienzyme counted on dietary composition and enzyme type (Attia; 2003; Abudabos, 2012 and Attia *et al*., 2014a).

Table (3): Effect of different dose of multienzymes given in water continuously or intermittently on apparent nutrient digestibility in broiler chicks[1].

Treatment effect	Apparent nutrients digestibility, %					
	Dry matter	Crude protein	Ether extract	Crude fiber	Nitrogen free extract	Ash
Effect of enzyme dose						
Control	74.3c	65.7c	76.1c	28.2	75.8	35.8
100%	77.0a	70.9a	80.5a	30.4	77.9	37.7
150%	76.4b	69.8b	79.1b	30.4	78.0	37.4
Effect of administration method						
Control	74.3	65.7c	76.1	28.2	75.8c	35.8
Con	76.8	69.6b	80.0	30.3	77.3b	37.4
Int	76.6	71.0a	79.6	30.5	78.6a	37.7
Interaction between enzyme dose and administration method						
Control	74.3	65.7	76.1	28.2	75.8c	35.8c
100% continuums	77.2	70.2	80.4	30.5	77.8a	38.1a
100% Int	76.9	71.6	80.6	30.3	78.1ab	37.4ab
150% continuums	76.4	69.1	79.7	30.1	76.8bc	36.8bc
150% Int	76.3	70.4	78.5	30.7	79.2ab	38.0ab
RMSE	0.892	0.960	1.059	0.812	1.539	1.397
Probability level						
Dose	0.0215	0.0010	0.0002	0.9384	0.8864	0.4529
Method	0.4934	0.0001	0.1775	0.5121	0.0093	0.5227
Interaction	0.6349	0.8189	0.0524	0.1471	0.0389	0.0386

Con=Continuous; Int= intermittently

[1]Number of observation =6 replicates per subgroup of each treatments.

[abc] Within columns (for each effect),means not sharing similar superscripts are significantly different at P = 0.05.

Only the interaction between the dose of the multienzyme and the administration method had a significant effect on the digestibility of NFE and ash. Numerically, groups supplemented with either 100 or 150% multienzyme continuously or intermittently had significantly higher EE digestibility compared to the control group and group given 100% enzymes intermittently had better EE digestibility than those given 150% enzyme intermittently. In addition, NFE and ash digestibility was significantly higher of enzyme supplemented groups than the control groups with the exception of those given 150% continuously. On the other hand, broilers received multienzyme at 100% continuously had higher digestibility of NFE and ash than groups received 150% enzyme by the same method.

Carcass traits and inner body organs:

The carcass characteristics and body organs of broiler chicks as affected by multienzyme and/or the method of administration are shown in Table (4).

The weight and percentages of dressing, abdominal fat, gizzard and proventriculus were not significantly affected by the dose of the enzyme, their method of administration, and the interaction between them with the exception of carcass weight with the administration method. However, groups supplemented with 150% multienzyme had higher weight and percentages of the intestinal (Table 4) and lower percentages of pancreas (Table 5) than the 100% multienzymes and control groups. Moreover, groups supplemented with 100% multienzyme had higher percentages of liver weight than the control. Furthermore, broilers who received multienzyme with continuously method exhibited significantly higher carcass weight, as well as percentages and weight of the intestinal and heart than those given at multienzyme with intermittently method. Moreover, broilers received enzymes at 150% continuously had higher percentages of the intestinal than other groups.

Table (4): Effect of different dose of multienzymes given in water continuously or intermittently on some carcass characteristics and inner body organs in broiler chicks[1].

Treatment effect	Carcass and organs parameters									
	Carcass weight, g	Dressing, %	Abdominal fat, g	Abdominal fat, %	Gizzard, g	Gizzard, %	Proventriculus, g	ProventrIculus, %	Intestinal, g	Intestinal,%
Effect of enzyme dose										
Control	1490	73.5	15.37	0.71	23.4	1.15	6.22	0.312	94.0b	4.66b
100%	1441	71.2	25.17	1.26	23.2	1.14	7.46	0.380	97.1b	4.78b
150%	1439	68.1	23.18	1.10	22.5	1.07	7.25	0.341	122a	5.78a
Effect of administration method										
Control	1490b	73.5	15.37	0.71	23.4	1.15	6.22	0.312	94.0b	4.66b
Con	1523a	71.0	25.03	1.16	24.5	1.14	7.47	0.351	122.2a	5.73a
Int	1358c	68.4	23.32	1.19	21.2	1.08	7.24	0.367	96.9b	4.83b
Interaction between enzyme dose and administration method										
Control	1490	73.5	15.37	0.710	23.4	1.15	6.22	0.312	94.0	4.66b
100% Con	1550	71.3	24.82	1.13	25.7	1.19	7.40	0.350	104.4	4.80b
100% Int	1332	71.2	25.52	1.38	20.6	1.10	7.50	0.404	89.8	4.76b
150% Con	1495	70.7	25.24	1.19	23.2	1.10	7.520	0.352	140.0	6.66a
150% Int	1383	65.6	21.12	1.20	21.9	1.05	6.980	0.330	104.0	4.90b
RMSE	167	3.58	5.85	0.262	3.69	0.177	1.247	0.063	15.636	0.645
Probability level										
Dose	0.979	0.071	0.457	0.198	0.711	0.400	0.732	0.229	0.002	0.002
Method	0.039	0.119	0.521	0.821	0.065	0.428	0.706	0.587	0.002	0.005
Interaction	0.485	0.139	0.369	0.079	0.253	0.784	0.584	0.205	0.142	0.007

Con=Continuous; Int= intermittently

[1]Number of observation =6 replicates per subgroup of each treatments.

[abc] Within columns (for each effect), means not sharing similar superscripts are significantly different at P = 0.05.

Our resulted showed that the weight and percentages of dressing, abdominal fat, gizzard and were not significantly affected by the dose of the enzymes, their method of administration, and the interaction between them. Based on these results, supplemental enzyme blend at the concentrations evaluated in this study may not exert drastic impacts on broilers. These results are in line with Mushtaq *et al*. (2009) who found no effect of enzyme supplementation on carcass traits. Also, De Araujo *et al*. (2014) and Alagawany *et al*. (2017) who found no effect of enzyme supplementation on carcass traits except liver percentage which was decreased with enzyme supplementation. Also, Rabie and Abo El-Maaty (2015) found that enzyme addition did not significantly affect carcass traits of Japanese quail. Attia *et al*. (2014b), Dalólio *et al*. (2016) and Al-Harthi (2017) reported that the parameters of carcass yield and carcass parts were not affected by the enzyme supplementation of diets fed to broiler chickens. These differences in carcass parameters of broiler chickens may be returned to composition and form of the diet as well as type and levels of enzymes used.

Blood serum biochemical constituents and indices of liver and kidney functions:

The results for serum indices of liver and kidney functions of the broiler chicks as they were affected by multienzyme supplementation and/or the administration method are shown in Tables (6 and 7). There were no significant effects from the multienzyme dose and the administration method on blood biochemical constituents and the serum indices of liver and kidney functions (Table 6) except for triglycerides, creatinine and HDL (Table 7). Broilers received multienzyme with continuously method exhibited significantly lower blood creatinine, but higher triglycerides and HDL than those given at multienzyme with intermittently method and the control group. Also, there were no significant differences in liver and renal functions indices due to the interactions between the dose of enzymes and the administration method except in ALT, alkaline phosphatase, urea, albumin, albumin/globulin ratio and triglycerides.

Table (5): Effect of different dose of multienzymes given in water continuously or intermittently on inner body organs in broiler chicks[1].

Treatment effect	Absolute weight (g) and relative weight (%) of carcass characteristics and inner organ					
	Liver weight, g	Liver weight, %	Pancreas weight, g	Pancreas weight, %	Heart weight, g	Heart weight, %
Effect of enzyme dose						
Control	39.7	2.00b	4.38	0.222 a	9.4	0.458
100%	48.1	2.39a	4.37	0.221 a	10.1	0.491
150%	45.0	2.14ab	3.59	0.169 b	11.7	0.554
Effect of administration method						
Control	39.7	2.00	4.38	0.222	9.4b	0.458b
Con	47.0	2.21	4.33	0.203	12.5a	0.582a
Int	46.1	2.32	3.71	0.189	9.3b	0.463b
Interaction between enzyme dose and administration method						
Control	39.7	2.00	4.38	0.222	9.4	0.458
100% Con	1.19	2.21	4.52	0.212	12.6	0.576
100% Int	47.2	2.50	4.22	0.228	7.68	0.406
150% Con	45.1	2.10	4.10	0.193	12.4	0.588
150% Int	44.9	2.10	3.18	0.150	11.0	0.520
RMSE	6.540	0.254	0.788	0.045	2.260	0.073
Probability level						
Dose	0.299	0.039	0.059	0.030	0.120	0.069
Method	0.741	0.345	0.109	0.532	0.005	0.002
Interaction	0.787	0.345	0.404	0.176	0.097	0.137

Con=Continuous; Int= intermittently

[1]Number of observation =6 replicates per subgroup of each treatments.

[abc] Within columns (for each effect), means not sharing similar superscripts are significantly different at P = 0.05.

Broilers, who received 150% intermittently in water had lower ALT than other groups. In addition, broilers received 100% continuously and 150% intermittently in water, had higher alkaline phosphatase than the other groups. Moreover, broilers received 150% continuously in water, had lower urea than those given at 100% continuously and control group, and higher albumin and triglycerides than the other groups. However, broilers received 150% continuously had the highest serum albumin.

In general, with a few exceptions, our results showed that there were no significant effects from the multienzymes dose and the administration method on the serum indices of liver and kidney functions and blood biochemical constituents. These results partially agree with Mehri *et al*. (2010) suggested that β-mannanase did not influence the blood serum proteins (albumin, alpha 1-, alpha 2-, beta and gamma-globulins). Also, Gheisari *et al*. (2011) showed that dietary enzyme treatments had no impact on serum protein concentrations. El-Katcha *et al*. (2014) observed that supplementation of enzyme had no significant effect on blood serum AST and ALT as well as cholesterol and triglyceride concentrations when compared with birds fed on the same diet without enzyme addition. Dinani *et al*. (2017) showed that enzyme supplementation had no significant on serum total protein, albumin, globulin and their ratio. Khaled *et al*. (2017) did not observe any significant (P>0.05) effect of β-mannanse supplementation on serum alkaline phosphates, ALT, AST, uric acid and creatinine. Conversely to our results, Azarfar (2013) and Alagawany *et al*. (2017) who pointed out that the control diet resulted in significantly higher concentrations of total cholesterol and its fractions than the other diets which contained 1 g enzyme /kg. All blood serum parameters were not affected by enzyme supplementation (El-Serwy *et al*., 2012 and Fathey, 2012).

Table (6): Effect of different dose of multienzyme given in water continuously or intermittently on indices of liver and kidney functions in broiler chicks[1].

Treatment effect	Indices of liver and renal function						
	ALT* (U/L)	AST** (U/L)	AST/ALT ratio	Alkaline phosphatase (U/L)	Urea, mg/dl	Creatinine, g/dl	U/C ratio
Effect of enzyme dose							
Control	60.8	54.6	1.114	8.4	22.4	1.04	21.72
100%	60.6	54.2	1.118	9.6	21.9	1.01	22.28
150%	59.4	54.3	1.096	9.4	21.3	0.98	22.45
Effect of administration method							
Control	60.8	54.6	1.114	8.4	22.4	1.04a	21.72
Con	60.6	54.2	1.118	9.1	21.4	0.92b	23.73
Int	59.4	54.3	1.096	9.9	21.8	1.07a	21.01
Interaction between enzyme dose and administration method							
Control	60.8a	54.6	1.114	8.4b	22.40a	1.04	21.72
100% Con	60.0a	53.6	1.118	10.4a	22.40a	0.92	24.92
100% Int	61.2a	54.8	1.118	8.8b	21.40ab	1.10	19.64
150% Con	61.2a	54.8	1.118	7.8b	20.40b	0.92	22.54
150% Int	57.6b	53.8	1.074	11.0a	22.20ab	1.04	22.36
RMSE	1.41	1.393	0.41	1.10	1.48	0.158	3.97
Probability level							
Dose	0.071	0.874	0.247	0.687	0.374	0.676	0.925
Method	0.071	0.874	0.247	0.118	0.552	0.047	0.140
Interaction	0.001	0.093	0.247	0.001	0.046	0.676	0.167

Con=Continuous; Int= intermittently

[1]Number of observation =6 replicates per subgroup of each treatments.

[abc] Within columns (for each effect), means not sharing similar superscripts are significantly different at P = 0.05.

ALT Alanine aminotransferase.*

*AST** Aspartate aminotransferase.*

Table (7): Effect of different dose of multienzymes given in water continuously or intermittently on blood biochemical constituents of broiler chicks[1].

Treatment effect	Blood biochemical constituents									
	Total protein, g/dl	Albumin, g/dl	Globulin, g/dl	A/G ratio	Total lipids, mg/dl	Trigl, mg/dl	Chol., mg/dl	HDL, mg/dl	LDL, mg/dl	HDL/LDL ratio
Effect of enzyme dose										
Control	6.44	2.82	3.62	0.788	6.4	172.4	213.6	37.4	84.2	0.445
100%	6.21	2.92	3.28	0.910	9.5	172.4	211.9	36.4	83.6	0.436
150%	6.15	3.0	3.15	0.971	10.1	173.4	212.3	36.1	84.5	0.427
Effect of administration method										
Control	6.44	2.82	3.62	0.788	6.4	172.4b	213.6	37.4a	84.2	0.445
Con	6.11	3.01	3.09	0.990	9.4	174.0a	212.0	37.7a	84.6	0.446
Int	6.25	2.91	3.34	0.881	10.2	171.8b	212.2	34.8b	83.5	0.417
Interaction between enzyme dose and administration method										
Control	6.44	2.82d	3.62	0.788a	6.40	172.4b	213.6	37.4	84.2	0.444
100% Con	6.14	2.86 c	3.28	0.870b	9.0	172.4b	211.2	37.6	83.4	0.450
100% Int	6.26	2.98b	3.28	0.920b	10.0	172.4b	212.6	35.2	83.8	0.421
150% Con	6.06	3.16 a	2.90	1.10b	9.8	175.6a	212.8	37.8	83.8	0.440
150% Int	6.24	2.84 c	3.40	0.840b	10.4	171.2b	212.8	34.4	83.2	0.413
RMSE	0.205	0.194	0.300	0.130	0.980	1.86	3.95	2.87	2.41	0.036
Probability level										
Dose	0.591	0.367	0.345	0.237	0.186	0.245	0.823	0.817	0.414	0.601
Method	0.117	0.262	0.078	0.077	0.083	0.016	0.911	0.034	0.320	0.092
Interaction	0.745	0.019	0.078	0.016	0.653	0.016	0.505	0.699	0.179	0.941

Con=Continuous; Int= intermittently; Trigl.= Triglycerides; Chol.= Cholesterol; HDL= High density lipo-protein; LDL= Low density lipo-protein

[1]Number of observation =6 replicates per subgroup of each treatments.

[abc] Within columns (for each effect), means not sharing similar superscripts are significantly different at P = 0.05.

CONCLUSION

Given the above, based on the results obtained in this study, it can be inferred that the inclusion of the multienzyme in broiler drink water, in the levels recommended by the manufacturer, 100%, enhanced the efficiency of the growth performance and did not significantly influence the carcass characteristics and blood biochemical constituents. Furthermore, intermittent supplementation resulted in 50% saving in the cost of additives.

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الأداء الإنتاجي وهضم العناصر الغذائية والصفات الكيميائيه للدم فى كتاكيت التسمين وتأثرها بجرعه وطريقه اضافه الأنزيمات

علي سعيد الشافعي[1] ، أسماء شوقي النجار[1] و محمود إبراهيم الكيلاوي [2]

[1] قسم الانتاج الحيواني والداجني – كليه الزراعة – جامعه دمنهور – مصر.

[2] قسم انتاج الدواجن – كليه الزراعة – جامعة الوادي الجديد – مصر.

تهدف هذه الدراسه لتقييم مدي استجابه الأداء الإنتاجي وهضم العناصر الغذائية والصفات الكيميائية للدم لطريقه إضافة وكذلك جرعة الانزيمات. استخدم عدد 150 كتكوت تسمين اربورايكرز وتم توزيعهم بالتساوي وبشكل عشوائي إلى خمس مجموعات تجريبية، كل مجموعة تحتوي على سته مكررات بحيث تحتوي كل مكرره علي خمسة كتاكيت. المجموعة الأولى استخدمت كمجموعة كنترول والتي لم يضاف لها اي انزيمات. المجموعة الثانية والثالثة والرابعه والخامسه اضيف لهم مخلوط الانزيمات في ماء الشرب بنسبه اضافه 100و150% من الجرعه الموصي بها اعطيت لهم بشكل مستمر او متقطع على التوالي. الطريقة المستمرة لإضافة مخلوط الانزيمات كانت تضاف للكتاكيت على مدار اليوم. بينما الطريقه المتقطعه لاضافه خليط الانزيمات كانت تضاف على مدار اليوم يليها يوم بدون اضافه خلال الفتره من عمر يوم حتى عمر 35 يوم.

اوضحت النتائج أن اضافه خليط الانزيمات سواء عند مستوي 100% او 150% فى الماء ادت الي زيادة معنويه فى الأداء الإنتاجي وهضم العناصر الغذائيه مقارنه بمجموعة الكنترول كما اوضحت النتائج ان اضافه 100% من مخلوط الانزيمات اعطت أداء إنتاجي أفضل من تلك التي اضيف لها 150% من مخلوط الأنزيمات. الكتاكيت التي اضيف لها مخلوط الأنزيمات بشكل متقطع أعطى أداء إنتاجي وهضم العناصر الغذائية أفضل معنويا من تلك الطيور التي أضيف لها مخلوط الأنزيمات بشكل مستمر. لم تؤثر جرعة أو طريقة إضافة مخلوط الإنزيمات على خصائص الذبيحة والصفات الكيميائية للدم عدا الجلسريدات الثلاثيه والكرياتنين .

من هذه الدراسة يمكن أن نستنتج أن إضافة مخلوط الإنزيمات بشكل متقطع بنسبة إضافة 100% في الماء أعطت أفضل زيادة معنويه فى معدل النمو ومعامل التحويل وكذلك معامل الإنتاج.