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

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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 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-Serwyy 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.

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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 supplemements. 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:10000000 unit, xylanase 1500000 unit, lipase 6500 unit, alpha amylase 250000 unit, protease 400000 unit and Pectinase 300000 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                        | 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             | 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                  | 864            | 880             |
| Crude protein(CP)           | 227            | 209             |
| CP                          | 221            | 210             |
| ME (Kcal./Kg)              | 3018           | 3055            |
| Crude fat,                 | 61             | 65              |
| Crude fibre                 | 40.2           | 37.2            |
| Crude fibre,                | 36.1           | 35.5            |
| NFE,                       | 625            | 640             |
| Calcium                    | 8.58           | 8.45            |
| Available phosphate        | 4.07           | 3.78            |
| Methionine                  | 5.48           | 5.71            |
| Methionine+cystine         | 9.10           | 9.05            |
| Lysine                     | 13.18          | 12.53           |
| Ash,                       | 51.1           | 53.5            |

1Vit+Min mix. provides per kilogram of the diets: Vit. A, 12000 IU; vit. E (DL-a-tocopheryl acetate) 20 mg; menadione 2.3 mg, Vit. D3, 2200 IU, riboflavin 5.5 mg, calcium pantothenate f2 mg, nicotinic acid 50 mg, Choline 250 mg, vit. B12 10 µg, vit. B6 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. 2Analyzed values. 3Calculated 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 to 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 multi-enzymes (0, 100 and 150%), method of administration (continuously vs. intermittently) and their interactions according to the following model:

\[ Y_{ij} = \mu + D_i + AM_j + (D \times AM)_{ij} + e_{ij} \]

Where \( Y_{ij} \) = observed value; \( \mu \) = 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(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.

| Treatment effect | Body weight gain (g) | Feed intake (g) | Feed conversion ratio² |
|------------------|----------------------|-----------------|------------------------|
|                  | 1-21 d 22-35d 1-35d | 22-35d          | 1-21 d 22-35d 1-35d   |
| 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 enzyme dose

| Control          | 567c 1108 1675c    | 898 2105 3003   | 1.58a 1.90a 1.79a     |
| Con              | 686b 1163 1848b   | 1019 2104 3123ab | 1.48b 1.81b 1.68b     |
| Int              | 710a 1188 1898a   | 1009 2054 3063ab | 1.42c 1.73c 1.61c     |

Effect of 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     |

Interaction between enzyme dose and administration method

| Control          | 567b 1108 1675c    | 898 2105 3003   | 1.58a 1.90a 1.79a     |
| Con              | 686b 1159 1845b   | 1022 2102 3125  | 1.49b 1.81b 1.69b     |
| 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 32.04 0.032 0.037 0.021

Probability level

| Dose Method Interaction | 0.015 0.005 0.411 0.134 0.0004 0.0004 0.0017 0.0001 |
|-------------------------|---------------------------------------------------|

Con=Continuous; Int= intermittently

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

abWithin 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.

| 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

1Number 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.
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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<sup>1</sup>.

| Treatment effect | Carcass and organs parameters |
|------------------|-----------------------------|
|                  | Carcass weight, g | Dressing, % | Abdominal fat, g | Abdominal fat, % | Gizzard ulus, 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 |
| Control          | 1490b | 73.5 | 15.37 | 0.71 | 23.4 | 1.15 | 6.22 | 0.312 | 94.0b | 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 | 0.643 |
| 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 |

<sup>1</sup>Number of observation = 6 replicates per subgroup of each treatments.

| Con=Continuous; Int= intermittently |
|-------------------------------------|
|<sup>4</sup> Within columns (for each effect), means not sharing similar superscripts are significantly different at P = 0.05. |

Our results 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.

| Treatment effect: Effect of enzyme dose | 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, % |
|----------------------------------------|--------------------------------------------------------------------------------------|-----------------|-----------------|-------------------|-------------------|-----------------|-----------------|
| Control                                |                                                                                      | 39.7            | 2.00            | 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                      |                                                                                      | 0.299           | 0.039           | 0.059             | 0.030             | 0.120           | 0.069          |
| Dose                                   |                                                                                      | 0.741           | 0.345           | 0.109             | 0.532             | 0.005           | 0.002          |
| Method                                 |                                                                                      | 0.787           | 0.345           | 0.404             | 0.176             | 0.097           | 0.137          |
| Interaction                            |                                                                                      |                 |                 |                   |                   |                 |                 |

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-mannanase 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.

| Treatment effect | Indices of liver and renal function |  |
|------------------|-------------------------------------|---|
| 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 | 1.04 | 21.72 |
| Con | 60.6 | 54.2 | 1.118 | 9.1 | 21.4 | 0.92 | 23.73 |
| Int | 59.4 | 54.3 | 1.096 | 9.9 | 21.8 | 1.07 | 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 | 0.046 | 0.676 | 0.167 |

 AST: Aspartate aminotransferase.
 AST**: Aspartate aminotransferase.
 ALT: Alanine aminotransferase.
 ALT*: Alanine aminotransferase.

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

| Treatment effect | Blood biochemical constituents |
|------------------|-------------------------------|
| 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 | 213.6 | 36.4 | 83.6 | 0.436 |
| 150% | 6.15 | 3.0 | 3.15 | 0.971 | 10.1 | 173.4 | 213.6 | 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 | 2.86c | 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 | 3.16a | 2.90 | 1.10b | 9.8 | 175.6a | 212.8 | 37.8 | 83.8 | 0.440 |
| 150% Int | 6.24 | 2.84c | 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
 *Number of observation = 6 replicates per subgroup of each treatments.
 abWithin columns (for each effect), means not sharing similar superscripts are significantly different at P = 0.05.
 ALT*: Alanine aminotransferase.
 AST**: Aspartate aminotransferase.

El-Shafey et al.
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 الكيميائية للدم في كتائikit التسمين وتأثيرها بجرعه وطريقة إضافة الأنزيمات

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تهدف هذه الدراسة لتقديم مدى استجابة الأداء الإنتاجي وهضم العناصر الغذائية والصفات الكيميائية للدم للمواد إضافة إضافية وكذلك جرعة الأنزيمات. استخدم عدد 150 كنكة تسمين أربوزيكر وتوزيعها بتساوي وشكل عشوائي إلى خمس مجموعات تجريبية، كل مجموعة تحتوي على ست مكرات بحيث تحتوي كل مكررة على خمسة كتائيت. المجموعة الأولى استخدمت كمجموعة كنترول والتي لم يضاف لها أي انتيويات. المجموعة الثانية والثالثة والرابعة والخامسة اضف لهم مخطط الأنزيمات في ماء التربة بنسبه إضافيه 100 و150% من الجرعة الموصى بها اعطت لهم بشكل مستمر أو متقطع على التوالي. العينة المستمرة لإضافة مخطط الأنزيمات كانت تضاف للكلائتات على مدار اليوم. بينما الطريقة المتقطعة لإضافة مخطط الأنزيمات كانت تضاف على مدار اليوم بليبي يوم بدون إضافه خلال الفترة من عمر يوم حتى عمر 35 يوم.

وأوضح النتائج أن إضافة مخطط الأنزيمات سواء عند مستوي 100% أو 150% في الماء أدت إلى زيادة معيارى في الأداء الإنتاجي وهضم العناصر الغذائية مقارنة بمجموعة الكنترول. كما أوضحت النتائج أن إضافة 100% من مخطط الأنزيمات أعطت أداء إنتاجي أفضل من تلك التي اضف لها 150% من مخطط الأنزيمات. الكتائيت التي اضف لها مخطط الأنزيمات بشكل متقطع أعطى أداء إنتاجي وهضم العناصر الغذائية أفضل معنى من تلك الطيور التي أضيف لها مخطط الأنزيمات بشكل مستمر. لم تؤثر جرعة أو طريقة إضافة مخطط الأنزيمات على خصائص الطيور والمصطلحات الكيميائية للماء الجريسيات الثلاثي والكروتدين. من هذه الدراسة يمكن أن نستنتج أن إضافة مخطط الأنزيمات بشكل متقطع بنسبة إضافة 100% في الماء أعطت أفضل زيادة معيارى في معدل النمو ومعامل التحويل وكذلك معامل الإنتاج.