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EFFECT OF INCORPORATING NATURAL ZEOLITE WITH OR WITHOUT PHYTASE ENZYME INTO BROILERS DIETS ON BLOOD CONSTITUENTS AND CARCASS TRAITS

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ABSTRACT: The aim of the present study is to evaluate the effect of Clinoptilolite (Zeolite) addition to the broiler diets with or without phytase enzyme on blood constituents and carcass traits. Total number 594 one-day-old broiler chicks (Ross 308) were randomly divided into nine equal experimental groups with 3 replicates of 22 birds in each for 35 day of age. Birds of the 2nd and 3rd groups were fed diets contained 0.05% and 0.075% phytase (5000 FTU/g), the 4th group was fed diet contained 1% Zeolite, the 5th and 6th groups were fed diet containing 1% Zeolite with 0.050% and 0.075% phytase (5000 FTU/g), respectively, the 7th group was fed diet containing 2% Zeolite, the 8th and 9th groups were fed diet containing 2% Zeolite with 0.05% and 0.075% phytase (5000 FTU/g), respectively. While, the first group presented as basal diet without Zeolite and/or phytase supplementation. Body weight and feed conversion at 35 days of age were significantly improved by Zeolite addition and broiler chickens treated with 0.05% phytase diet had the best body weight. Blood hematology was not affected by Zeolite or phytase treatments, while serum total protein concentration was significantly increased compared with those of the control group. Also, Zeolite addition had a significant decreasing effect on broiler chicken's cholesterol and triglyceride concentrations, as well as phytase supplementation had a significant decreasing effect on broiler chicken's cholesterol, triglyceride and low density lipoprotein values. At the end of the experiment, it can be seen that carcass and dressing percentages significantly improved with Zeolite treatments. Generally, it can be considered that natural Zeolite addition to the broiler diets supplemented with or without phytase enzyme enhanced physiological status included serum protein and lipid profile.

Key words: Zeolite Clinoptilolite, phytase, blood parameters, carcass traits, broiler

INTRODUCTION

High quality broiler meals and improving the environmental conditions of the chicken house are important for maximizing production and maintaining healthy chicken especially intensive livestock productive performance (Tahseen, 2010 and Karovic *et al.*, 2013). During the life time of the broiler chickens, they were confrontation a number of stresses one of which is the high level of ammonia that is generated as a result of the fermentation of chicken secretions (Whyte, 1993). Ammonia gas emitted from chicken litter and negatively affects chicken productivity (Beker *et al.*, 2004). Natural Zeolites may improve the nutrient digestibility by increasing the average retention time in layer hens (Evans & Farrell, 1993). Zeolites can also affect calcium utilization and metabolism by maintaining or selectively releasing calcium as it passes through the digestive system (Roland *et al*., 1985 and Öztürk *et al*., 1998). The natural and synthetic Zeolites (Oğuz *et al.*, 2000), Bentonites (Rosa *et al.*, 2001), Mycosorb (Basmacloglu *et al.*, 2005) and other sorbents were preferred due to their binding capabilities against aflatoxin (AF) and their reduced effect on AF adsorption from the intestinal gut. Key advantages of adsorption include cost, safety and easy management by adding animal feed. The improvement in the availability of phosphor (P) and other cations by nutritional phytase (Ph) supplementation has been generally well accepted. Recently, Lalpanmawia *et al.* (2014) cleared that laboratory phytase and commercial phytase supplementation resulted in 30% decrease in P secretion.

However, it is clear the effect of combining the use of Zeolite and phytase in diets with a low level of P on broiler performance and bone characteristics has not been reported to date. A wide range of Zeolites applications depend on their physical and chemical properties, the type of Zeolite, purity and the level of supplementation used in diets, which are important factors affecting its effectiveness (Utlu *et al*., 2007). This study was applied to investigate the effect of incorporating Zeolite into the broiler chicken diets supplemented with or without phytase enzyme on the blood constituents and carcass traits.

MATERIALS AND METHODS

The present study was carried out at the Poultry Research Center and Laboratories of the Poultry Production Department, Faculty of Agriculture (El-Shatby), Alexandria University from May to June, 2017. All treatments and birds care procedures were approved by the Institutional Animal Care and Use Committee in AU-IACUC, Alexandria University, Egypt with the review report number AU0820022259. Authors declare that the procedures imposed on the birds were carried out to meet the Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals and birds used for scientific purposes.

Chemical properties of natural Zeolite and phytase enzyme

The chemical formula of the tested material Zeolite (Clinoptilolite) is (Ca, K_2, Fe, Na, Mg) 4 Al_8 Si_{40} O_{96} .24H_2O and its cations included Potassium 27%, Iron 8%, Calcium 2.6% and Sodium 0.58. While, CHELL PHYTASE – 5000 is a Thermostable Phytase enzyme produced from submerged fermentation by Korean Veterinary Good Manufacturing Practice (KVGMP, Chell Bio company, LTD. The physical properties are granulated, with Withstand pelleting temp without

significant loss in activity and appearance is light yellow brown coating type.

Broiler and experimental design

A total of 594 one-day old of broiler chicks (Ross 308) with a mean body weight (BW) of 41.1 ±0.7g, obtained from a commercial hatchery were used in the current study. Broiler chicks were randomized divided into 9 experimental groups with 3 replicates of 22 birds in each for a 35-day feeding trial. Birds of the 2nd (T2) and 3rd (T3) groups were fed diet contained (0.050 and 0.075 %) phytase (5000 FTU/g), the 4th (T4) group was fed diet contained 1% Zeolite, the 5th (T5) and 6th (T6) groups were fed diet contained 1% Zeolite with 0.050% and 0.075% phytase (5000 FTU/g), supplementation, respectively and the 7th (T7) group was fed diet contained 2% Zeolite, the 8th (T8), 9th (T9) groups were fed diet contained 2% Zeolite with 0.050% and 0.075% phytase (5000 FTU/g) supplementation, respectively. While, the first group was served as control group (T1) fed basal diet without Zeolite and/or phytase addition. All diets were formulated to meet or exceed NRC (1994) nutrient recommendations except P in diets contained Zeolite (Z) and phytase (Ph) of broilers chickens for starter (0-21 days), grower and finisher from 21 to 35 days of age. Composition and nutrient levels of experimental diets were shown in Table (1 and 2). Zeolite was obtained from Yemen Zeolite Company, Yemen.

Flock management

All chicks were housed in breeding pens with fresh wood shavings; gas heater was used to supply the chicks with heat needed for brooding, in an open ventilated system and remained under the same administrative, hygienic and environmental conditions. Birds of all experimental groups were vaccinated against Newcastle via drinking water at 7, 18 and 28 days of age of age respectively. Likewise, to protect the chicks against Gambro they were vaccinated at 12 days of age via drinking water. Ambient temperature was reached at 30-32 ^{o}C during the 1st week and weekly decreased by 3 ^{o}C for the next three weeks. During the 4th and 5th weeks, temperature was maintained at 22-24 ^{o}C. A similar light schedule to commercial condition was used; 23 h light from one-day old until 7th day, followed by 20 h light from 8th day to the end experiment (35 days of age). The feeding trial was extended for 5 weeks of age.

Productive performance

During the trial period, body weights (BW) were recorded for each replicate to determine weight gain. The feed consumption (FC) was recorded for each pen and calculated based on each pen 35 days of the experimental period. The feed conversion (FCR) was calculated by the average of feed consumption per unit of body weight gain during the same periods.

Blood analysis

At five weeks of age, six birds from each group were randomly taken at 08:00–09:00 am and about 3 ml blood was collected from the wing vein into vacationer tubes with or without containing K3-EDTA (1 mg/ ml). The first part was used to test shortly after collection for estimating hematological parameters (blood picture) of the blood including erythrocytes like red blood cells (RBCs, 10^6/ml), hemoglobin (Hb, g/dl), packed cell volume (PCV, %), blood mean corpuscular volume (MCV fl), mean corpuscular hemoglobin (MCH pg), and mean corpuscular hemoglobin concentration (MCHC g/dl) counts were

calculated. Leukocytes differential counts like white blood cells (WBCs, 10^3/ml), the H/L ratio was estimated by dividing the total count of Heterophils of the total number of lymphocytes. All blood biochemical variables were the second part was centrifuged at 4000 rpm for 15 min and the clear serum was separated and stored in a deep freezer at–20 ºC until biochemical analysis for its total protein and albumin by a colorimetric method using a commercial kit of sentinel CH Company, Milano, Italy. However, serum globulin level was calculated by subtraction of albumin from total proteins. Serum cholesterol, triglycerides, high density lipoprotein (HDL) and low density lipoprotein (LDL) were determined calorimetrically using the commercial kits (Bio-Merieux, Franc and Stambio, USA).

Carcass traits

At the end of the trial period (35 days of age), six birds from each treatment were randomly selected for slaughtering with body weight similar to the mean, the assigned chicks were slaughtered to determine carcass characteristics. Birds were fasted (by feed withdrawal overnight), approximately 12 h, then individually weight to the nearest gram and slaughtered by severing the jugular veins of the neck with a sharp knife (Islamic method). When complete bleeding was achieved, scalded, de-feathered, and manually eviscerated. Carcass weight and calculated as percentage from live body weight and dressing percentage included relative weights of carcass and giblets included of liver, gizzard and heart were estimated as a percentage of live body weight.

Statistical Analysis

All data obtained were subjected to two-way analysis of variance (ANOVA) across treatment groups, if the effect of supplemented natural Zeolite and phytase enzyme were tested in completely randomized design (CRD) by SPSS Ver. 21, IBM Corp., USA (SPSS program 2007). If a significant effect was noted, the significance between treatments was determined by Duncan's multiple range tests (DMRT) with significance level defined at $P \leq 0.05$.

$Y_{ijk} = \mu + Zi + Pj + Z P ij + eijk$

Y_{ijk} = Observation of the statistical measured.

μ = Overall mean.

Z = Effect of Zeolite

P = Effect of phytase

ZP_{ij} = Interaction between Zeolite and phytase

e_{ijk} = Experimental error

RESULTS AND DISCUSSION

Productive performance

The effect of feeding diets supplemented with different levels of natural Zeolite and phytase is shown in Table (3). It is clear that inclusion natural Zeolite (Z1 and Z2) significantly enhanced on body weight (BW) and feed conversion ratio (FCR) ($P \leq 0.001$) by about 0.69 and 1.10%; 1.10 and 1.65%, respectively compared to those of the control group (Z0). While, the effect of different levels of natural Zeolite on feed consumption (FC) was significantly decreased ($P \leq 0.04$) by 0.48 and 0.73%, respectively compared to that of the Z0. Regardless of natural Zeolite effect, phytase level (0.05%) was significantly enhanced ($P \leq 0.001$) BW compared to P0 group. While, phytase level (0.075%) was not significantly influenced. Interaction between the effect of dietary natural Zeolite and phytase levels were cleared that T8 (natural Zeolite Clinoptilolite 2 % and phytase enzyme 0.05 %), significantly improved BW ($P \leq 0.001$)

and FCR (P≤0.018) compared with either levels of natural Zeolite Clinoptilolite and phytase enzyme or control groups. Such improvement was 2.9 and 4.4% in BW and FCR compared with those of the control group, respectively. This finding is in agreement with Amad *et al*. (2018) who found that addition of natural Zeolite (Clinoptilolite) 2% was significantly increased BW and FCR when compared to that in the control group. Our results also were in agreement with Raut *et al*. (2018) and Pieniazek *et al.* (2017) who reported that supplemental diet with phytase was significantly improved BW and FCR. The exact mechanism effect of Zeolite or phytase on productive performance of animals may be related to their purity, type, concentration, particle and level of them. Also, the positive effect of Zeolite on animal growth can be summarized as follows: Zeolite contains a large number of macro- and micro-chemical elements that are necessary for animal growth. These elements are present in an ionic form and may be released to the bodies as reported by (Zhang *et al*., 2013). Also, these elements can counteract harmful effects of existing toxic substances (like ammonia gas, hydrogen sulfide, etc.) and low bacterial contamination counts in the intestine (e.g., *E. coli*, salmonella and dysentery bacillus) which due to their high absorption capacity. Then, harmful substances can be eliminated from animal body (Slamova *et al*., 2011; Wu *et al*., 2013a). Growth performance is related to changes that occur when digesting nutrient and secreting digestive enzymes (Ouhida *et al*., 2000; Wu *et al*., 2013b). So, the significant increase was seen in the compatibility process between diets contained natural Zeolite (Clinoptilolite 2% plus phytase enzyme, 0.05%).

Hematological parameters

The results of haematological parameters of broiler chickens under effect of different dietary levels of natural Zeolite and phytase are summarized in Tables (4 and 5). It is obvious that values of haematological parameters varied within physiological ranges. Haematological parameters of RBCs, Hb, PCV, MCV, MCH and MCHC, also WBCs, lymphocyte, heterophils and H/L ratio didn't differ between natural Zeolite and phytase groups and control ones. This result agreed with findings of Daramola *et al*. (2005) who reported that WBC counts, RBC and PCV percentage were not affected by dietary phytase. Emam *et al*. (2019) noticed that no significant differences in PCV and MCH were seeing between groups of laying hens received dietary Zeolite. While, there is reinforcement in the blood hematological parameters of hens fed with Zeolite 2 and 4 % that may be due to the main role of the additional Zeolite.

Blood biochemical parameters

Result of blood serum biochemical constituents under effect of different dietary levels of natural Zeolite and phytase are summarized in Tables (6 and 7).

Blood protein profile

The results of serum protein profile as feeding different dietary levels of natural Zeolite and phytase were summarized in Table (6). The results show a significant increase in total serum protein concentrations in the groups treated by adding 2% of natural Zeolite compared to the control group, but albumin and globulin levels were not affected in this respect. While, data cleared a significant increase in total serum protein concentration in the groups treated by adding 0.05% and 0.075% of phytase

compared to the control group, whereas albumin and globulin levels were not affected by phytase treatment. However, there is no significant difference in the interaction factors between them. These results are in agreement with Safaeikatouli *et al*. (2011a; 2011b) which cleared that serum total protein, serum albumin level and albumin/globulin ratio for groups received 15 or 30 g/ kg kaolin and 30 g/kg Zeolite in diets significantly increased compared to those of the basal diet. Demirel *et al.* (2011) found that dietary Clinoptilolite increased in serum albumin. Also, Kavan *et al.* (2013) observed that serum total protein and albumin were high significant in birds receiving 1.5% Clinoptilolite with particle size of 0.4- 0.8 mm compared to the control diet. However, Eleroğlu *et al.* (2011) found that inclusion of Ca-Zeolite, at various levels, did not have any significant effect on blood total protein. Meanwhile, Bintaş *et al.* (2017) reported that dietary Zeolite decreased serum total protein levels.

Blood lipid profile

Results illustrates in Table (7) shows that serum cholesterol and triglycerides were significantly decreased with natural Zeolite (7.08 and 11.37%) and (12.24 and 15.21%) or phytase (9.29 and 11.35%), (7.76 and 9.34%), respectively but serum HDL and LDL levels didn't differ between natural Zeolite compared to control group. It can be observed that phytase enzyme treatment resulted in a significant decrease in chick's serum cholesterol ($P \leq 0.039$), triglyceride ($P \leq 0.004$) and LDL ($P \leq 0.010$) values, while it being insignificant on HDL value. Thus, the percentages of the differences compared with the control mean were 9.29 and 11.35% (cholesterol), 8.29 and 9.45% (triglyceride) and 9.77 and 5.71% (LDL) for 0.05% and 0.075% phytase enzyme treated groups, respectively. Interaction between Zeolite and phytase levels were significantly lower in serum LDL concentrations at treatment groups compared to the control group. On the other hand, cholesterol, triglyceride and HDL concentrations did not significantly affected by the interaction treatments. Generally, the presented findings followed the same trend of those reported by several workers. In that, Safaeikatouli *et al.,* (2011a) showed that broiler chickens fed diet of 15 g/kg kaolin and Zeolite had a significantly decrease in serum triglyceride and no significant differences was seen in total cholesterol, high density lipoprotein and low density lipoprotein concentrations. While, Huff *et al*., (1998) revealed that diet of broiler chicks supplemented with 500 FTU/kg of phytase had not significant effects on triglycerides levels. Kavan *et al.* (2013) found that cholesterol and triglyceride not significantly affected by supplementation with Clinoptilolite and sodium Zeolite.

Carcass characteristics

The results of carcass characteristics of broiler chickens received different dietary levels of natural Zeolite and phytase and their combination are summarized in Table (8) significant effects occurred in carcass (%) and dressing (%) only under levels of natural Zeolite inclusion. The percentages of those increases compared with those of the control were (4.12 and 5.02%) and (2.05% and 5.95%) with the levels of 1 and 2% at 35 days of age, respectively. While, no significant effects occurred under effect of phytase enzyme addition and their interaction. Also, edible (%), liver (%) and heart (%) were no significant affects as feeding different dietary levels of natural Zeolite and phytase and their interaction inclusion.

These findings are in agreement with Christaki *et al*. (2001) which mentioned that the addition of 2% natural Zeolite to broiler diet increased carcass weight at 42-days. Moghaddam *et al*. (2005) found that use of Zeolite in diets had no significant effects on carcass percentage. Safaeikatouli *et al*. (2011a) concluded that using dietary Zeolite increased meat production of broilers and consequently yielded higher pectoral and thigh weight percentage. Amad (2018) adding 1.5% Zeolite to diet significantly increased the relative edible organs. In contrast, Saçakli *et al*. (2015) reported that addition of natural Zeolite and phytase had no significant differences in broiler dressing percentage, breast, wings, leg quarters, gizzard, liver, heart and abdominal fat of live body weight. Schneider *et al*. (2016) studied the inclusion of 0.5 and 10% Zeolite in the diet did not differ of the total carcass yield, or breast, leg and thigh meat of broilers.

CONCLUSION

Data obtained from this study indicated that the inclusion of natural Zeolite and phytase enzyme may have beneficial effects on performance, hematology, blood lipids and carcass characteristics of broiler chickens.

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Table (1): Composition and calculated analysis of experimental starter diets offered to broiler chickens from 1 to 21 days of age.

Ingredients %	Starter diet from 1 to 21 days								
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
Yellow corn	552.00	556.00	553.75	539.80	539.10	537.55	519.15	518.50	517.75
Soybean meal 47%	362.80	362.00	360.00	362.50	362.70	363.00	365.00	365.15	365.15
Glutein, 60%	20	20	22	22	22	22	23	23	23
Vegetable oil	23	23	25	27	27	28	34	34	34.5
DCP	18.0	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Limestone	12.0	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
Premix*	3	3	3	3	3	3	3	3	3
L-lysine	1.20	1.20	1.20	1.31	1.31	1.31	1.38	1.38	1.38
DL–methionine	2.75	2.75	2.75	2.84	2.84	2.84	2.92	2.92	2.92
Salt	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Bicarbonate	1	1	1	1	1	1	1	1	1
Anti-toxin	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Anti-coccidian	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Choline	0.10	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Enzymes energy	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Clinoptilolite	0	0	0	10	10	10	20	20	20
Phytase	0.0	0.500	0.750	0.0	0.500	0.750	0.0	0.500	0.750
Total	1000	1000	1000	1000	1000	1000	1000	1000	1000
Calculated composition									
Crude protein %	23.20	23.21	23.20	23.19	23.17	23.15	23.18	23.17	23.17
Calcium %	1.05	1.04	1.05	1.02	1.02	1.04	1.04	1.05	1.05
T. Phosphorus%	0.84	0.69	0.72	0.66	0.69	0.72	0.66	0.69	0.72
ME kcal/kg	3140	3145	3144	3141	3148	3141	3139	3138	3139

*Each 3 kg of vitamin and mineral premix contain: vitamin A 12000000 IU, vitamin D3 5000000 IU, vitamin E 50000 mg, vitamin K3 3000 mg, vitamin B1 2000 mg, vitamin B2 8000 mg, vitamin B6 3000 mg, vitamin B12 15 mg, biotin 120 mg, Choline Chloride 400000 mg; folic acid 2000 mg, pantothenic acid 12000 mg, manganese 100000 mg, zinc 100000 mg, iron 40000 mg, copper10000 mg, iodine 1000 mg, selenium 200 mg and cobalt 100 mg. **ME= Metabolic Energy, DCP = Di-calcium phosphate

Table (2): Composition and calculated analysis of experimental grower-finisher diets offered to broiler chickens from 21 to 35 days of age.

Ingredients %	Grower diet from 21 to 35 days								
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
Yellow corn	595.15	597.15	597	580	578.8	578.55	561	560.36	560.11
Soybean meal 47%	315.00	315.50	315.40	316.72	316.72	316.72	314.86	315.00	315.00
Glutein, 60%	18	18	18	18.8	19	19	23	23	23
Vegetable oil	34.0	34.0	34.0	39.5	40.0	40.0	46.0	46.0	46.0
DCP	15.5	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Limestone	11.0	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
Premix*	3	3	3	3	3	3	3	3	3
L-lysine	0.75	0.75	0.75	0.78	0.78	0.78	0.85	0.85	0.85
DL–methionine	2.25	2.25	2.25	2.35	2.35	2.35	2.44	2.44	2.44
Salt	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Bicarbonate	1	1	1	1	1	1	1	1	1
Anti-toxin	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
Anti-coccidian	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Choline	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Enzymes energy	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Clinoptilolite	0	0	0	10	10	10	20	20	20
Phytase	0	0.500	0.750	0	0.500	0.750	0	0.500	0.750
Total	1000	1000	1000	1000	1000	1000	1000	1000	1000
Calculated composition									
Crude protein %	21.15	21.15	21.15	21.14	21.14	21.14	21.13	21.14	21.13
Calcium %	0.96	0.96	0.96	0.98	0.98	0.98	0.99	0.99	0.99
T. Phosphorus %	0.77	0.65	0.67	0.63	0.65	0.67	0.63	0.65	0.67
ME kcal/kg	3190	3194	3194	3192	3190	3191	3187	3187	3187

*Each 3 kg of vitamin and mineral premix contain: vitamin A 12000000 IU, vitamin D3 5000000 IU, vitamin E 50000 mg, vitamin K3 3000 mg, vitamin B1 2000 mg, vitamin B2 8000 mg, vitamin B6 3000 mg, vitamin B12 15 mg, biotin 120 mg, Choline Chloride 400000 mg; folic acid 2000 mg, pantothenic acid 12000 mg, manganese 100000 mg, zinc 100000 mg, iron 40000 mg, copper10000 mg, iodine 1000 mg, selenium 200 mg and cobalt 100 mg. **ME= Metabolic Energy; DCP = Di-calcium phosphate.

Table (3): Effect of (Mean ± SE) different natural Zeolite (Z) and phytase enzyme (Ph) levels and the combination between them on productive performance body weight (BW), feed consumption (FC), feed conversion ratio (FCR) of (Ross 308) broiler chickens at 35 days of age.

Traits	Productive performance		
	Body weight (BW) g	Feed consumption (FC) g	Feed conversion ratio (FCR)
Effect of Zeolite			
Z 0	1871.6^{b}	3331.7^{a}	1.82^{a}
Z 1%	1884.5^{a}	3315.2^{ab}	1.80^{b}
Z 2%	1892.1^{a}	3307.0^{b}	1.79^{c}
SEM	10.48	18.90	0.03
P-value	0.001	0.040	0.001
Effect of phytase			
Ph 0	1876.9^{b}	3320.2	1.81^{a}
Ph 500	1895.7^{a}	3307.2	1.78^{b}
Ph 750	1875.9^{b}	3326.5	1.81^{a}
SEM	11.84	20.14	0.05
P-value	0.001	0.162	0.001
Effect of interaction			
T1	1856.9^{f}	3340.8	1.84^{a}
T2	1886.9^{bc}	3319.7	1.80^{b}
T3	1871.1^{e}	3334.6	1.81^{b}
T4	1884.2^{bc}	3313.7	1.80^{b}
T5	1888.9^{b}	3306.3	1.79^{b}
T6	1880.5^{cd}	3325.5	1.81^{b}
T7	1889.6^{b}	3306.1	1.79^{b}
T8	1910.8^{a}	3295.5	1.76^{c}
T9	1876.1^{cd}	3319.5	1.81^{b}
SEM	13.55	16.88	0.02
P-value	0.001	0.923	0.018

$^{a,b,c,...}$Means in the same column followed by different letters are significantly different at P≤0.05

SEM, Standard error of mean; T1, fed basal diet as control; T2, phytase enzyme 500 mg/Kg diet; T3, phytase enzyme 750 mg/Kg diet; T4, natural Zeolite Clinoptilolite 10 g/Kg diet; T5, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 500 mg/Kg diet; T6, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 750 mg/Kg diet; T7 natural Zeolite Clinoptilolite 20g/Kg diet; T8 natural Zeolite Clinoptilolite 20 g/Kg + phytase enzyme 500 mg/Kg diet; T9 natural Zeolite Clinoptilolite 20 g/Kg + Phytase enzyme 750 mg/Kg diet.

Table (4): Effect of (Mean ± SE) different natural Zeolite (Z) and phytase enzyme (Ph) levels and the combination between them on haematological parameters of (Ross 308) broiler chickens at 35 days of age.

Traits	Haematological parameters					
	RBCs (10^6/ml)	**HB (g/dl)**	**PCV (%)**	**MCV (fL)**	**MCH (pg)**	**MCHC (g/dl)**
Effect of Zeolite						
Z 0	4.98	10.91	32.39	65.03	21.90	34.10
Z 1%	5.10	11.14	32.87	64.48	21.86	33.91
Z 2%	5.23	11.29	33.17	63.39	21.59	34.02
SEM	0.09	0.67	2.40	3..27	1.10	1.58
P-value	0.167	0.306	0.390	0.092	0.945	0.901
Effect of phytase						
Ph 0	5.07	10.97	32.18	63.52	21.66	34.10
Ph 500	5.17	11.25	33.34	64.46	21.74	33.73
Ph 750	5.07	11.12	32.91	64.91	21.93	33.78
SEM	0.09	0.17	0.40	1.27	1.10	0.58
P-value	0.632	0.536	0.135	0.638	0.904	0.851
Effect of interaction						
T1	4.89	10.76	31.50	64.42	22.00	34.16
T2	5.06	11.02	32.86	64.94	21.78	33.54
T3	4.99	10.94	32.80	65.73	21.92	33.35
T4	5.10	11.00	32.42	63.57	21.57	33.93
T5	5.14	11.32	33.56	65.29	22.02	33.73
T6	5.05	11.11	32.62	64.59	22.00	34.06
T7	5.21	11.16	32.62	62.61	21.42	34.21
T8	5.32	11.40	33.60	63.16	21.43	33.93
T9	5.17	11.30	33.30	64.41	21.86	33.93
SEM	0.157	0.30	0.70	2.21	1.91	1.02
P-value	0.988	0.987	0.944	0.483	0.998	0.969

a,b,c...Means in the same column followed by different letters are significantly different at P≤0.05

SEM, Standard error of mean; T1, fed basal diet as control; T2, phytase enzyme 500 mg/Kg diet; T3, phytase enzyme 750 mg/Kg diet; T4, natural Zeolite Clinoptilolite 10 g/Kg diet; T5, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 500 mg/Kg diet; T6, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 750 mg/Kg diet; T7 natural Zeolite Clinoptilolite 20g/Kg diet; T8 natural Zeolite Clinoptilolite 20 g/Kg + phytase enzyme 500 mg/Kg diet; T9 natural Zeolite Clinoptilolite 20 g/Kg + Phytase enzyme 750 mg/Kg diet.

Table (5): Effect of (Mean ± SE) different natural Zeolite (Z) and phytase enzyme (Ph) levels and the combination between them on haematological parameters of (Ross 308) broiler chickens at 35 days of age.

Traits	Haematological parameters			
	WBCs (10^3/ml)	Lymphocyte (%)	Heterophils (%)	H/ L Ratio
Effect of Zeolite				
Z 0	11.78	37.13	45.47	1.25
Z 1%	11.90	36.87	45.80	1.26
Z 2%	12.04	37.93	47.87	1.27
SEM	0.26	1.18	0.99	0.04
P-value	0.780	0.804	0.194	0.947
Effect of phytase				
Ph 0	11.81	36.33	47.67	1.33
Ph 500	11.97	38.00	45.27	1.20
Ph 750	11.93	37.60	46.20	1.25
SEM	0.26	1.18	0.99	0.04
P-value	0.903	0.588	0.240	0.184
Effect of interaction				
T1	11.55	35.60	46.60	1.35
T2	11.77	38.40	44.60	1.16
T3	12.01	37.40	45.20	1.23
T4	11.51	34.60	45.60	1.33
T5	11.99	37.40	44.40	1.20
T6	12.19	38.60	47.40	1.26
T7	12.37	38.80	50.80	1.30
T8	12.16	38.20	46.80	1.25
hT9	11.59	36.80	46.00	1.26
SEM	0.46	2.05	3.71	0.08
P-value	0.555	0.660	0.452	0.944

[a,b,c...]Means in the same column followed by different letters are significantly different at P≤0.05

SEM, Standard error of mean; T1, fed basal diet as control; T2, phytase enzyme 500 mg/Kg diet; T3, phytase enzyme 750 mg/Kg diet; T4, natural Zeolite Clinoptilolite 10 g/Kg diet; T5, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 500 mg/Kg diet; T6, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 750 mg/Kg diet; T7 natural Zeolite Clinoptilolite 20g/Kg diet; T8 natural Zeolite Clinoptilolite 20 g/Kg + phytase enzyme 500 mg/Kg diet; T9 natural Zeolite Clinoptilolite 20 g/Kg + Phytase enzyme 750 mg/Kg diet.

Table (6): Effect of (Mean ± SE) different natural Zeolite (Z) and phytase enzyme (Ph) levels and the combination between them on protein profile (g/dl) of (Ross 308) broiler chickens at 35 days of age.

Traits	Protein profile (g/dl)		
	Total Protein	**Albumin**	**Globulin**
Effect of Zeolite			
Z 0	4.74[b]	2.61	2.14
Z 1%	5.03[a]	2.81	2.22
Z 2%	5.11[a]	2.84	2.27
SEM	0.08	0.09	0.11
P-value	0.006	0.155	0.684
Effect of phytase			
Ph 0	4.77[b]	2.72	2.06[b]
Ph 500	5.15[a]	2.85	2.31[a]
Ph 750	4.96[ab]	2.70	2.26[a]
SEM	0.06	0.04	0.08
P-value	0.007	0.477	0.231
Effect of interaction			
T1	4.53	2.62	1.91
T2	4.98	2.71	2.28
T3	4.72	2.51	2.22
T4	4.87	2.75	2.12
T5	5.17	2.87	2.30
T6	5.04	2.80	2.24
T7	4.92	2.78	2.14
T8	5.29	2.97	2.35
T9	5.11	2.79	2.31
SEM	0.14	0.15	0.98
P-value	0.923	0.990	0.984

[a,b,c,...]Means in the same column followed by different letters are significantly different at P≤0.05

SEM, Standard error of mean; T1, fed basal diet as control; T2, phytase enzyme 500 mg/Kg diet; T3, phytase enzyme 750 mg/Kg diet; T4, natural Zeolite Clinoptilolite 10 g/Kg diet; T5, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 500 mg/Kg diet; T6, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 750 mg/Kg diet; T7 natural Zeolite Clinoptilolite 20g/Kg diet; T8 natural Zeolite Clinoptilolite 20 g/Kg + phytase enzyme 500 mg/Kg diet; T9 natural Zeolite Clinoptilolite 20 g/Kg + Phytase enzyme 750 mg/Kg diet.

Table (7): Effect of (Mean ± SE) different natural Zeolite (Z) and phytase enzyme (Ph) levels and the combination between them on lipids profile (mg/dl) of (Ross 308) broiler chickens at 35 days of age.

Traits	Lipids profile (mg/dl)			
	Cholesterol	Triglyceride	HDL	LDL
Effect of Zeolite				
Z 0	93.20[a]	85.00[a]	35.87	54.93
Z 1%	86.60[ab]	74.60[b]	36.07	53.13
Z 2%	82.60[b]	72.07[b]	35.07	51.27
SEM	3.24	4.68	1.80	1.19
P-value	0.043	0.001	0.653	0.109
Effect of phytase				
Ph 0	93.93[a]	82.07[a]	36.20	56.00[a]
Ph 500	85.20[ab]	75.27[b]	35.87	50.53[b]
Ph 750	83.27[b]	74.33[b]	34.93	52.80[ab]
SEM	6.35	5.94	2.44	4.66
P-value	0.039	0.004	0.521	0.010
Effect of interaction				
T1	102.20	90.00	37.20	60.80[a]
T2	86.00	80.00	34.20	51.40[bc]
T3	91.40	85.00	36.20	52.60[bc]
T4	89.60	77.40b	37.00	56.60[ab]
T5	86.20	75.80	36.60	52.00[bc]
T6	84.00	70.60	34.60	50.80[bc]
T7	90.00	78.80	34.40	50.60[bc]
T8	83.40	70.00	36.80	48.20[c]
T9	74.40	67.40	34.00	55.00[ab]
SEM	5.61	2.90	1.39	2.06
P-value	0.636	0.338	0.296	0.035

[a,b,c,...]Means in the same column followed by different letters are significantly different at P≤0.05

SEM, Standard error of mean; T1, fed basal diet as control; T2, phytase enzyme 500 mg/Kg diet; T3, phytase enzyme 750 mg/Kg diet; T4, natural Zeolite Clinoptilolite 10 g/Kg diet; T5, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 500 mg/Kg diet; T6, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 750 mg/Kg diet; T7 natural Zeolite Clinoptilolite 20g/Kg diet; T8 natural Zeolite Clinoptilolite 20 g/Kg + phytase enzyme 500 mg/Kg diet; T9 natural Zeolite Clinoptilolite 20 g/Kg + Phytase enzyme 750 mg/Kg diet.

Table (8): Effect of (Mean ± SE) different natural Zeolite (Z) and phytase enzyme (Ph) levels and the combination between them on carcass characteristics (%) of (Ross 308) broiler chickens at 35 days of age.

Traits	Carcass characteristics (%)				
	Carcass	**Dressing**	**Edible**	**Liver**	**Heart**
Effect of Zeolite					
Z 0	66.78[b]	71.10[b]	4.52	2.29	0.433
Z 1%	69.73[a]	72.89[b]	4.70	2.47	0.460
Z 2%	70.13[a]	75.33[a]	4.81	2.45	0.479
SEM	2.85	3.77	0.08	0.07	0.02
P-value	0.019	0.002	0.061	0.188	0.243
Effect of phytase					
Ph 0	68.81	73.29	4.59	2.35	0.453
Ph 500	69.16	73.16	4.84	2.49	0.467
Ph 750	68.50	72.87	4.59	2.37	0.447
SEM	3.02	4.02	0.06	0.19	0.24
P-value	0.847	0.964	0.064	0.379	0.694
Effect of interaction					
T1	65.65	69.84	4.50	2.30	0.42
T2	67.10	71.46	4.62	2.30	0.46
T3	67.59	72.00	4.44	2.26	0.42
T4	70.69	74.90	4.58	2.38	0.46
T5	69.03	71.70	4.84	2.58	0.46
T6	68.98	72.08	4.68	2.46	0.46
T7	70.09	75.14	4.70	2.38	0.48
T8	71.36	76.32	5.05	2.60	0.48
T9	68.94	74.54	4.66	2.38	0.46
SEM	1.47	1.33	0.14	0.13	0.03
P-value	0.584	0.441	0.841	0.909	0.930

[a,b,c...]Means in the same column followed by different letters are significantly different at P≤0.05

SEM, Standard error of mean; T1, fed basal diet as control; T2, phytase enzyme 500 mg/Kg diet; T3, phytase enzyme 750 mg/Kg diet; T4, natural Zeolite Clinoptilolite 10 g/Kg diet; T5, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 500 mg/Kg diet; T6, natural Zeolite Clinoptilolite 10 g/Kg + phytase enzyme 750 mg/Kg diet; T7 natural Zeolite Clinoptilolite 20g/Kg diet; T8 natural Zeolite Clinoptilolite 20 g/Kg + phytase enzyme 500 mg/Kg diet; T9 natural Zeolite Clinoptilolite 20 g/Kg + Phytase enzyme 750 mg/Kg diet.

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الملخص العربى

تأثير إضافة الزيولايت الطبيعي مع أو بدون إنزيم الفايتيز في علائق كتاكيت اللحم على مكونات الدم ومواصفات الذبيحة

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هدفت الدراسة لتقييم تأثير إضافة الزيولايت الطبيعي مع أو بدون وإنزيم الفايتيز على مكونات الدم ومواصفات الذبيحة في كتاكيت التسمين، تم استخدام عدد إجمالي 594 كتكوت تسمين (روص 308) في عمر يوم، وزعت بشكل عشوائي إلي تسع مجموعات متساوية بثلاثة مكررات تم تغذية المجموعة الثانية والثالثة على النظام الغذائي الأساسي مضافا إليه 0.05% و0.075% من انزيم الفايتيز (FTU 5000/ جم)، المجموعة الرابعة غذيت بإضافة 1% من الزيولايت طبيعي، المجموعة الخامسة والسادسة غذيت بإضافة 1% من الزيولايت طبيعي و 0.05% و0.075% من إنزيم الفايتيز (FTU 5000/ جم) على التوالي، المجموعة السابعة غذيت بإضافة 2% من الزيولايت طبيعي، المجموعة الثامنة و التاسعة غذيت بإضافة 2% من الزيولايت طبيعي و 0.05% و0.075% من إنزيم الفايتيز (FTU 5000/ جم) على التوالي، و المجموعة الأولى ضابطة بدون أي إضافات. أظهرت النتائج عامة تحسن معنوي في وزن الجسم، معدل التحويل الغذائي في المجموعات المعاملة بالزيولايت الطبيعي وكان أفضل وزن عند إضافة 2% من الزيولايت طبيعي و إنزيم الفايتيز بنسبة 0.05%. كما لوحظ زيادة معنوية في نسبة البروتين الكلي في سيرم الدم مقارنة بمجموعة المقارنة. وأظهرت النتائج أن الزيولايت وكذلك إنزيم الفايتيز لهما تأثير معنوي في خفض تركيز الكوليسترول والدهون الثلاثية. كما لوحظ عند عمر 35 يوم زيادة معنوية في النسبة المئوية للذبيحة والتصافي في المجموعات المعاملة بالزيولايت. عموما يمكن اعتبار أن إضافة الزيولايت الطبيعي مع أو بدون إنزيم الفايتيز الي أعلاف كتاكيت اللحم حسن من الخصائص الفسيولوجية وصورة البروتين والدهون في كتاكيت اللاحم.

الكلمات الدالة: كتاكيت اللحم ، الزيولايت ، الفايتيز ، مقاييس الدم ، خصائص الذبيحة.