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Influence of Dietary Phytase and Multiple Enzymes Supplementations on Growth Performance, Carcass Characteristics and Immune Response in Japanese Quail

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Abstract: This work was conducted to study the effect of dietary phytase and other enzymes supplementation on growth performance, carcass traits, some blood parameters and immune response of Japanese quail. A total of 159 one-day-old quail chicks were used. The quail chicks were randomly allotted into 3 groups (53 unsexed chicks per group). Group 1 was fed on the basal diet (BD) without enzymes supplementation (control), quail chicks of group 2 were fed on the BD supplemented with Amecozyme® at 0.5 g / kg diet. While quail chicks of group 3 were fed BD supplemented with Feedophyte5000 (phytase) at 0.1 g / kg diet. From the obtained results it was observed that, the quail chicks of group 2 showed a significant increase in body weight development throughout the growing period when compared with the control group while, quail chicks of group 3 showed non-significant increase in body weight development throughout the growing period, enzymes supplementation in the diet of quail chicks in group2 and 3 significantly improved total body weight gain, increased total feed intake, decreased FCR when compared with the control group. There was a significant increase in RBCs in group 3 when compared with the quail chicks of control group or quail chicks of group 2. There was a significant increase in HI titer at 7th, 14th, 28th and 42nd days in group 3 which fed the BD with phytase supplementation when compared with the control group. There were no significant differences in phagocytic activity in supplemented enzymes groups (group 2 and 3) and non-supplemented group. While phagocytic activity increased with enzymes supplementation in quail chicks of groups 2 and 3. There was a significant increase in SGPT in quail chicks of group 3 when compared with other enzymes supplementation in group 2 or control group. There was no significant difference between control group and supplemented enzymes groups in SGOT or Alkaline phosphatase levels. While there was a significant increase in Cholesterol and Triglycerides levels in quail chicks of group 3 when compared with control group and a non-significant increase in these parameters when compared with the quail chicks of group 2. . there were no significant difference between control group and supplemented enzymes groups in dressing or other carcass parameters ,while, spleen % and thymus % of quail chicks of groups 2 and 3 increased significantly when compared with the quail chicks of control group.

Keywords: Japanese quail, Phytase, Enzymes, Performance, Immune Response, Blood Parameters, Carcass Quality.

INTRODUCTION

Quail are raised for many reasons; it can be used as one of poultry species for meat and egg production to share in solving the lack of animal protein for human nutrition in several countries. For this, it is important to research for economically meat-producing quail. Japanese quail have become an important laboratory animal because of their small body size, sexual maturity in 6 – 7 weeks, high rate of reproduction and the ability to produce 3 – 4 generation in the year[1].

Phosphorous is an important feed ingredient and is supplied to animals in needed amounts through raw material and added phosphates. Vegetable feeds contain significant amount of this mineral; however, 50-80% of phosphorous is bound in phytates that cannot be broken down by endogenous enzymes in poultry[2]. As a consequence, phosphorous from vegetable sources is poorly digested and cannot meet nutritional requirements of poultry regardless the fact that cereals, leguminous and oilseed plants contain 1-5% phytate. In order to become available to broiler chicks, phosphorous from vegetable sources must be hydrolyzed, with phytase as a catalyst, to inositols and inorganic phosphates which are readily absorbed in digestive tract.[2]

It is nutritionally essential by its several roles in the body, and it is particularly important during growth. However, two thirds of the phosphorus contained in cereal grains and oil seeds are in the form of phytate, which can bind to other nutrients, rendering them unavailable for poultry, thereby, requiring dietary inorganic phosphorus supplementation.[3]

Phytate is a compound that contains bound phosphorus (P) and other minerals, and it is found in most plants, including corn and soybeans[4] . Because corn and soybean meal make up a substantial portion of diets for chickens, much of the P in these diets is unavailable for absorption. Therefore, inorganic P must be supplemented to these diets. Phytase is an enzyme that hydrolyzes the release of P from the phytate molecule.

Addition of exogenous phytase have been reported to improve growth performance, feed intake and feed efficiency of broiler[5-10] , also improve phosphorus digestibility for certain plant based feedstuffs and overall utilization of broiler diet. Moreover, found that phytase supplementation in broiler diet reduces the feed cost and makes broiler production profitable. Moreover, [11] found that Phytase at 500 U/kg had a favorable effect on weight gain of broiler chicks at 3wk and 6wk of age and on feed consumption only at 3 wk and feed efficiency was not affected by addition of phytase. Also Phytase supplementation increased serum AST activity, and reduced serum alanine aminotransferase (ALT)[12].

fed broiler a diet with low and non-phytate phosphorus NPP levels with or without supplemental phytase (500 units Natuphos/kg) and observed that, low dietary NPP significantly decreased body weight gain at 3 weeks of age, Supplemental phytase significantly increased body weight at 6 and 9 weeks of age, low NPP rations had a negative effect on body weight at 7 weeks of age, which was overcome by phytase supplementation. While, carcass yields were not

affected by NPP level; however, leg quarter weights were significantly greater in broilers fed the low NPP plus phytase diet. In the same time, [13] reported that phytase at 500 phytase units (FTU)/kg of feed in broiler diets improved feed intake, BW, feed conversion ratio ($P < 0.05$), and increased the percentages of erythrocyte rosette-forming cells and erythrocyte-antibody complement whereas high dietary phytate depressed bird performance; Increasing the phytase dose to 1,000 FTU/kg did not improve immune function further than 500 FTU/kg. The results suggest that application of phytase in nutritionally marginal diets could enhance lymphocyte numbers suggesting that both phytate and phytase may have a role in immune competence[14] .

Found that, the supplementation of dietary microbial phytase caused a significant ($P<0.05$) increasing in the body weight gain and feed intake, while the effect on feed efficiency and dressing percentage was not significant. Found that the addition of E. coli phytase to P-deficient broilerdiets improves growth, bone, and carcass performance.

Exogenous enzymes, added to the feed or used during feedstuffs processing, have the potential to improve feed efficiency, reduce pollution associated with poultry manure and increase the use of low cost feed ingredients[15, 16], dietary supplementation with a multi-enzyme complex containing nonstarch polysaccharide enzymes and phytase in birds is efficient increasing ($P<0.001$) feed intake of birds and lower ($P<0.05$) feed: gain than the control group[17], No effect of enzyme supplementation on gizzard and liver weights or abdominal fat percentage was observed[18].

The aim of this study is to differentiate between the effect of using phytase enzyme and another enzyme supplementation on the performance, immune response and carcass composition on Japanese quail.

MATEREAL AND METHODS

This work was carried out at Nutrition and Clinical Nutrition Department, Faculty of Veterinary Medicine, Alexandria University to investigate the possible effect phytase and multiple enzymes supplementations on growth performance, carcass traits, some blood constituents and immune response of Japanese quail during the growing period.

Birds: A total of 159 one-day-old Japanese quail chicks were used in this study. They were obtained from a private quail farm at Motobis city (Kafer El-Sheikh govemorate) the quail chicks were randomly allotted into 3 equal groups (53 per each) of mixed sex.

Accommodation and management: The quail chicks were housed in a clean well ventilated room, previously disinfected with formalin. The room was provided with electric heaters to adjust the environmental temperature according to the age of the birds. The room floor was partitioned into 3 partitions 1 square meter, each compartment was bedded by fresh clean wheat straw forming a deep litter of four centimeters depth. The litter was turned over every ten days and removed every 20 days. Feeds and water were supplied ad-libitum.

Prophylactic measures against the most common infectious diseases were carried out by using Colistine sulphate (1g/4 liter water) for Salmonellosis & E.coli infections at the first three days. The chicks were vaccinated against Newcastle disease with different types of Newcastle disease vaccine as presented in table 1.

Experimental design and feeding program: The Japanese quail chicks were randomly allotted into 3 groups; each group of quail (53per each). The ingredient composition and chemical analysis of the (BD) are presented in table, 2. The applied experimental design is presented in table3 .

Evaluation of growth performance: Body weight development (according to and feed intake of quail in different groups were weekly recorded. The weight gain (expressed in grams) was calculated as the difference between two successive body weights; feed conversion ratio and relative growth rate (RGR) according to[22, 6] respectively were calculated.

Immune response measurements:

1. Haemagglutination Inhibition test: Four sets of blood samples were collected from the experimental birds of each group at 14, 24, 33 and 42 days of age. Blood samples was collected without anticoagulant for separation of sera to detect the titer of antibodies against Newcastle disease vaccine using haemaglutination inhibition test as an indicative of the bird's immune response in the different experimental groups. Micro technique of HI test was done according to[18] . Geometric mean titer (GMT) was calculated according to[19].

2. Phagocytic activity (PA) and index (PI): phagocytic activity was determined according to[20].

$$PA = \frac{\text{Macrophages containing yeast}}{\text{Total number of macrophages}} \times 100$$

$$PI = \frac{\text{Number of cell phagocytized}}{\text{Number of phagocytic cell}} \times 100$$

3. Differential leucocytic count: This test was done at the end of growing period as blood film was prepared according to the method described by[21] . The percentage and absolute value for each type of cells were calculated according to[22] .

Table 1. Vaccination program against Newcastle disease of J. quail.

Age (days)	Vaccine	Route of administration
7	Hitchner B1*	Eye Drops
18	Lasota*	Eye Drops
28	Lasota	Eye Drops
36	Lasota	Eye Drops

*Vaccine produced by Intervet Co.

Table 2. Ingredient composition and chemical analysis of the basal diet.

Physical Composition		calculated Analysis	
Ingredients	%	Items	**%**
Yellow Corn, ground	57.97	Moisture	10.76
Soybean (44%)	25.9	CP	24.39
Corn gluten meal	12.4	EE	3.85
MCP[1]	0.8	CF	3.87
Limestone	1.6	NFE	51.63
Common salt	0.4	Ash	5.5
Vitamin and mineral.Premix[2]	0.3	Ca	0.806
Lysine	0.33	Av. P	0.306
Methionine	0.05	ME(Kcal/ kg diet)	2980.8
Anticoccidial [3]	0.1	C/P ratio	122.21
Anticlostridial[4]	0.15		

1= (MCP) = monocalcium phosphate. 2= Vitamin and mineral premix (Heromix) produced by Heropharm and composed of (per 3 kg) vitamin A 12000000 IU, vitamin D3 2500000 IU, vitamin E 10000 mg, vitamin K3 2000 mg, vitamin B1 1000 mg, vitamin B2 5000 mg, vitamin B6 1500 mg, vitamin B12 10 mg, niacin 30000 mg, biotin 50 mg, folic acid 1000 mg, pantothenic acid 10000 mg, manganese 60000 mg, zinc 50000 mg, iron 30000 mg, copper 4000 mg, iodine 300 mg, selenium 100 mg and cobalt 100 mg. 3= Coxistac (produced by Pfizer Co.). 4= Zinc bacitracine. The basal diet was formulated according to [23].

Table 3. Applied experimental design.

Group	Diet	Supplementation(g/Kg diet)	
		Amecozyme®*	**Feedophyte5000®****
1 (Control)	**BD**	**--**	**--**
2	**“”**	**0.5**	**--**
3	**“”**	**--**	**0.1**

*Each on kilo gram contains amylase5500000u, protease 2000000u, B-Glucanase 30000u, lipase 150000u, xylanase 500u, cellulose 15000u.

** It is a 3-phytase (EC3.1.3.8) Myo-inositol-hexaphospate 3-phosphohydrolase, available in concentration of 5000FTU/g.

Blood parameters determination: At the end of the experimental period (6 weeks), blood samples were taken from quails (five birds from each group). Blood samples were left to drop on the side of the tube to prevent destruction of RBCs. Each blood sample was left to coagulate at room temp. Separation of serum was carried out by centrifugation of coagulated blood at 3000 rpm for 10 minutes. The clear serum was transferred carefully to clean and dry vials and kept in deep freezer until analysis for determination of total serum protein, albumin, alkaline phosphatase, total cholesterol, triglycerides, phospholipids, according to[23, 28] respectively, SGPT and SGOT according to[29] and HDL and LDL ***according*** to[30] .

Carcass characteristic: At the end of the experimental period, 5 chicks from each group were randomly selected, fastened for 6 hours and then weighed and slaughtered to complete bleeding and weighed to determine the dressing percentage. Liver, spleen, thymus and bursa were weighed and their relative weights to body weight were calculated. Gizzard, heart and visible fat were weighed[31] .

Statistical analysis: The analysis of variance for the obtained data was performed using **Statistical Analysis System**[32] to assess significant differences.

RESULTS AND DISCUSSION

Growth performance: The effects of dietary supplementation of Amecozyme or Feedophyte5000 on body weight development of J. quail chicks are illustrated in table (4). The analysis of variance of the obtained data at the start of the experiment showed that there was no significant difference in body weight between different experimental groups, while there were differences in body weight development between the quail chicks fed diet supplemented with either Amecozyme at 0.5 g/kg diet in group 2 or Feedophyte5000 at 0.1 g/kg diet in group 3 which began in the second week and more appeared at the end of the experiment.

From the obtained data, it was observed that the quail chicks of group 2 which fed diet supplemented with Amecozyme at 0.5 g/kg diet showed a significant increase in body weight development throughout the growing period while, quail chicks of group 3 which fed on the BD supplemented by Feedophyte5000 at 0.1 g/kg diet showed non-significant increase in body weight development throughout the growing period when compared with the control group (No., 1). The data declared that J. quail chick body weight improved linearly with increasing the supplementation of enzymes in general and with phytase enzyme and these observations are in agreement with those obtained by[5][6][7][9] who concluded that Addition of exogenous phytase have been reported to improve growth performance of broiler. Also the data agree with those obtained[24] who reported that phytase at 500 phytase units (FTU)/kg of feed in broiler diets improved body weight development ($P < 0.05$) .

Table (5) shows the effects of dietary supplementation of Amecozyme or Feedophyte5000 on body weight gain of J. quail chicks. The analysis of variance of the obtained data revealed that enzymes supplementation improved body weight gain in groups 2 and 3 during the growing period when compared with the control group which fed the BD without enzyme supplementation. Enzymes supplementation in the diet of quail chicks in group2 and 3 significantly improved total body weight gain when compared with the control group. The data agree with that of [5, 6, 10] .

The effects of dietary supplementation of Amecozyme or Feedophyte5000 on feed intake, feed conversion ratio (FCR) and relative growth rate(RGR) are illustrated in table 6, 7 and 8 respectively. It is observed that total feed intake increased by enzymes supplementation in group 2 and 3 when compared with the control group, while the total FCR throughout the experiment decreased in quail chicks of group 2 and 3 which fed diet supplemented with enzymes although no difference were observed between the two groups when compared with the control group and theses observation are in harmony with those reported by[13] . From table 8 it is cleared that the total RGR was increased in quail chicks which fed the BD supplemented with phytase or other enzymes supplementation when compared with the quail chicks of control group.

The growth-promoting caused by phytase can be partially attributed to the increased concentrations of myo-inositol, the final product of phytate desphosphorylation and to the release minerals and trace elements from complexes with phytic acid. Similarly, it could also be due to a possible increase of starch digestibility or to an increased availability of protein.

Table 4. Effect of dietary enzymes supplementation on body weight development (g) in different J. quail experimental groups.

Group No.	Age ((Weeks)						
	0	1	2	3	4	5	**6**
1	7.45± 0.01a	22.06± 0.67b	56.13± 1.39b	104.10± 2.18b	149.04± 2.69a	181.13± 2.94b	**200.08± 3.90b**
2	7.47± 0.01a	27.75± 0.49a	65.63± 1.30a	112.12± 1.74a	153.86± 2.20a	191.16± 3.10a	**222.70± 5.00a**
3	**7.43± 0.01a**	**23.57± 0.78b**	**57.67± 1.86b**	**106.07± 2.28b**	**152.69± 2.76a**	**189.07± 3.53ab**	**215.69± 3.79ab**

Values are means ± standard error

Means values with different letters at the same column differ significantly at p = 0.05.

Table 5. Effect of dietary enzymes supplementation on body gain in different J. quail experimental groups.

Group No.	Age ((Weeks)						
	0-1	1-2	2-3	3-4	4-5	5-6	0-6
1	14.61± 0.66b	34.06± 0.79b	47.98± 0.86b	44.94± 0.76a	32.08± 0.71b	18.96± 1.14b	192.63± 3.89b
2	20.28± 0.49a	37.88± 0.83a	46.49± 0.65b	41.74± 0.85b	37.31± 1.42a	31.54± 1.88a	215.23± 4.99a
3	16.13± 0.77b	34.10± 1.11b	48.40± 0.64a	46.62± 0.70b	36.38.± 0.80a	24.53± 1.11ab	208.26± 3.78a

Values are means ± standard error

Means values with different letters at the same column differ significantly at p = 0.05.

Table 6. Effect of dietary enzymes supplementation feed intake (FI/g/Bird) in different J. quail experimental groups.

Group No.	Age ((Weeks)						
	0-1	1-2	2-3	3-4	4-5	5-6	0-6
1	25.54	65.55	109.14	127.95	158.45	176.34	662.97
2	30.86	63.75	101	139	166.4	170	671.01
3	28.1	59.86	103.93	129.32	176.35	173.77	671.33

Values are means ± standard error

Means values with different letters at the same column differ significantly at p = 0.05.

Table 7. Effect of dietary enzymes supplementation on feed conversion ratio (FCR) in different J. quail experimental groups.

Group No.	Age (Weeks)						
	0-1	1-2	2-3	3-4	4-5	5-6	**0-6**
1	1.75	1.64	2.60	2.85	4.94	9.30	**3.44**
2	1.52	1.68	2.17	3.33	4.73	6.15	**3.21**
3	**1.74**	**1.76**	**2.15**	**3.11**	**4.06**	**7.08**	**3.22**

Values are means ± standard error

Means values with different letters at the same column differ significantly at p = 0.05.

Table 8. Effect of dietary enzymes supplementation on relative growth rate (RGR) in different J. quail experimental groups.

Group No.	Age ((Weeks)						
	0-1	1-2	2-3	3-4	4-5	5-6	0-6
1	96.67± 2.16b	95.71± 0.83a	50.60± 0.45b	35.85± 0.68a	19.61± 0.49b	9.68± 0.45b	185.41± 0.25b
2	114.52± 1.11a	80.95± 0.47c	52.62± 0.70b	31.42± 0.47c	20.21± 0.57b	13.26± 0.74a	186.41± 0.29a
3	101.44± 2.39b	83.86± 0.61b	60.30± 1.27a	33.08± 0.54b	25.88± 0.57a	11.93± 0.43a	186.51± 0.21a

Values are means ± standard error. Means values with different letters at the same column differ significantly at p = 0.05

Blood Picture: The effects of dietary supplementation of Amecozyme or Feedophyte5000 on some blood picture of Japanese quail in different groups are shown in table (9). The results regarding RBCs showed that there was a significant increase in RBCs in quail chick of group 3 which fed the BD supplemented with Feedophyte5000 at 0.1 g /kg diet when compared with the quail chicks of control group or quail chicks of group 2 which fed BD supplemented with Amecozyme. While there was no significant difference in WBCs between the quail chicks which fed BD supplemented with enzymes in groups 2 and 3 when compared with the control group. Multiple enzyme supplementation improved Hb% and PCV% when compared with that of quail chicks fed diet supplemented with phytase enzyme alone or that of control group. These results agree with that of [13] who reported that phytase at 500 phytase units (FTU)/kg of feed in broiler diets increased the percentages of erythrocyte rosette-forming cells and erythrocyte-antibody complement.

Table 9. Effect of dietary enzymes supplementation on blood picture {erythrocyte count (RBCs), leucocyte count (WBCs), hemoglobin (Hb) and packed cell volume (PCV) % of Japanese quail groups

Group No.	Items							
	RBCs 10^6		WBCs 10^3		Hb%		**PCV%**	
1	1.29	0.05c	22.10	0.53a	7.60	0.27c	24.90	0.74b
2	1.51	0.05b	21.40	0.56a	10.50	0.34a	30.70	0.56a
3	1.71	0.06a	22.30	0.62a	8.80	0.39b	28.30	1.10a

Hemagglutination Inhibition test (HI) to Newcastle disease vaccine :

Table (10) illustrates the effects of dietary supplementation of Amecozyme or Feedophyte5000 on the results of HI titer to Newcastle disease vaccine. The analysis of variance of the obtained data showed different variations in HI titer at 7^{th}, 14^{th}, 28^{th} and 42^{nd} days that there was a non-significant increase in HI titer in quail chicks of group 2 which fed the BD supplemented with Amecozyme. While it

is observed that there is a significant increase in HI titer at 7th, 14th, 28th and 42nd days in group 3 which fed the BD with phytase supplementation when compared with the control group, and a non-significant increase in quail chicks of group 3 when compared with quail chicks of group 2 which fed the BD with other enzymes supplementations. Multiple enzymes supplementation increased HI titer at 7th, 14th, 28th and 42nd days in comparison with that of the control one. These findings indicate that enzymes supplementation may have a role in improving immune responses in quail chicks. The results agree with[33] who suggested that both phytase may have a role in immune competence.

Table 10. Haemagglutination inhibition (HI) titer of Japanese quail in different experimental groups at 7, 14, 28 and 42 days of the growing period:

Group No.	Days				
	7		14	28	42
1	3.33±	0.33b	4.00± 0.00a	4.33± 0.33b	3.60 0.24b
2	4.67±	0.33ab	4.67± 0.67a	5.33± 0.33ab	4.00 0.63ab
3	5.00±	0.58a	5.00± 0.58a	6.33± 0.33a	5.20 0.49a

Values are means ± standard error

Means values with different letters at the same column differ significantly at p = 0.05.

Phagocytosis and Differential Leukocytic count:

The effects of dietary supplementation of Amecozyme or Feedophyte5000 on phagocytosis and differential leukocytic count are presented in table (11). The analysis of variance of the obtained data cleared that there were no significant differences in phagocytic activity in supplemented enzymes groups (group 2 and 3) and non-supplemented group, while phagocytic activity increased with enzymes supplementation in quail chicks of groups 2 and 3 although there was no significance difference between phytase supplementation in group 3 and other enzymes supplementation in group 2 when compared with the control group. It was noticed that there was no significant difference between supplemented enzymes groups (group 2 and 3) and the control group in differential leucocytic count%.

Effect of enzymes supplementations on serum total protein, albumin and globulin levels:

The effects of dietary supplementation of Amecozyme or Feedophyte5000 on serum total protein, albumin, globulin and albumin/globulin (A/G) ratio of Japanese quail in different groups are illustrated in table (12). It was noticed that, there was no significant difference in serum total protein or albumin between quail chicks fed diet supplemented with enzymes or unsupplemented control group. While serum globulin increased in quail chicks fed diet supplemented with phytase enzyme (group 3) when compared with quail chicks of other groups.

Table 11. Phagocytic activity, phagocytic index and differential leucocytic count% of Japanese quail in different groups at the end of exp

Group No.	Items						
	Phagocytic activity	Phagocytic index	Lymphocyte	Monocyte	Basophile	Eosinophile	Neutrophile
1	23.10 0.50a	1.77 0.05b	45.60 0.37a	1.50 0.17a	7.00 0.33b	9.00 0.39a	36.90 0.72a
2	23.10 0.43a	1.93 0.05a	44.60 0.75a	1.50 0.22a	9.00 0.42a	8.20 0.33a	36.70 0.78a
3	22.20 0.39a	1.82 0.04ab	44.30 1.11a	1.60 0.37a	8.90 0.38a	8.50 0.48a	36.70 1.31a

Table 12. Effect of dietary enzymes supplementation on serum total protein, albumin, globulin and albumin/globulin (A/G) ratio of Japanese quail groups.

Group No.	Items							
	Total protein (g/dl)		Albumin (g/dl)		Globulin (g/dl)		A/G ratio	
1	5.06	0.14a	2.50	0.06a	2.56	0.09ab	0.98	0.03a
2	4.96	0.11a	2.78	0.22a	2.18	0.17b	1.34	0.20a
3	5.14	0.12a	2.52	0.18a	2.62	0.10a	0.97	0.09a

Values are means ± standard error

Means values with different letters at the same column differ significantly at p = 0.05.

Some Blood Serum Parameters:

Table (13) shows the effects of dietary supplementation of Amecozyme or Feedophyte5000 on SGPT, SGOT, alkaline phosphatase, cholesterol, triglycerides, phospholipids, HDL and LDL of Japanese quail in different groups.From the obtained results, it can be noticed that there was a significant increase in SGPT in quail chicks of group 3 which fed the BD supplemented with feedophyte5000 at 0.1 g/kg diet when compared with Amecozyme supplementation in group 2 or control group. From the same table it can be observed that, there is no significant difference between control group and supplemented enzymes groups in SGOT or Alkaline phosphatase levels. While there is a significant increase in Cholesterol and Triglycerides levels in quail chicks of group 3 which fed the BD supplemented with feedophyte 5000 at 0.1 g/kg diet when compared with control group and a non-significant increase in these parameters when compared with the quail chicks of group 2, but there is a non-significant increase in cholesterol level and a significant increase in triglycerides levels in quail chicks of group 2 when compared with control group. From the same table, it can be observed that phospholipids levels increased significantly in quail chicks of group 2 and 3 which fed the BD supplemented with different enzymes when compared with the control group but there is a variation in the effect of supplementation on HDL and LDL levels.

Table 13. Effect of dietary enzymes supplementation on some blood parameters of Japanese quail groups.

Groups	Parameters							
	SGPT (U/100 ml)	SGOT (U/100 ml)	Alkaline phosphatase (U/100ml)	Cholesterol (mg/dl)	Triglyceride (mg/dl)	phospholipids (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
1	64.60 1.03b	73.00 1.38a	12.20 0.73a	199.80 2.24b	193.40 0.98b	104.20 0.80b	42.40 0.81a	96.60 2.14b
2	67.40 0.51b	72.40 0.60a	11.00 0.84a	201.80 1.85ab	201.40 1.36a	115.00 2.30a	36.80 0.86c	107.20 2.15a
3	71.60 1.78a	71.60 1.25a	11.20 0.49a	206.60 2.11a	205.80 2.27a	112.60 4.08a	39.60 0.75b	100.80 1.28b

Values are means ± standard error. Means values with different letters at the same column differ significantly at p = 0.05

Carcass characteristics : the effects of dietary supplementation of Amecozyme or Feedophyte5000 on dressing percent; feather, gizzard, proventriculas, head, heart and visible fat percent of Japanese quail in different groups at the end of experimental period are summarized in table (14).

From the obtained data, it can be noticed that there was no significant difference in dressing percent; feather, gizzard, Proventriculas, head, heart and visible fat percent between all experimental groups. But there is a numerical improvement in dressing percent in quail chicks of groups 2 and 3 which fed diet supplemented with Amecozyme or Feedophyte5000 when compared with the quail chicks of control group. The results agree with that of[18] who observed that No effect of enzyme supplementation on gizzard and liver weights or abdominal fat percentage.

Effect of dietary enzymes supplementation on liver, spleen, thymus and bursa (% relative to the live body weight) of Japanese quail groups is showed in table (15). The analysis of variance of the obtained data showed that there was no significant difference in liver % in quail chicks of all experimental groups. While, spleen % and thymus % of quail chicks of groups 2 and 3 which fed BD supplemented with different enzymes increased significantly when compared with the quail chicks of control group. But there is a numerical increase in bursa % in quail chicks of group 2 and 3 when compared with the control group. This indicates that enzymes supplementation may have a role in improving immune responses in quail chicks. The results are in agreement with that of[34] who reported that phytase addition to diets enhanced the bursa weight of 21-d-old Hubbard broilers. Because the bursa is the source organ for B cells, the development of the bursa may induce the proliferation of B cells. Thus, the growth-promoting effect of phytase may be expressed via both nutrient release

and a physiological regulation mechanism; also the results agree with[13] who suggested that both phytase may have a role in immune competence.

Table 14. Effect of dietary enzymes supplementation dressing percent; feather, gizzard, Proventriculas, head, heart and visible fat percent (% relative to the live body weight) of Japanese quail groups.

Group No.	Items						
	Dressing%	Feather %	Gizzard %	Proventriculas	Head %	Heart %	Visible fat%
1	63.04 2.97a	9.90 0.58a	1.43 0.10a	0.37 0.08a	4.44 0.28a	0.81 0.06a	1.00 0.27a
2	66.38 2.91a	9.68 0.58a	1.54 0.11a	0.44 0.02a	4.21 0.17a	0.75 0.00a	1.02 0.33a
3	65.38 2.28a	9.25 1.08a	1.34 0.06a	0.43 0.01a	4.09 0.29a	0.69 0.01a	1.15 0.26a

Values are means ± standard error

Means values with different letters at the same column differ significantly at p = 0.05.

Table 15. Effect of dietary enzymes supplementation on liver, spleen, thymus and bursa (% relative to the live body weight) of Japanese quail groups.

Group No.	Organs			
	Liver	Spleen	Thymus	Bursa
1	2.00 0.22a	0.05 0.00b	0.08 0.01b	0.07 0.01a
2	1.77 0.18a	0.86 0.05a	0.22 0.03a	0.11 0.01a
3	1.95 0.13a	0.77 0.06a	0.32 0.02a	0.11 0.02a

Values are means ± standard error

Means values with different letters at the same column differ significantly at p = 0.05.

CONCLUSION

Amecozyme supplementation in quail chick's diets significantly improved total body weight gain, increased total feed intake, decreased FCR. Phytase supplementation significantly increase in RBCs , SGPT, Cholesterol and Triglycerides HI titer at 7th, 14th, 28th and 42nd days there were no significant difference effect of enzymes.

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