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Effect of Dietary Enzyme Supplementation on Growth Performance of Japanese Quails

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ABSTRACT

A study was performed to evaluate the effect of adding dietary enzyme on performance of Japanese Quails. A total number of two hundred and forty (240) healthy Japanese quails (14 days old) of both sexes were arranged into four dietary groups. The first group of chick was considered as control and fed the basal diet without supplementation of any dietary enzyme; second group was fed basal diet supplemented with 0.5g Kemzyme plus dry®/kg diet, third group was fed basal diet supplemented with 0.1g phytase/kg diet, fourth group was fed on basal diet supplemented with Kemzyme® plus phytase. No significant difference was observed in feed conversion ratio. In the period from 14 to 42 days of age, there was significant ($P<0.05$) increase in body weight body, weight gain, relative growth rate and feed intake of group fed on diet supplemented with kemzyme plus dry® 0.5g/kg when compared with control group.

Key words: Japanese quails; performance; dietary enzyme

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INTRODUCTION

Feeding enzymes to poultry is one of the major nutritional advances in the last fifty years. Indeed, the theory of dietary enzymes is simple. Plants contain some compounds that either the animal can not digest or which hinder its digestive system, often because the animal can not secrete the necessary enzyme to degrade them. Nutritionists can help the animal by identifying these indigestible compounds and feeding a suitable enzyme (Khattak e*t al*., 2006). Non-starch polysaccharides (NSP) comprises about 70-90% of the plant cell wall (Knudsen, 2001), usually undesirable in poultry feeds because they reduce growth performance and nutrient digestibility (Hetland and Svihus, 2001). Moreover, the NSP gel may act as a physical barrier between substrates, enzymes and digestion end-products (Petterson and Aman, 1989). NPS may cause disturbance of intestinal microflora (Preston *et al*., 2001).

Phytate, an anionic acid with strong anti-nutritional properties, has been shown to bind to cations including Ca, Zn, Cu, Pb, Mn, Mg, Co and Fe (Oberleas and Harland, 1996), form complexes with trace minerals and decrease their availability (Ravindran *et al*., 1995), has negative effects on other nutrients and amino acids (Cosgrove, 1969; Okubo *et al*., 1976), form complexes with both dietary and digestive proteins (Satterlee and Abdul-Kadir, 1983) and may influence starch digestibility through interaction with amylase, proteins associated with starch, Ca (which catalyzes amylase activity), or with starch itself (Thompson *et al*., 1987). Gibson and Ullah (1990) reported that phytase is an enzyme that breaks down phytate allowing the release of nutrients bound to phytate and increasing their availability for digestion and utilization. Phytase, on the other hand, was originally used for one express purpose to increase the availability of plant phytate phosphorus, which reduces phosphorus pollution and allows reductions in the amount of inorganic phosphate used.

Enzymes are added to animal ration with the goal of increasing its digestibility, removing antinutritional factors, improving nutrient availability as well as environmental issues. A large number of carbohydrases, proteases, phytases and lipases are used for this purpose (McCleary, 2001). Mixed enzymes might degrade both the soluble and insoluble NSP, increasing the apparent metabolisable energy (AME) contents of the diet and ultimately improving the growth performance of broilers (Tahir *et al*., 2005). Dietary enzyme supplementation has been shown to alleviate osmotic diarrhea by improving nutrient digestion via reduction in the concentration of osmotically active compounds in the gut (Fischer and Classen, 2000). Carbohydrase enzymes have a direct, positive effect on animal performance by improving nutrient digestion and absorption, thereby reducing substrate availability for microbial growth in the ileum (Bedford and Apajalahti, 2001).

MATERIALS AND METHODS

The present study was conducted at the Faculty of Veterinary Medicine, Benha, University to investigate the effect of dietary enzyme supplementation as feed additive to quail chicks on growth performance. Two types of dietary enzymes were used (Kemzyme® plus dry and Phytase). A total of two hundred forty (240) healthy Japanese quails of mixed sexes were randomly arranged into four dietary treatment groups. Each treatment group contained 60 birds which were allotted to three replicates, each replicate contained 20 birds. The first group of chick was considered as control and fed the basal diet without supplementation of any dietary enzyme, while the other three groups were fed on the basal diet supplemented with dietary enzyme as described in Table 3. Feed and water were provided *ad libitum*. Nutrient requirements of the rations were determined according to National Research Council (NRC, 1994). For each group, body weight and feed consumption at 14, 21, 28, 35 and 42 days of age was recorded. Gain in body weight and feed conversion, protein efficiency ratio, relative growth rate values were calculated. Data obtained throughout the trial were analyzed using SPSS version 10 (2000) pocket programme and differences between the averages were tested with Duncans multiple-range test (Duncan, 1955).

Table 1: Ingredients of the basal diets used in the experiment which contain 2900 kcal/kg diet

Ingredients	Starter and growing diet
Ground yellow corn	55.03
Soyabean meal (CP 44%)	34.61
Corn gluten meal (CP 60%)	6
Wheat bran	1.36
Lime stone	0.838
Dicalcium phosphate	1.602
Common salt (NaCl)	0.20
DL-Methionine	0.0743
L-lysine	0.085
Vitamin-mineral mix*	0.20
Total	100.00

Vitamin-mineral mixture was composed of: Each 3 kgcontain: Vit. A 12000000 IU, vit. D_3 2000000 IU, vit. E 10000 mg, vit. K_3 2000 mg, vit $B_1$1000 mg, vit. B_2 5000 mg, vit B_6 1500 mg, vit. B_{12} 10 mg, Biotin 50 mg, pantothenic acid 10000 mg, Nicotinic acid 30000 mg, Folic acid 1000 mg, Manganese 60000 mg, Zinc 50000 mg, Iron 30000 mg, Copper 10000 mg, Iodine 1000 mg, Selenium 100 mg, Cobalt 100 mg, carrier ($CaCo_3$) add to 3 kg . Vitamin-mineral mixture produced by AGRI-VET 10th of Ramadan city A2, Egypt

Table 2: Proximate chemical analysis of feed ingredients used in the experiment (as fed Basis)

Chemical analysis (%)	Starter and Grower
Moisture	10.29
Dry matter	89.71
Crude protein	23.26
Ether extract	2.41
Ash	4.33

RESULTS AND DISCUSSION

There was significant increase ($P<0.05$) in body weight of group fed Kemzyme plus phytase (T4), and phytase only (T3) when compared with control group at (21th day of age). There was significant ($P<0.05$) increase in body weight of group fed on diet supplemented with Kemzyme® plus phytase (T4) when compared with control group at (28th and 35th day of age). There was significant ($P<0.05$) increase in body weight of group fed on diet supplemented with Kemzyme plus dry® (T2) when compared with control group at (42th day of age). Results indicated that growth of Japanese quails fed dietary Kemzyme plus dry® at 0.5g/kg diet (T2) was better than other group especially on the last week of finishing period. This improvement in body weight for Japanese quails fed dietary enzyme supplemented diet may be attributed to improvement in nutrient extraction in the small intestine by the host through accelerated digestion and reduced microbial activity (Apajalahti *et al*., 1995; Bedford and Apajalahti, 2001), overcome some of the reasons for poor starch digestion (Classen, 1996), significant improvement in chicks apparent metabolizable energy (Marquardt *et al.,* 1996; Kocher *et al*., 2003), minimize the growth suppression associated with the *C. perfringens* challenge and elimination of the nutrient-encapsulating effect of the cell wall polysaccharides (Jia *et al*., 2009). The negative effects of NSP and phytates in poultry can be alleviated by adding dietary enzymes degrading those compounds (Choct, 2006) and enzymatic supplementation can reduce environmental problems (Hana *et al.,* 2010). These results could be in agreement with Pourreza1 *et al*. (2007) and Greenwood *et al*. (2002) who found that enzyme supplementation improved body weight. Mondal *et al*. (2007) found that the body weight of the broilers fed the control and low phosphorus plus phytase diet were heavier.

Concerning body weight gain, Table 5 showed the effect of dietary enzyme supplementation on body weight gain of Japanese quails. The analysis of variance of the obtained data at the first week (14-21 day) revealed that there was significant ($P<0.05$) increase in the quail group fed phytase supplemented diet at level 0.1g/kg diet (T3) and group fed on diet supplemented with Kemzyme® plus phytase (T4) when compared with control group. At the 21-28day, there was insignificant difference in body weight gain (BWG) of quail chicks of all dietary treatment when compared with control group. At the 4th week, (35-42 day) there was significant ($P<0.05$) increase in BWG of quail fed diet supplemented with Kemzyme plus dry® (T2) when compared with control group which received basal diet. From obtained results, at the end of experiment (14-42days), it was observed that there was a significant ($P<0.05$) increase in BWG of (T2) Kemzyme plus dry® 0.5g/kg diet, when compared with control group. Also there was improvement in BWG in quails fed on diet supplemented with Kemzyme® plus phytase (T4) but the best group was that fed diet supplemented with Kemzymeplus dry® 0.5g/kg diet (T2). Concerning with relative growth rate, Table 6 showed the effect of dietary enzyme supplementation on relative growth rate of Japanese quails. From obtained results, in the period (14-42days), it was observed that there was a significant ($P<0.05$) increase in relative growth rate of Kemzyme plus dry® 0.5g/kg (T2), also there was improvement in relative growth rate in quails fed on diet supplemented

Table 3: Enzymatic treatment of the experiment

Groups	Number of birds	Diets	Supplemented levels of dietary enzyme(g /kg diet)	
			Kemzyme plus dry	Phytase
T1	60	Basal diet	-------	-------
T2	60	Basal diet	0.5 g Kemzyme® /Kg diet	-------
T3	60	Basal diet	-------	0.1 gPhytase /Kg diet
T4	60	Basal diet	0.5 g Kemzyme® /Kg diet	0.1 gPhytase /Kg diet

Table 4: The effect of dietary enzyme supplementation on body weight changes (g) of Japanese chicks (Means ± SE)

Age (day)	T1	T2	T3	T4
14	53.62±0.12[a]	53.58±0.13[a]	53.31±0.63[a]	53.41±0.089[a]
21	97.32± 0.90[b]	99.44±1.04[ab]	100.81±0.07[a]	100.70±0.77[a]
28	132.12± 1.44[b]	137.15±1.35[ab]	134.10±2.45[ab]	138.90±1.79[a]
35	167.4± 3.07[c]	178.49±1.34[ab]	172.07±1.92[bc]	180.03±2.08[a]
42	194.77± 4.22[b]	215.37±6.27[a]	196.70±0.82[b]	205.4±1.75[ab]

[a, b, c] Mean values having different letters in column differ significantly (P<0.05)

Table 5: The effect of dietary enzyme supplementation on body weight gain (g) of Japanese quails chicks (means ± SE).

Age (day)	T1	T2	T3	T4
14-21	43.7± 0.7[b]	45.86±1.17[ab]	47.16 ±0.25[a]	47.28±0.84[a]
21-28	34.80± 0.54[a]	37.71±1.22[a]	33.29±2.38[a]	38.19±1.24[a]
28-35	35.27± 2.46[a]	41.34±0.41[a]	37.96± 1.84[a]	41.13±3.81[a]
35-42	27.37± 1.82[b]	36.87±4.98[a]	24.63±1.10[b]	25.36± 1.98[b]
14-42	141.15± 4.17[b]	161.78±6.37[a]	143.38 ±0.24[b]	151.98±1.69[ab]

[a, b, c] Mean values having different letters in column differ significantly (P<0.05)

Table 6: The effect of dietary enzyme supplementation on relative growth rate (%) of Japanese quails (means ± SE)

Age (day)	T1	T2	T3	T4
14-21	57.89±0.64[b]	59.92±1.17[ab]	61.19 ±0.60[a]	61.35±0.82[a]
21-28	30.33±0.17[a]	31.87± 0.99[a]	28.30 ±1.71[a]	31.86±0.77[a]
28-35	23.52±1.40[a]	26.19±0.35[a]	24.81± 1.32[a]	25.78±2.37[a]
35-42	15.09± 0.86[ab]	18.63±2.17[a]	13.36± 0.70[b]	13.16 ±1.05[b]
14-42	113.60±1.39[b]	120.21±1.96[a]	114.70±0.52[b]	117.43±0.47[ab]

[a, b, c] Mean values having different letters in column differ significantly (P<0.05)

Table 7: The effect of dietary enzyme supplementation on feed intake (g) of Japanese quails (means ± SE)

Age (day)	T1	T2	T3	T4
14-21	165.70±2.21[a]	166.71±2.88[a]	164.81±4.64[a]	166.16±0.98[a]
21-28	179.61±3.00[b]	203.11±2.47[a]	179.45±9.47[b]	185.31±1.68[b]
28-35	148±3.75[b]	170.86±2.10[a]	153.76±0.60[b]	168.85±6.2[a]
35-42	179.37±8.61[b]	206.63±3.76[a]	167.35±2.46[b]	190.87+10.09[ab]
14-42	672.68±10.05[c]	747.33±6.47[a]	665.38±6.66[c]	711.20+14.92[b]

[a, b, c] Mean values having different letters in column differ significantly (P<0.05).

Table 8: The effect of dietary enzyme supplementation on feed conversion ratio of Japanese quails (means ± SE)

Age (day)	T1	T2	T3	T4
14-21	3.79±0.022[a]	3.63 ±0.12[a]	3.67±0.14[a]	3.51 ±0.061[a]
21-28	5.16 ±0.15[a]	5.39±0.19[a]	5.4± 0.22[a]	4.85± 0.11[a]
28-35	4.21 ±0.18[a]	4.13± 0.12[a]	4.07± 0.21[a]	4.15 ±0.29[a]
35- 42	6.62±0.60[a]	5.78± 0.69[a]	6.82± 0.33[a]	7.63±0.83[a]
14-42	4.77±0.11[a]	4.63±0.14[a]	4.64± 0.043[a]	4.67±0.054[a]

[a, b, c] Mean values having different letters in column differ significantly (P<0.05).

Table 9: The effect of dietary enzyme supplementation on protein efficiency ratio of quail chicks (means ± SE)

Age (day)	T1	T2	T3	T4
14-21	1.12 ±0.0064[b]	1.17 ±0.038[ab]	1.21±0.025[a]	1.22±0.014[a]
21-28	0.82±0.024[a]	0.79 ±0.029[a]	0.79± 0.033[a]	0.87± 0.021[a]
28-35	1.01±0.044[a]	1.03± 0.023[a]	1.05± 0.055[a]	1.03 ±0.071[a]
35-42	0.65 ±0.058[a]	0.75± 0.089[a]	0.62± 0.032[a]	0.57±0.061[a]
14-42	0.894 ±0.02[a]	0.922±0.028[a]	0.919± 0.0087[a]	0.911± .01[a]

[a, b, c] Mean values having different letters in column differ significantly (P<0.05).

with Kemzyme® plus phytase (T4) but the best group was that fed diet supplemented with Kemzyme plus dry® (T2) 0.5g/kg diet. This improvement may be attributed to that enzyme supplementation reduced intestinal viscosity improved feed intake, nutrient availability and digestibility. Enzyme supplementation decreases retention time of digesta in the gut, allowing more consumption and therefore improve growth (Mikulshi *et a.,*1998; La´zaro *et al*., 2003), increase in the diffusion rates of nutrients and endogenous enzymes enabling the bird to digest and absorb more nutrients and breakdown of water-soluble Non-starch polysaccharides (NSPs) into oligo and monosaccharides (Pawlik *et al*., 1990). The addition of enzyme is effective to overcome antinutritive effect of NSPs on poultry performances (Alam *et al*., 2003). Feed enzymes have the ability to alter the bacterial population that colonize the tract and increase the quantity of amino acid in the pre cercal section of the tract (Bedford, 1997) which result in enhanced weight gain of the birds. The enhanced weight gain of the birds on enzymatic diets compared to the birds fed unsupplemented diets suggests that exogenous enzyme supplementation could improve growth in chickens. Response to enzymes could be due to hydrolysis of NPS and consequent elimination of the negative effects of those polysaccharides on chicks. This may have resulted in greater digestion and absorption of nutrients within the small intestine (Onu*et al*., 2011). Finally exogenous enzymes supplementation has been proved to improve nutritional value of feed and decrease environmental pollution (Annison, 1993; Bdeford, 1995; Classen, 1996; Gdala *et al*., 1997).

These results could be in agreement with Zhengkang, (1997) La´zaro, *et al*. (2003) and Hana *et al*. (2010) who found that enzyme supplementation to the diet result in improvement of the body weight gain. When concerning with relative growth rate, the obtained result was supported by Hajati *et al*. (2009) who stated that enzyme supplementation significantly increased relative growth. Also Mikulshi *et al.* (1998) and Jia *et al*. (2009) reported that dietary enzyme result in faster growth rate of broilers. The effect of dietary enzyme supplementation on feed intake is demonstrated in Tables 7. From the obtained result there was significant ($P<0.05$) increase in feed intake in group supplemented with Kemzyme plus dry® 0.5g /kg diet (T2) group, while other treatment groups showed insignificant increase in feed intake when compared with control in the period from 14-42day. These result explained by La´zaro *et al*. (2003) who reported that enzyme supplementation decreases retention time of digesta in the gut, allowing more consumption of feed. The obtained results are in agreement with findings of Alam *et al*. (2003) and Pourreza1 *et al*. (2007) who found that dietary enzyme supplementation increased feed intake. However, these results disagree with Samarasinghe*et al.* (2000), Arumbackam *et al*. (2004) and Hana *et al.* (2010) who found that enzyme supplementation had no significant effect on feed intake of birds.

From the obtained result there was improvement in feed conversion ratio in all groups supplemented with dietary enzyme when compared with control in the period from 14-42day. The improvement of FCR may be due to improvement of energy availability in diet (Kidd *et al*., 2001). These result were supported by other reports (Zhengkang, 1997; Zou *et al*., 2006; Pourreza1 *et al*., 2007; Youssef *et al*., 2011; Onu*et al.,* 2011) who found that enzyme supplementation improved feed conversion ratio of broilers. Also these results agreed with Ghasemi *et al.* (2006) reported that phytase supplementation improved feed conversion ratio. From the obtained result, there was insignificant increase in protein efficiency ratio (PER) in all groups supplemented with dietary enzyme when compared with control in the period from 14-42 day. We can suggest that dietary enzyme supplementation may improve PER. These results are in agreement with Boling-Frankenback *et al.* (2001) indicated that no effect of phytase supplementation on the PER of soybean meal (SBM), corn gluten meal, canola meal, casein, cottonseed meal, peanut meal, wheat bran, wheat middlings, rice bran, defatted rice bran, or meat and bone meal in chicks, but disagree with Hajatiet al.(2009) stated that adding enzyme significantly increased protein efficiency from 29-44 d of age ($P<0.05$).

Conclusion

From the results, it can conclude that adding enzyme to corn-soybean diet can improve Japanese quail's performance. Japanese quails fed on diet supplemented with kemzyme plus dry® at 0.5g/kg diet was better than other group.

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