Caecal enzyme status of quails fed diets supplemented with commercial enzyme preparation

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The present study was conducted to evaluate the effect of feed grade enzyme supplementation in diets with varying levels of energy on the caecal enzyme activity of Japanese quails. Day- old Japanese quails, 504 in number, were subjected to 6 dietary treatments with 6 replicates at each treatment. Each replicate had 14 chicks. The dietary treatments consisted of 3 energy levels i.e. 12.15 MJ (2900 kcal), 11.30 MJ (2700 kcal) and 10.48 MJ (2500 kcal) ME kg^{-1} diet and 2 enzyme levels (0 and 50 g 100 kg^{-1} diet). At the end of 5 weeks of age, 20 quails (10 of each sex) per treatment were sacrificed for collection of caecal contents and those of two quails of similar sex were pooled for analysis. The caecal contents were collected, processed and analyzed for different enzyme activities. Commercial feed grade enzyme preparation contained ß- glucosidase, 35132± 216; ß- D-xylanopyrosidase, 98466±481; xylanase, 2202±58; CM cellulase, 1906±12.5; FTPase (filter paper degrading activity), 397±4.6; and amylase 5773±51 mIU g^{-1} preparation. The Caecal contents contained contained ß- glucosidase, 2953±223; ß- D-xylanopyrosidase, 13369±1077; xylanase, 274±7.6; CM cellulase, 188±18; FTPase, 290±27; and amylase 920±66 mIU g^{-1} of caecal contents. The results indicated that the activities of all these enzymes increased with the lowering of the energy level and also on enzyme supplementation except that of amylase where at lowest energy level, lower activity was observed. It can be concluded that the enzyme supplementation in feed led to a higher enzyme activity in caecum of quails and also the activity of polysaccharidases was enhanced with the increasing of substrate (fibre) due to lowering of energy levels.

Keywords: quails; feed grade enzymes; energy levels; caecal enzyme activity

Introduction

In the past few decades, the use of feed grade enzymes as supplements in the diet of chickens especially broilers has expanded dramatically. Most of the researchers have concentrated on the destruction of gel-form polysaccharides leached from cereal cell walls in amounts sufficient to depress performance (Annison and Choct, 1991; Bedford, 1993; Chesson, 1993). However, the main beneficial effects of added enzymes have been due to disruption of intact cell walls and release of entrapped nutrients, rather than reduced viscosity. The nutrient consistency and digestibility of corn soy-based poultry diets have generally been considered as high. However, recent studies indicate that there is room for improvement. Exogenous enzymes have been used commercially for a number of years to improve nutrient digestibility in corn/soy-based diets and to supplement the bird's developing endogenous enzymes but with contradictory results. Scanty information is available on the use of feed grade mixed enzymes in maize-soy based diet of Japanese quails. Further, since the microbial activities of caeca of chicken / quail are not very prominent in the nutrient utilizing ability, not much work has conducted in this aspect. The present work was carried out to explore the possibility of both the dietary energy levels as well the influence of enzyme supplementation on the caecal enzyme activity of Japanese quail.

Materials and method

Day-old Japanese quails with mean body weight of 8.63±0.037g, 504 in number, were subjected to 6 dietary treatments with 6 replicates at each treatment. Each replicate had 14 chicks. The chicks were housed in battery cages with identical housing and management conditions. Six dietary treatments (Table 1) were prepared consisting three levels of energy viz.12.15 MJ (2900 kcal), 11.30 MJ (2700 kcal) and 10.46 MJ (2500 kcal) ME kg^{-1} diet and 2 enzyme levels (0 and 50 g 100 kg^{-1} diet). At the end of 5 weeks of age, 20 quails (10 of each sex) per treatment were sacrificed for collection of caecal contents and those of two quails of similar sex were pooled for analysis. The caecal contents were collected, processed and analyzed for different enzyme activities. The enzyme preparation and caecal contents were analyzed for different enzyme activities viz. ß- glucosidase, ß- D-xylanopyrosidase, xylanase, CM cellulase, FTPase (filter paper degrading activity), and amylase following standard methods (Sastry *et. al*., 1999). Data were subjected to statistical analysis employing two-way analysis of variance for completely randomized design (Snedecor and Cochran (1989) and tested for statistical significance among the dietary treatment means using Duncan's multiple range tests.

Table 1. Ingredient (%) and nutrient composition of experimental diets

Ingredient	**Dietary group**		
	D1&D2	**D3&D4**	**D5&D6**
Maize	62	48	34
Soybean meal	28	25.5	23
DORB	1.7	18.2	34.7
FM	6	6	6
Lime stone	1	1	1
Constant *	1.3	1.3	1.3
Total	100	100	100
Nutrient composition (on DM basis)			
ME***, kcal kg^{-1}	2903	2704	2505
ME***, MJ kg^{-1}	12.15	11.30	10.48
CP**,%	23.0	23.0	23.0
Crude-fibre**, %	3.40	4.93	6.45
Lysine**,%	1.35	1.3	1.26
Methionine**,%	0.45	0.44	0.42
Met+cys**,%	0.73	0.62	0.51
Thr**,%	0.82	0.71	0.61
Arg**,%	1.48	1.3	1.13
Phe**,%	1.14	0.99	0.84
Ca**,%	1.18	1.18	1.18
P, avail***,%.	0.52	0.58	0.65

*Constant includes DCP, 1.0; trace mineral premix 0.1%; vitamin premix, 0.1% and salt, 0.1%.
Trace mineral premix supplied mg / kg diet: Mg, 300; Mn, 55; I, 0.4; Fe, 56; Zn, 30; Cu, 4.
The vitamin premix supplied per kg diet: Vit. A, 8250 IU; Vit.D_3,, 1200 ICU; Vit. K, 1mg; Vit.E, 40 IU; Vit. B_1, 2mg; Vit. B_2 4mg; Vit.B_{12} ,10mcg; niacin,60mg; pantothenic acid, 10mg; choline, 500mg.
Analysed values * calculated values
D1, D3, D5- without enzyme supplementation
D2, D4, D6- with enzyme supplementation

Results and discussion

The commercial feed grade enzyme preparation contained ß- glucosidase, 35132±216; ß- D-xylanopyrosidase, 98466±481; xylanase, 2202±58; CM cellulase, 1906±12.5; FTPase (filter paper degrading activity), 397±4.6; and amylase 5773±51 mIU g^{-1} preparation. The first part of the study involving growth performance and carcass traits has already been reported (Elangovan *et al*., 2005). Result of growth performance indicated that body weight of quails at 5 weeks of age fed 12.15 (160.8g) and 11.30 MJ ME kg^{-1} diet (161.1g) was higher (P<0.01) than that of those fed diets with 10.48 MJ ME kg^{-1} (154.6g). The enzyme supplementation as well as the interaction of energy levels and enzyme supplementation did not influence the live weight gain. Many of the earlier studies with maize as the major energy source in broilers also did not show any significant effect on enzyme supplementation (Marquardt *et al*., 1994; Irish *et al*., 1995; Marsman *et al*., 1997).

The caecal weight (4.61 – 4.80 % of live weight) and caecal length (6.91 – 7.57 % of live weight) of quails did not differ significantly either due to energy levels, enzyme supplementation or their interaction. The Caecal contents contained ß- glucosidase, 2953±223; ß- D-xylanopyrosidase, 13369±1077; xylanase, 274±7.6; CM cellulase, 188±18; FTPase, 290±27; and amylase 920±66 mIU g^{-1} of caecal content, whereas, in terms of specific activity, the caecal contents contained contained ß-glucosidase, 736±62.9; ß- D-xylanopyrosidase, 3304±294; xylanase, 67.7±2.86; CM cellulase, 46.4±4.81; FTPase, 72.7±7.67; and amylase 232±19.7 mIU mg^{-1} g^{-1} faeces (activity per unit enzyme protein). The activities of all the enzymes increased with the lowering of the energy level and also on enzyme supplementation except that of amylase where at lowest energy level, lower activity was observed (Table 2). In the present experiment, though the amount of fibre increased (3.40 to 6.45%) due to inclusion of de-oiled rice bran (upto 34.5%) with decrease in dietary energy, which in turn led to an increase in caecal enzyme activity but with no positive response of enzyme supplementation in growth performance. Most of the caecal enzyme activity increased with both increase in dietary fibre and enzyme supplementation. This might probably due to increase in the fibre degrading microbes or due to increased production of fibrolytic enzymes, which might have led to the increased caecal enzyme activity. In an earlier work, Francis *et al*. (1999) observed that enzyme supplementation led to significant reduction in colony forming units of salmonella and clostridia species in the caeca of broilers. The benefit of enzyme use has been reported to be likely related to an increase in the rate of diet digestibility and production of short chain sugars (from fiber degradation). With the improvements in diet digestibility, there is a significant change in the substrate quality and quantity available to the intestinal microflora in both the upper and lower gut. Bedford (2001) reported that much of the performance response is thought to relate to the changes in the intestinal microflora, rather than to a direct effect of the enzyme per se on diet digestibility. An increase in the NSP content in the digesta has been demonstrated to influence the gut microflora in a negative manner to birds (Choct *et al*., 1996). The gut microflora contribution in the digestion of fibre is greater in older birds than in younger birds, with the positive effects of enzymes in layers due to active microflora to degrade the NSP solubilized by enzyme action (Choct *et al*., 1995). The study indicates that even caecal enzyme activities can be altered by dietary energy and or enzyme supplementation, but growth performance cannot be altered due to the change in caecal enzyme activities. The main emphasis in future should be targeted on the complete hydrolyses of celluloses and hemicelluloses to individual monosaccharides, which may lead to the increase in AME value.

Table 2 Mean values of enzyme activities (mIU / mg / g caecal contents) in caecal contents of quails fed diets of different dietary energy with enzyme supplementation.

Groups	Amylase	ß-glucosidase	ß- D-xylanopyrosidase	Xylanase	CM cellulase	FTPase
Effect of energy x enzyme						
E_1	189.4	408.4^d	1907^c	62.3^b	11.6^f	30.6^d
E_1+ Enz	244.2	424.2^d	2216^c	57.1^b	20.5^e	26.2^d
E2	302.4	631.2^c	2398^c	63.2^b	43.7^d	78.4b
E2+ Enz	407.0	792.8^b	3471^b	83.9^a	63.6^b	127.6^a
E3	89.8	765.4^b	3363^b	52.3^b	87.1^c	53.7^c
E3+ Enz	157.8	1394.6^a	6474^a	87.6^a	52.1^a	119.5^a
Significance	NS	P<0.01	P<0.01	P<0.01	P<0.01	P<0.01

Effect of energy						
E_1	216.8 [b]	416.3 [c]	2062 [c]	59.7 [b]	16.0 [c]	28.4 [c]
E2	354.7 [a]	712.0 [b]	2935 [b]	73.6 [a]	53.7 [b]	103.0 [a]
E3	123.8 [c]	1080.0 [a]	4918 [a]	69.9 [a]	69.6 [a]	86.6 [b]
Significance	P<0.01	P<0.01	P<0.01	P<0.01	P<0.01	P<0.01
Effect of enzyme						
No enzyme	193.9 [b]	601.7 [b]	2556 [b]	59.2 [b]	35.8 [b]	54.2 [b]
Enzyme	269.7 [a]	870.5 [a]	4053 [a]	91.1 [a]	57.1 [a]	91.1 [a]
Significance	P<0.01	P<0.01	P<0.01	P<0.01	P<0.01	P<0.01
SEM	19.72	62.96	293.8	2.86	4.81	7.67

SEM Standard error (±) of means

Means with the same superscript in the column are not significantly different

E1=12.15 MJ/kg; E_2=11.30 MJ/kg and E_3=10.48 MJ/kg

It can be concluded that the enzyme supplementation in feed led to a higher enzyme activity in caecum of quails and also the activity of polysaccharidases was enhanced with the increasing of substrate (fibre) due to lowering of energy levels.

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