THE EFFECTS OF SUPPLEMENTAL MICROBIAL PHYTASE IN DIETS ON THE GROWTH PERFORMANCE AND MINERAL EXCRETION OF REX-RABBITS

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ABSTRACT

To investigate the effects of supplemental microbial phytase (Natuphos 5000) in diets on performance and mineral excretion, fifty three-month old healthy rex-rabbits with similar weight was assigned randomly into 5 groups for a 6-week trial. Group I-V rex-rabbits were fed with basal diet supplement with 0(I), 400(II), 600(III), 800 U/Kg (IV) phytase and 1.8% $CaHPO_4$ (V) respectively. The basal diet contained normal levels of Ca (0.9%) and total phosphorus (TP) (0.35%), other nutrients and energy levels were close to the rabbit requirements, without phytase and dicalcium phosphate ($CaHPO_4$). The results indicated that: (1) In comparison to negative control of Group I, the average daily gain of Group II, III, IV and V increased by 1.65% ($p<0.05$), 5.77% ($p<0.05$), 11.48% ($p<0.05$) and 5.57% ($p<0.05$) respectively. Among the treatments, the average daily gain in Group IV was the highest, but the difference is not significant when compared with Group III and V ($p>0.05$). However, no significant effect on the average daily feed intake and the feed-gain ratio of rabbits ($p>0.05$) were observed in the dietary phytase experiment. (2) Dietary phytase remarkably reduced the excretion of total phosphorus (TP) and phytate phosphorus (PP), are slightly decreased the excretion of Ca. The excretion of Ca, TP, PP of Group I, II, III, and IV were lower than that in Group V. Compared with Group V, fecal TP decreased by 28.24% ($P<0.01$), 30.59% ($P<0.01$), 42.35%($P<0.01$), 47.00% ($P<0.01$) respectively and it was shown significant difference between Group and ($P<0.05$) fecal PP decreased by 11.1% (P>0.05), 19.4% (P>0.05), 25% (P<0.05), 33.3% (P<0.01), respectively, the forth group was much lower than other three groups (P<0.01) fecal Ca decreased by 14.50% (P>0.05), 9.92% (P>0.05), 12.21% (P>0.05), 19.08% (P<0.05), there were no significant difference between Group II, III, IV and Group I (P>0.05).As the dietary phytase increased, the excretion of Cu increased and the excretion of Zn and Mn were decreased slightly (P>0.05). In addition, it shown no regular varying trend in fecal Fe. In conclusion, the difference of faecal Cu, Fe, Zn, and Mn among treatments were not significant (P>0.05).

Key words: Rex-rabbit, phytase, growth performance, mineral element.

INTRODUCTION

Phytase, a member of phosphoesterase group, can cleave phosphate group from the phytate molecule. It has been shown in literature that supplemental of microbial phytase to diets of pigs and poultry improved the utilization of phosphorus and other minerals. Further studies proved that the addition of phytase increased the growth rate and feed conversion ratio. Moreover, the increased degradation of phytate phosphorus by adding exogenous phytase enables up to 50% reduction in phosphorus excretion, therefore, reduced environmental pollution from pig and poultry production (KORNEGAY *et al*, 1996; PERNEY *et al*, 1993). However, studies related to phytase were mainly focused on the efficacy of microbial phytase in diets of pig, broiler, turkey, laying hens, duck, fish etc., the efficacy of phytase in rex-rabbits is not reported. It has been reported that phytase exited in intestinal striated border of rabbit, but its activity is weak. Therefore the experiment was conducted to determine the effects of supplementing lower phosphorus diet with phytase on the performance and mineral excretion of rex-rabbits. Our results may provide useful data for the application of phytase in rex-rabbits production.

MATERIAL AND METHODS

Experimental Materials and Animals

Phytase purchased from BASF Inc., contains 5,000 FTU/g phytase activity.

Fifty German-American crossbred rex-rabbits age three-month with similar weight were assigned randomly into 5 groups. No significant difference in the initial weight of rex-rabbit among treatments.

Experimental design and composition of the diets

The composition and nutritional level of the basal diets are shown in Table 1. Group I, Ⅱ, III, and Ⅳ were fed with basal diets supplemented with 0, 400, 600 and 800 U/Kg phytase respectively. The desired level of TP in Group V was achieved by the addition of dicalcium phosphate.

Table1. Composition and nutritional values of the basal diet

Ingredients	Percentage (%)	Nutritional	Level
Corn	27	Digestion energy (MJ/kg) *	10.81
Bran	5	Crude protein (%) **	15.77
Soybean meal	14	Crude fibre (%) **	14.01
Peanut stover	24	Ca (%) **	0.91
Yeast	2	Total P (%) **	0.35
Peanut placentiform	9		
Defatted rice bran	18		
Salt	0.5		
Vitamin/mineral premix	0.5		

* Calculated composition ** Measured composition

Experimental methods

The experiment was carried out in Dingzhou rex-rabbit farm for 49 days. After the adjustment period (7 days), rabbits were weighed and randomly placed on treatments groups based on sex and weight. All rabbits had access to diet and water freely. Body weight and diet consumption were recorded weekly on cage basis.
In the last three days of the feeding experiment. Four rabbits in each group, with average body weight, were selected to carry out digestive experiment by using intrinsic indicator methods. Faeces were collected everyday and the combined samples were stored in refrigerator at 0～4℃. The contents of water, Ca, TP, PP, and trace element of faecal samples were analyzed.

Data were subjected to ANOVA analysis using the general linear models procedures of SAS (SAS Institute, 1990). Differences among treatments were assessed using DUNCAN.

RESULTS

Growth performance of rex-rabbits

The experimental results (table 2) showed that in comparison to Group I, the average

daily gain of Group II, III, IV and V increased by 1.65% (p>0.05), 5.77% (p>0.05), 11.48% (p<0.05) and 5.57% (p>0.05) respectively. Among the treatments, the average daily gain in Group IV was the highest, but the difference is not significant when compared with Group III and V (p>0.05). However, no significant effect on the feed-gain ratio of rabbits (p>0.05) were observed in the dietary phytase experiment.

Table 2. Growth performance of rex-rabbits

Treatments	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ
Initial body weight（g）	1730.00 ±95.32	1820.00 ±109.93	1786.20 ±105.20	1801.25 ±108.68	1848.75 ±141.1
Daily gain（g/d）	14.55 ±2.40^{b}	14.79 ±3.17^{b}	15.39 ±3.82^{ab}	16.22 ±4.12^{a}	15.36 ±2.38^{ab}
feed intake (g/d）	95.87 ±12.51	94.80 ±15.92	97.73 ±7.01	105.83 ±7.88	103.50 ±8.15
F/G	6.59	6.41	6.35	6.52	6.74

Superscript letters indicate significant differences（P<0.05）.

Effects of phytase supplementation on mineral excretion of rex-rabbits

The results of dietary phytase experiments were shown in Table 3. The data indicate that the excretion of Ca, TP, PP of Group I, II, III, and IV were lower than that in Group V. Compared with Group V, fecal TP decreased by 28.24%（*P*<0.01）, 30.59%（*P*<0.01）, 42.35%（*P*<0.01）, 47.00%（*P*<0.01） respectively and it was shown significant difference between Group Ⅰ and Ⅳ（*P*<0.05）; fecal PP decreased by 11.1%（P>0.05）, 19.4%（P>0.05）, 25%（*P*<0.05）, 33.3%（*P*<0.01）, respectively, the forth group was much lower than other three groups（*P*<0.01）; fecal Ca decreased by 14.50%（P>0.05）, 9.92%（P>0.05）, 12.21%（P>0.05）, 19.08%（*P*<0.05）, there were no significant difference between Group II, III, IV and Group I (p>0.05). As the dietary phytase increased, the excretion of Cu increased and the excretion of Zn and Mn were decreased slightly（P>0.05）. In addition, it shown no regular varying trend in fecal Fe. In conclusion, the difference of faecal Cu, Fe, Zn, and Mn among treatments were not significant（P>0.05）.

DISCUSSION

Effects of phytase content in diet on growth performance of rex-rabbits

A number of studies have demonstrated that adding moderate proportional microbial phytase to low phosphorus diets significantly improved growth performance of weanling pigs (YOUNG *et al*, 1993), growing pigs (CROMWELL *et al*, 1993), broiler chicks, laying hens

(YI *et al*, 1996; XU *et al*, 1997), and ducks (WANG *et al*, 2000). The results presented here demonstrate that the largest BW gain was obtained with 800 U/kg phytase, but the difference among 600U/kg, 800 U/kg phytase and positive group were not significant. We have concluded that supplement of 600 U/kg phytase is optimal for rex-rabbits based on the growth performance and economy efficiency. Its effect is close to the addition of dicalcium phosphate, but no significant effect on feed intake and feed-gain ratio. Our results are in agreement with the findings by using broiler chickens (SWICK R, *et al.* 1990) and ducking (FARRELL *et al*, 1993).

Table 3. Mineral excretion of rex-rabbits (Based on dry substances)

Treatments	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ
Faecal Ca（%）	1.12 ±0.10^{ab}	1.18 ±0.01^{ab}	1.15 ±0.10^{ab}	1.06 ±0.07^{b}	1.31 ±0.05^{a}
Faecal TP（%）	0.61 ±0.02^{Ab}	0.59 ±0.09^{Ab}	0.49 ±0.02^{Abc}	0.45 ±0.05^{Ac}	0.85 ±0.03^{Ba}
Faecal PP（%）	0.32 ±0.01^{Aab}	0.29 ±0.02^{Abc}	0.27 ±0.01^{Acd}	0.24 ±0.03^{Bd}	0.36 ±0.02^{Aab}
Faecal Cu （mg/kg ）	10.87 ±3.26	11.01 ±4.79	11.25 ±3.85	12.18 ±2.97	10.68 ±2.48
Faecal Fe （mg/kg）	922.31 ±41.49	1005.39 ±84.78	1029.14 ±169.47	977.75 ±58.57	1000.38 ±66.05
Faecal Zn （mg/kg）	142.94 ±13.63	139.06 ±15.37	128.72 ±16.51	119.07 ±23.08	150.04 ±27.43
Faecal Mn （mg/kg）	168.24 ±29.31	170.06 ±22.4	163.42 ±18.97	157.68 ±23.19	162.76 ±28.19

Superscript letters indicate the difference is significant at P = 0.05 level; capitalized superscript letters designate the difference is significant at P = 0.01 level.

Effects of phytase supplementation on mineral excretion of rex-rabbits

In recent years, people are quite cautions about the environmental pollutions derived from metals like N, P, Cu, Zn, As, Se and toxic gas like ammonia, hydrogen sulfide etc. Among them, N and P are probably the most important contaminants. It was demonstrated, in other animals, that diet supplement with microbial phytase can reduce phosphorus excretion (SIMONS *et al*, 1990; KORNEGAY *et al*, 1996; PERNEY *et al*, 1993). CROMWELL *et al* (1991) and SIMONS *et al* (1990) reported that faecal phosphorus excretion of pigs and poultry was reduced 34 ~54% and 40%, by adding phytase in

maize-soyabean-meal diets. The results presented by our experiments is in agreement with the finding list above and further supported the notion that phytase supplementation to rex-rabbits diet can improve the phytase phosphorus utilization by increasing the efficiency and decreasing TP and PP excretion.

Published data regarding the effect of phytase on the other mineral element is scanty. In theory, supplemental microbial phytase can release phosphate bond, at the same time, should release all kinds of mineral elements chelated by phytase. However a few published data against the notion leading to confused conclusions. Some researchers showed that phytase supplementation enhanced the utilization of Zn and Mn (BIEHI *et al*, 1995), but others showed different results (QIAN *et al*,1996). JOHN GOIHLL (1996) reported that supplementing phytase for young pigs increased Ca, P, Mg, Zn, and Cu absorption and retention. But our data indicated that phytase supplementation to rex diets did not affect the excretion of Cu, Fe, Zn, Mn significantly（P>0.05）.

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