Effects of Phytezyme Supplementation on the Growth Performance and Nutrient Digestibility in Growing Pigs

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ABSTRACT : Forty eight Duroc×Yorkshire×Landrace pigs (15.2±0.3 kg average initial BW) were used conducted to evaluate the effects dietary phytase (Phytezyme, WOOJIN, Co. Ltd) supplementation on the growth performance and nutrient digestibility in growing pigs. There were three pigs per pen and four pens per treatment. Treatments were 1) Con (corn-wheat-SBM), 2) PE0.1 (low-P diet+0.1% Phytezyme), 3) PE0.2 (low-P diet+0.2% Phytezyme), 4) PE0.3 (low-P diet+0.3% Phytezyme). During d 0 to 28, average daily gain was not significantly different among the treatments. Pigs fed PE0.3 diet significantly decreased ($p<0.05$) their average daily feed intake compared to pigs fed Con diet. Also, gain/feed in pigs fed PE0.1 and PE0.3 diet was improved ($p<0.05$) compared to pigs fed Con and PE0.2 diet ($p<0.05$). For d 28 to 56, pigs fed PE0.2 diet grew significantly faster ($p<0.05$) than pigs fed Con and PE0.1 diet. Gain/feed was greater ($p<0.05$) for PE0.2 and PE0.3 treatments than for Con. For overall period, average daily gain was increased ($p<0.05$) by the addition of 0.2% Phytezyme compared with Con. Gain/feed was significantly improved ($p<0.05$) by supplementation of PE0.3. Pigs fed PE0.2 showed increased DM and N digestibilities compared to pigs fed other treatments. Supplemented diets PE0.2 and PE0.3 improved ($p<0.05$) the apparent digestibility of Ca and P compared to other treatments. In conclusion, the results obtained from these feeding trials suggest that the Phytezyme supplementation of diets for growing-finishing pigs had improved growth performance and nutrient availability. *(Asian-Aust. J. Anim. Sci. 2001. Vol 14, No. 10 : 1440-1443)*

Key Words : Phytase, Growth Performance, Digestibility, Mineral, Pigs

INTRODUCTION

Early studies indicated that the inclusion of supplemental proteases, α-amylases, β-glucanases, and mixed enzymes may positively influence animal growth performance (Moss et al., 1977; Petersson and Aman, 1989). However, the expense of the enzyme product limits its practical use.

Phytate is the primary storage form of P in most of plant seeds (Cromwell, 1989). Approximately 66% of the P in corn and 61% of the P in soybean meal are in the form of phytate (Nelson et al., 1968). Also, the phytase activity in corn is in general very low. Relatively high intrinsic phytase activity is present in feedstuffs, such as wheat and its by-products (Nelson et al., 1968), and this naturally occurring phytase also improves dietary phytate P utilization by pigs (Pointillart et al., 1984). Inclusion of 10 and 20% wheat bran in the growing and finishing diets, respectively, provided sufficient cereal phytase activity to replace inorganic P supplementation completely from growing to finishing phase (Han et al., 1997). Also, Han et al. (1998) reported that cereal phytase provided by 15% wheat middlings (461 IU cereal phytase/kg) improved phytate-P bioavailability in corn-soybean meal diet.

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Previous investigations indicated that supplemental microbial phytase in the diets for pigs improved the bioavailability of dietary phytate P (Cromwell et al., 1995; Yi et al., 1996; Murry et al., 1997; O'Quinn et al., 1997; Matsui et al., 2000) and other nutrients (Lei et al., 1993a, b; Adeola et al., 1995). Phytezyme is a combination of Phytase 80,000 IU, Amylase 1,050,000 IU, Xylanase 10,000 IU, β-Glucanase 100 IU, Protease 11,000 IU, Lipase 500 IU and *Saccharomyces cerevisae* 2×10^8. Data about the Phytezyme obtained from malt on growth performance and nutrient utilization by pigs are limited.

Therefore, the objective of experiments was to determine the effect of Phytezyme supplementation on the growth performance and nutrient digestibility in growing pigs fed a corn-wheat-soybean meal based diet.

MATERIALS AND METHODS

Forty eight Duroc×Yorkshire×Landrace pigs (15.2±0.3 kg average initial BW) were used in a 56-d growth assay to determine the effects of Phytezyme supplementation on growth performance. The pigs blocked by weight were assigned to treatments based on sex. There were two pens of gilts and two pens of barrows for each treatment, with three pigs per pen.

Dietary treatments included 1) Con (corn-wheat-SBM based diet), 2) PE0.1 (low-P diet+0.1% Phytezyme, WOOJIN. Co. Ltd.), 3) PE0.2 (low-P diet+0.2% Phytezyme), 4) PE0.3 (low-P diet+0.3% Phytezyme).

Phytezyme used in this study was a enzyme mixture (phytase 80,000 IU, amylase 1,050,000 IU, xylanase 10,000 IU, β-glucanase 100 IU, protease 11,000 IU, lipase 500 IU and *saccharomyces cerevisae* 2×10^8). Control diet (table 1) contained 3,350 kcal/kg of ME, 18.7% of CP, 1.0% of lysine, 0.7% of Ca and 0.6% of P. Low-P diet was formulated to contain 3,350 kcal/kg of ME, 18.7% of CP, 1.0% of lysine, 0.6% of Ca and 0.5% of P. All diets were formulated to meet or exceed the nutrient concentrations recommended by NRC (1998) for pigs from 20 to 50 kg, except Ca and P. Chromic oxide was added (0.2% in the diets) as an indigestible marker to allow digestibility determinations.

Pigs were allowed to consume feed and water *ad libitum* from a two-holes self-feeder and cup waterer. Pig weights and feed consumption were measured on d 28 and 56 to determine average daily gain, average daily feed intake and gain/feed. On d 56 of experiment, fecal samples were collected from two pigs per pen by rectal massage, pooled within pen, dried and ground. Laboratory analyses of feed and feces included DM, N, Ca and P (AOAC, 1994) and chromium concentration was determined by spectrophotometry (Shimadzu, UV-1201, Japan).

Table 1. Diet composition for Exp. 1 and Exp. 2 (as fed basis)

Ingredients, %	Control diet	Low-P diet
Corn[a]	55.63	56.44
Wheat	10.00	10.00
Soybean meal (CP 47.5%)	27.07	27.00
Animal fat	2.58	2.25
Molasses	2.50	2.50
Dicalcium phosphate (P 18%)	1.07	0.54
Limestone	0.59	0.70
Salt	0.20	0.20
Vitamin premix[b]	0.12	0.12
Mineral premix[c]	0.10	0.10
Growth promotor[d]	0.10	0.10
Antioxidant (Ethoxyquin 25%)	0.05	0.05
Chemical composition[e]		
ME, kcal/kg	3,350	3,350
Crude protein, %	18.74	18.74
Lysine, %	1.00	1.00
Methionine, %	0.30	0.30
Calcium, %	0.70	0.58
Total phosphorus, %	0.60	0.51
Available phosphorus, %	0.27	0.18

[a] Phytezyme was added in place of corn.

[b] Provided per kg of complete diet: 10,000 IU vitamin A, 2,000 IU vitamin D_3, 42 IU vitamin E, 5 mg vitamin K, 9.6 mg vitamin B2, 2.45 mg vitamin B_6, 40 μg vitamin B_{12}, 27 mg pantothenic acid, 49 mg niacin, 0.05 mg biotin.

[c] Provided per kg of complete diet: 140 mg Cu, 145mg Fe, 179 mg Zn, 12.5 mg Mn, 0.5 mg I, 0.25 mg Co, 04 mg Se.

[d] Provided by 50 mg carbadox per kg of complete diet.

[e] Calculated values.

Data were analyzed as a randomized complete block design using the general linear model prodecure of SAS (1996), with pen as the experimental unit. Duncan's multiple range test (Duncan, 1955) was used to determine significant differences among treatments.

RESULTS

Growth performance of pigs fed experimental diets are presented in table 2. During d 0 to 28, average daily gain was not significantly different among the treatments. Pigs fed PE0.3 diet significantly decreased ($p<0.05$) their average daily feed intake compared to pigs fed Con diet. Also, gain/feed in pigs fed PE0.1 and PE0.3 diet was improved ($p<0.05$) compared to pigs fed Con and PE0.2 diet ($p<0.05$). For d 28 to 56, pigs fed PE0.2 diet grew significantly faster ($p<0.05$) than pigs fed Con and PE0.1 diet. Gain/feed was greater ($p<0.05$) for PE0.2 and PE0.3 treatments than for Con.

Through the entire experimental period, average daily gain was increased ($p<0.05$) by the addition of 0.2% Phytezyme (PE0.2) compared with Con diet. Gain/feed for pigs fed Phytezyme treatment was higher ($p<0.05$) than that of pigs fed Con diet.

Proximate DM and N digestibilities (table 3) for pigs fed Phytezyme treatment were increased ($p<0.05$) compared to pigs fed Con diet. The supplement of 0.2% Phytezyme (PE0.2) improved ($p<0.05$) apparent digestibility of Ca and P compared to other treatments.

DISCUSSION

Our data indicated that dietary supplementation with Phytezyme improved growth performance and phytic phosphorus availability in growing pigs.

Cromwell et al. (1995) reported that responses in growth and bone traits to increasing levels of phytase activity in the low-P diet were linear. The highest level of phytase (1,000 PTU/kg) in the low-P diet restored growth rate and bone strength to levels that approached or met those of pigs fed the adequate P diet.

Cromwell et al. (1993) also estimated that approximately 10 to 15% of the P in corn and approximately 25% of the P in dehulled soybean meal (or approximately 15% of the P in a corn-soybean meal blend) were biologically able to pigs. Thus, of the 0.30 to 0.32% total P in the corn-soybean meal blend, only approximately 0.05% is available P. This is considerably less than the estimated available P requirement of 0.23 and 0.15% for pigs from 20 to 50 kg and from 50 to 110 kg, respectively (NRC, 1998). Also, Veum et al. (1994) demonstrated that the maximum response to added phytase ranged between 800 and 1,200 U/kg of diet for growing pigs fed a canola-sorghum diet

Table 2. Effects of Phytezyme supplementation on growth performance in growing pigs (Exp. 1)[a]

Item	Dietary P				
	Adequate	Low			
	Con	PE0.1[b]	PE0.2[b]	PE0.3[b]	SE[c]
0-28 days					
Average daily gain, g	421	483	441	400	33
Average daily feed intake, g	993[d]	823[dc]	887[de]	753[e]	52
Gain/feed	0.424[f]	0.586[d]	0.497[e]	0.566[d]	0.02
28-56 days					
Average daily gain, g	660[f]	695[ef]	838[d]	795[de]	44
Average daily feed intake, g	1,885[d]	1,674[e]	1,964[d]	1,697[e]	34
Gain/feed	0.350[e]	0.415[de]	0.426[d]	0.469[d]	0.06
0-56 days					
Average daily gain, g	541[e]	589[de]	639[d]	610[de]	30
Average daily feed intake, g	1,439[d]	1,249[e]	1,425[d]	1,225[e]	10
Gain/feed	0.376[e]	0.471[d]	0.448[d]	0.498[d]	0.05

[a] Forty eight pigs with an average initial BW of 15.2±0.3 kg (SD).
[b] Abbreviated PE0.1, PE0.2 and PE0.3 added Phytezyme 0.1%, 0.2% and 0.3%, respectively.
[c] Pooled standard error.
[d,e,f] Means in the same row with different superscripts differ ($p<0.05$).

Table 3. Effects of Phytezyme supplementation on apparent fecal nutrient digestibility of growing pigs

	Dietary P				
	Adequate	Low			
Item, %	Con	PE0.1[b]	PE0.2[b]	PE0.3[b]	SE[c]
Dry matter	83.70[e]	87.53[d]	88.20[d]	87.76[d]	0.30
Nitrogen	77.82[e]	82.96[d]	84.89[d]	83.53[d]	0.50
Calcium	71.66[g]	75.19[f]	81.15[d]	78.36[e]	0.51
Phosphorus	52.85[e]	54.35[e]	61.33[d]	61.24[d]	1.50

[a] Forty eight pigs with an average initial BW of 15.2±0.3 kg (SD).
[b] Abbreviated PE0.1, PE0.2 and PE0.3 added Phytezyme 0.1%, 0.2% and 0.3%, respectively.
[c] Pooled standard error.
[d,e,f,g] Means in the same row with different superscripts differ ($p<0.05$).

with 0.06% available P (0.44% total P). It indicated that the maximum response of added phytase was below or approximately at 1,000 U/kg of diet when included in low-P diets of pigs.

The use of cereal phytase in various feeds may be a more practical alternative than the use of microbial phytase. Pointillart et al. (1984, 1987) showed positive effects of cereal phytase of wheat and triticale on dietary phytate P utilization by pigs, but their experiments lasted for approximately 6 wk, and their diets contained too much (over 80%) wheat or triticlae to be applicable in the swine industry. Also, Han et al. (1997) suggested that cereal phytase in the commonly used dietary levels of wheat bran was also shown to be almost as effective as microbial phytase in improving phytate phosphorus utilization for body weight, but not for bone mineralization from weaning through finishing.

IMPLICATIONS

Supplementing Phytezyme to an corn-wheat-soybean meal diet for growing pigs increased growth performance and nutrients digestibility. The present experiment demonstrates the potential for complete replacement of inorganic phosphorus addition by Phytezyme in diets of growing pigs; a level of 0.2% Phytezyme to maximize performance and nutrient availability.

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