INTERACTIVE EFFECTS OF WHEAT PHOSPHORUS CONTENT AND ENZYMES ON MINERAL DIGESTIBILITY IN WEANER PIGS

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About 70% of total phosphorus (P) and 60% of calcium (Ca) are bound to phytate in wheat (Kim *et al.* 2002; Frolich and Asp, 1985), limiting the amount of P and Ca that is digestible in the gastrointestinal tract. The addition of Ca and P to pig diets is therefore required. Phytic acids are present in the aleurone layers of wheat, indicating a possible association of phytic acids with non-starch polysaccharides (NSP) (Frolich and Asp, 1985) and supplements of phytase and NSP-degrading enzyme may therefore increase P and Ca digestibility in weanling pigs fed a wheat-based diet. The hypotheses tested were 1) wheat P-content will influence mineral digestibility; 2) individual supplementation of xylanase and phytase will increase P and Ca digestibilities; and 3) simultaneous supplementation of xylanase plus phytase will have synergistic effects on P and Ca digestibilities in weanling pigs fed wheats that differ in their P content.

A 2 x 4 factorial experiment was done with the respective factors being wheat (Low-P: 223 mg and High-P: 335 mg/100 g) and enzyme supplementation (no enzyme, xylanase, phytase, and xylanase plus phytase). The enzymes were xylanase and phytase (Porzyme 9300®, minimum activity 4000 U/g endo-1,4-β-xylanase; Phyzyme XP 5000G®, minimum activity 4100 U/g phytase, Danisco Animal Nutrition, UK). The two pre-selected wheats were heat treated before diet manufacture. Eighty male weaner pigs (Landrace x Large White, 5.4 ± 0.07 kg) were fed an identical pre-trial diet for one week and received their respective experimental diet for three weeks, after random allocation based on liveweight. All diets contained 650 g/kg wheat and similar concentrations of calculated digestible energy (14.2 MJ/kg), available lysine (0.78 g/MJ DE), available P (0.32%) and Ca:P (1.46:1). Titanium dioxide (TiO_2) was added as an inert marker. Faecal 'grab' samples were collected for three consecutive days from day 14. Data were analysed using the ANOVA procedure of Statview.

Wheat P-content had no significant effect on mineral digestibility (Table 1). Xylanase improved P digestibility in the High-P wheat but not in the Low-P wheat. Phytase improved P digestibility alone in the Low-P wheat but improved the digestibility of P and Ca in the High-P wheat. However, interactions occurred between the wheat P content and enzyme supplementation, so that xylanase plus phytase did not improve P and Ca digestibility in the Low-P wheat, but did improve P ($P<0.001$) and Ca ($P<0.01$) digestibility in the High-P wheat.

Table 1. Effects of wheat P content (W) and enzyme supplementation (E) on digestibility coefficient (DC) of P and Ca (%) determined with 42-day-old male weaner pigs[1].

Wheat	Low-P wheat				High-P wheat				Pooled	Significance[2]		
Enzyme	No	Xyl	Phy	X+P	No	Xyl	Phy	X+P	SEM	W	E	WxE
DC_P	43.2^{a}	45.9^{a}	56.0^{b}	45.8^{a}	36.8^{a}	42.8^{b}	51.9^{c}	53.2^{c}	7.82	0.21	***	***
DC_{Ca}	59.1^{ab}	59.3^{ab}	61.9^{b}	55.7^{a}	54.8^{a}	59.2^{a}	67.6^{b}	63.2^{b}	7.08	0.12	**	*

[1]Mean digestibility determined from 10 pigs per treatment combination. Values with different superscripts within a row for each wheat are significantly different ($P<0.05$). [2]*$P<0.05$, **$P<0.01$, ***$P<0.001$.

These data indicate that the combined use of xylanase and phytase for P and Ca digestibility might be effective only in wheats having a higher total P-content, and therefore a higher phytate-P level (Kim *et al.* 2002). Phytase alone can enhance the total tract digestibility of P, independent of wheat P-content.

References

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