Effect of Xylanase and (or) Phytase Supplementation on Nutrient Digestibility and Growth Performance of Grower Pigs Fed Wheat-Based Diets Containing Wheat Millrun

T.N. Nortey[*1,2], J.F. Patience[1], P.H. Simmins[3], and R.T. Zijlstra[4]
[1]*Prairie Swine Centre Inc. Saskatoon, SK,* [2]*University of Saskatchewan, Saskatoon, SK*
[3]*Danisco Animal Nutrition, Marlborough, UK,* [4]*University of Alberta, Edmonton, AB*

Summary
The nutritional value of wheat millrun with xylanase and (or) phytase supplementation in wheat based diets for growing pigs was evaluated. Wheat millrun inclusion depressed energy and P digestibility and also ADG, but had not effect on ADFI and G:F. Xylanase and phytase reduced ADFI and improved nutrient digestibility. However, the improved nutrient digestibility did not result in improved growth performance which may be indicative of a nutrient imbalance.

Introduction
Feed cost might be reduced or nutrient intake might be enhanced if nutrients bound by the arabinoxylans and phytate of wheat millrun could be released through enzyme supplementation to a higher extent. This would allow for large inclusion rates of wheat millrun into swine diets, while maintaining growth performance. An increased energy and amino acid digestibility in the small intestine is especially beneficial to the pig, but increased energy digestibility in the large intestine will also be beneficial to improve the energy status. Improved utilization of dietary phosphorus will be beneficial economically, but will also reduce the pressure of swine production on the environment.

Results and Discussion
Ileal and total tract energy digestibility was affected by millrun inclusion, xylanase and phytase addition. Millrun addition reduced P digestibility linearly and phytase and xylanase supplementation improved P digestibility. In contrast to digestibility data, performance data were less conclusive. Millrun inclusion reduced ADG linearly, but did not affect ADFI or G:F. Xylanase and phytase reduced ADFI, and phytase tended to reduce ADG . Enzyme supplementation did not affect final BW or G:F.

Conclusions
Overall, millrun inclusion reduced nutrient digestibility and growth performance. Xylanase and phytase improved nutrient digestibility; however, the improved digestibility did not result in improved growth performance which may have been indicative of a nutrient imbalance.

Acknowledgements
Program funding was provided by Sask Pork, Alberta Pork, Manitoba Pork and Saskatchewan Agriculture and Food Development Fund. Danisco Animal Nutrition funded the project.

Table 1. Ingredient and nutrient composition of diets

Ingredient (%)	Wheat	20% Wheat millrun[z]	40% Wheat millrun[z]
Wheat	83.26	61.83	40.26
Wheat millrun	-	20.00	40.00
Soybean meal	12.50	12.50	12.50
Canola oil	-	1.80	3.60
Dicalcium phosphate	1.20	0.70	0.40
Limestone	0.85	1.00	1.10
L-lysine HCl	0.49	0.47	0.45
Vitamin premix[y]	0.50	0.50	0.50
Mineral premix[w]	0.50	0.50	0.50
Sodium bicarbonate	0.29	0.29	0.29
Salt	0.20	0.20	0.20
L-Threonine	0.15	0.14	0.13
DL-Methionine	0.06	0.07	0.07
Calculated nutrient content			
DE (Mcal kg^{-1})	3.34	3.34	3.34
Dig. Lysine (g $Mcal^{-1}$ DE)[v]	2.80	2.80	2.80
Calcium	0.70	0.70	0.70
Total phosphorus	0.60	0.60	0.63

[z] Xylanase was included at a rate of 167 g $Tonne^{-1}$ of finished feed and phytase at a rate of 100 g $Tonne^{-1}$ of finished feed.
[y]Provided per kilogram of premix: vitamin A, 1 650 000 IU; vitamin D_3, 165 000 IU; vitamin E, 8000 IU; niacin, 7 g; D-pantothenic acid, 3 g; riboflavin, 1g; menadione, 800 mg. folic acid, 400 mg; thiamine, 200 mg; D-biotin; 40 mg; vitamin B_{12}, 5 mg
[w]Provided per kilogram of premix: Zn, 20 g; Fe, 16 g; Cu, 10 g; Mn, 5 g; I, 100 mg; Se, 20 mg.
[v]Contained by calculation 2.80 apparent digestible lysine $Mcal^{-1}$ DE (0.94% apparent digestible lysine) and an ideal pattern of digestible amino acids compared to lysine (%); lysine 100; threonine 60; methionine 30 (NRC 1998).

Table 3. Effect of wheat millrun inclusion level and enzyme supplementation on ileal and total-tract energy and DM digestibility and DE content of diets fed to grower pigs

Variable	Millrun (%)									Pooled	Millrun[y]		Millrun diets[z]			
	0	20				40										
	Control	Control	Xyl	Phy	X+P	Control	Xyl	Phy	X+P	SEM[x]	Linear	Quadratic	20 vs 40	Xyl vs Phy	Phy vs non Phy	Xyl x Phy
Ileal																
Energy digestibility (%)	77.5[a]	68.1[bcd]	72.4[b]	71.6[bc]	72.5[b]	62.0[e]	68.1[bcd]	67.4[cd]	66.6[d]	1.21	<0.001	NS	<0.001	0.004	0.035	NS
DE (kcal kg^{-1} DM)	3416[a]	3097[b]	3292[ab]	3262[ab]	3318[ab]	2896[c]	3199[ab]	3141[b]	3129[b]	55.9	<0.001	NS	<0.005	0.001	0.026	NS
DM digestibility (%)	79.4[a]	69.9[c]	73.9[b]	73.8[b]	74.2[b]	63.4[d]	69.2[c]	68.7[c]	67.9[c]	1.09	<0.001	NS	<0.001	0.004	0.012	NS
Total-tract																
Energy digestibility (%)	84.4[a]	77.6[c]	79.8[b]	78.9[bc]	80.7[b]	71.5[f]	75.5[d]	73.4[e]	73.1[e]	0.55	<0.001	NS	<0.001	<0.001	NS	NS
DE (Kcal kg^{-1} DM)	3720[a]	3528[d]	3632[bc]	3596[cd]	3692[ab]	3337[f]	3548[cd]	3424[e]	3433[e]	25.4	<0.001	NS	<0.001	<0.001	NS	NS
DM digestibility (%)	86.7[a]	80.3[c]	82.2[b]	81.7[b]	83.1[b]	74.2[f]	77.9[d]	76.1[e]	75.9[e]	0.45	<0.001	NS	<0.001	<0.001	NS	NS
Total-tract minus ileum																
Energy digestibility (%)	6.9	9.5	7.5	7.3	8.2	9.4	7.6	6.1	6.5	1.27	NS	NS	NS	NS	NS	NS
DE (kcal kg^{-1} DM)	304	430	340	334	374	441	359	282	303	58.9	NS	NS	NS	NS	NS	NS

NS: Not significant
[abcd] Means within the same row with the same letter are not different P>0.05.
[x] SEM:Pooled standard error of the mean.
y:: Linear and quadratic responses were analyzed using 0%, 20%, and 40% control diets.
[z] Source of variation and probability only among diets that contain millrun and/or enzyme.
Xyl: Xylanase.
Phy: Phytase.

Table 5. Effect of millrun and enzymes on performance of grower pigs over time

	Millrun (%)														
	0	20				40				Pooled SEM[x]	Millrun[y]		Millrun diets[z]			
	Control	Control	Xyl	Phy	X+P	Control	Xyl	Phy	X+P		Linear	Quadratic	20 vs 40	Xyl vs Phy	Phy vs non Phy	Xyl x Phy
Average daily feed intake (kg d-1)																
Days																
0-7	1.9[a]	1.9[a]	1.7[a]	1.8[a]	1.8[a]	1.6[a]	1.8[a]	1.7[a]	1.6[a]	0.11						
8-14	2.3[a]	2.2[ab]	2.1[ab]	2.1[ab]	1.9[b]	1.9[b]	1.9[b]	2.3[a]	2.0[ab]	0.11						
15-21	2.7[a]	2.6[ab]	2.6[ab]	2.6[ab]	2.4[b]	2.8[a]	2.4[b]	2.6[ab]	2.4[b]	0.11						
22-28	2.8[a]	2.8[a]	2.8[a]	2.5[b]	2.6[b]	2.9[a]	2.7[ab]	2.5[b]	2.5[b]	0.11						
29-35	3.2[a]	3.2[a]	3.1[a]	2.4[bc]	2.9[ab]	3.2[a]	3.1[a]	2.9[ab]	2.8[b]	0.11						
0-35	2.6[a]	2.6[a]	2.4[bc]	2.4[bc]	2.3[c]	2.5[ab]	2.4[bc]	2.4[bc]	2.3[c]		NS	NS	NS	0.004	0.002	0.043
Average daily gain (kg d-1)																
0-7	0.96[a]	0.88[a]	0.92[a]	0.85[a]	0.88[ab]	0.76[b]	0.81[b]	0.76[b]	0.76[b]	0.05						
8-14	0.90[a]	0.88[a]	0.90[a]	0.85[a]	0.86[a]	0.90[a]	0.77[a]	0.91[a]	0.87[a]	0.05						
15-21	1.23[a]	1.09[ab]	1.14[a]	1.07[b]	1.04[b]	1.02[b]	1.01[b]	1.03[b]	0.99[b]	0.05						
22-28	0.97[a]	0.95[a]	0.91[a]	0.84[a]	0.89[a]	0.89[a]	0.91[a]	0.88[a]	0.93[a]	0.05						
29-35	1.19[a]	1.13[a]	1.08[a]	0.99[b]	1.07[a]	1.10[a]	1.06[ab]	1.08[ab]	1.03[b]	0.05						
0-35	1.05[a]	0.98[a]	0.99[a]	0.92[b]	0.95[b]	0.94[b]	0.91[b]	0.93[b]	0.92[b]		<0.001	NS	0.023	NS	0.09	NS
Feed efficiency																
0-7	0.49	0.45	0.53	0.47	0.48	0.46	0.46	0.44	0.46	0.03						
8-14	0.39[b]	0.39[b]	0.43[b]	0.41[b]	0.43[b]	0.55[a]	0.39[b]	0.41[b]	0.42[b]	0.03						
15-21	0.46[a]	0.41[a]	0.45[a]	0.41[a]	0.44[a]	0.37[b]	0.42[a]	0.40[ab]	0.41[ab]	0.03						
22-28	0.34	0.33	0.32	0.34	0.34	0.31	0.34	0.36	0.37	0.03						
29-35	0.37	0.36	0.35	0.35	0.36	0.34	0.34	0.36	0.37	0.03						
0-35	0.41	0.39	0.42	0.39	0.42	0.41	0.39	0.39	0.41		NS	NS	NS	NS	NS	NS
Final body weight (kg)																
d 7	42.1[a]	41.6[a]	41.9[a]	41.4[a]	41.7[a]	40.8[a]	41.1[a]	40.8[a]	40.8[a]	0.95						
d 14	53.8[a]	47.9[b]	48.2[b]	47.3[b]	47.7[b]	47.2[b]	46.5[b]	47.2[b]	46.9[b]	0.94						
d 21	62.2[a]	55.6[b]	56.2[b]	54.7[b]	54.9[b]	54.4[b]	53.7[b]	54.5[b]	53.9[b]	0.94						
d 28	68.7[a]	62.3[b]	62.5[b]	60.6[b]	61.2[b]	60.7[b]	60.0[b]	60.7[b]	60.4[b]	0.94						
d 35	76.8[a]	70.3[b]	70.1[b]	67.5[c]	68.7[b]	68.5[b]	67.5[c]	68.3[b]	67.7[c]	0.94	<0.001	<0.001	<0.001	NS	NS	NS

NS: Not significant

[abcd] Means within the same row with the same letter are not different P>0.05.

[x] SEM:Pooled standard error of the mean.

y:: Linear and quadratic responses were analyzed using 0%, 20%, and 40% control diets.

[z] Source of variation and probability only among diets that contain millrun and/or enzyme.

Xyl: Xylanase.

Phy: Phytase