Effect of an NSP-hydrolysing enzyme (Rovabio Excel ®) in the diet of lactating sows on feed intake, body condition and litter performance and in vivo and in vitro nutrient digestibility

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SUMMARY

A non-starch polysaccharide (NSP)-hydrolyzing enzyme (Rovabio Excel®, Adisseo), was added to barley- and wheat-based diets and fed to lactating sows to determine if there would be an improvement in sow and piglet performance and feed digestibility. An in-vitro experiment was also performed to assess how the enzyme would influence fermentation of dietary fibre in the pig's large intestine. Although the enzyme improved nutrient digestibility and the energy content of the diet, there was no effect on sow or piglet performance.

"The non-starch polysaccharide (NSP)-hydrolyzing enzyme increased nutrient digestibility, both in-vitro and in-vivo"

INTRODUCTION

Starch and protein, the main nutrients in cereal grains, are surrounded by cell walls composed of indigestible carbohydrates called dietary fibre or non-starch polysaccharides (NSP). These walls must be broken down to allow for the release of nutrients such as starch, oil, and protein. However, a fraction of these carbohydrates is soluble in water and has swelling and viscous properties that can negatively affect the digestive processes by preventing the activity of the digestive enzymes. Barley and wheat contain soluble fibres which can affect the digestive processes. Some exogenous enzymes, extracted from mould or bacteria, are now added routinely in animal feeds to hydrolyse the soluble fibre fractions of barley (ß-glucans) and wheat (arabinoxylans) and improve their digestibility. We hypothesized that the addition of enzymes into the diets could also affect the amount and structure of fermentable substrate in the pig's large intestine, thereby affecting the intestinal microbial community. This is of specific interest as some studies have shown that cereal NSP may exert prebiotic properties or shift N excretion from urine to faeces. However, information on the effect of NSP hydrolyzing enzymes on intestinal microbial community composition in pigs is scarce. The objectives of these studies were to evaluate the effects of the enzyme when added to barley- and wheat-based diets for lactating sows on nutrient digestibility and animal performance. An in-vitro model was also used to study the possible effect of the enzyme on the rate of dietary fibre fermentation in the pig large intestine, metabolite production, and the hindgut microbiota.

MATERIALS AND METHODS

In-vivo (in the pig)

Five experimental diets were prepared and divided into two categories: control diets (CD) supplying all the nutritional requirements (NRC, 1998) of the lactating sows and reformulated diets (RD) supplying 1.5% less lysine and digestible energy, as compared to the CD. The latter were supplemented with 0, 50, or 500 g enzyme/tonne and the RD diets with 0 or 50 g enzyme/tonne. Different diets were also prepared for gilts (first parity) and sows (≥ 2 parities), due to the fact that the gilts require more protein for their growth. A tolerance study (10 times the recommended dose) was made comparing the diets containing 0 and 500 g/t of Rovabio enzyme. Each experimental diet was tested on 25 sows; they were fed from one week before farrowing until weaning (3 weeks). The voluntary feed intake, bodyweight, and backfat thickness of the sows were measured. In piglets, the bodyweight gain and the rate of mortality were recorded.

In-vitro (in test tube)

Seven wheat and barley samples with different carbohydrate fractions (CHO) were hydrolyzed using pepsin and pancreatin with or without the Rovabio Excel enzyme and then fermented for 72 h in a gas test with sow faeces as an innoculum. Dry matter, starch, crude protein, and β-glucan digestibilities were measured. Fermentation kinetics of the hydrolyzed ingredients were modeled, short-chain fatty acids (SCFA) production and profiles after 12, 24, and 72 h compared. Microbial communities after 72 h of fermentation were also analyzed using terminal restriction fragment length polymorphism (TRFLP).

RESULTS

In-vivo (in the pig)

We observed no effect of the enzyme on the sow's performance, possibly because of high variability. There was a tendency for increased feed intake and reduced backfat with the enzyme on the control diets. Nutrient digestibility (+ 3 to 8%) and energy content (+180 kcal/kg) increased when the enzyme was added to the diets of the gilts (Table 1). No negative effects were observed on the sow's and piglet's performances when the level of the enzyme was 10 times the recommended dose.

In-vitro (in test tube)

Besides the expected differences among cereal samples, there were significant effect of the enzyme on almost all parameters. Nutrient digestibilities were increased (Table 2) and fermentability as well as SCFA production decreased ($P < 0.001$). SCFA and bacterial community profiles indicated a shift from propionate to acetate production and Ruminococcus- and xylanolytic Clostridium-like bacteria increase in response to increased slow fermentable insoluble CHO and decreased fast fermentable β-glucan and starch in the hydrolyzed residues when incubated in the presence of the enzyme.

CONCLUSIONS

The NSP hydrolyzing enzyme increased nutrient digestibility, both in-vitro and in-vivo, however, there was no effect on the performance of the sows, gilts, or piglets. This may be because digestibility is a more sensitive response criteria than growth.

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Filling feeders in the nursery

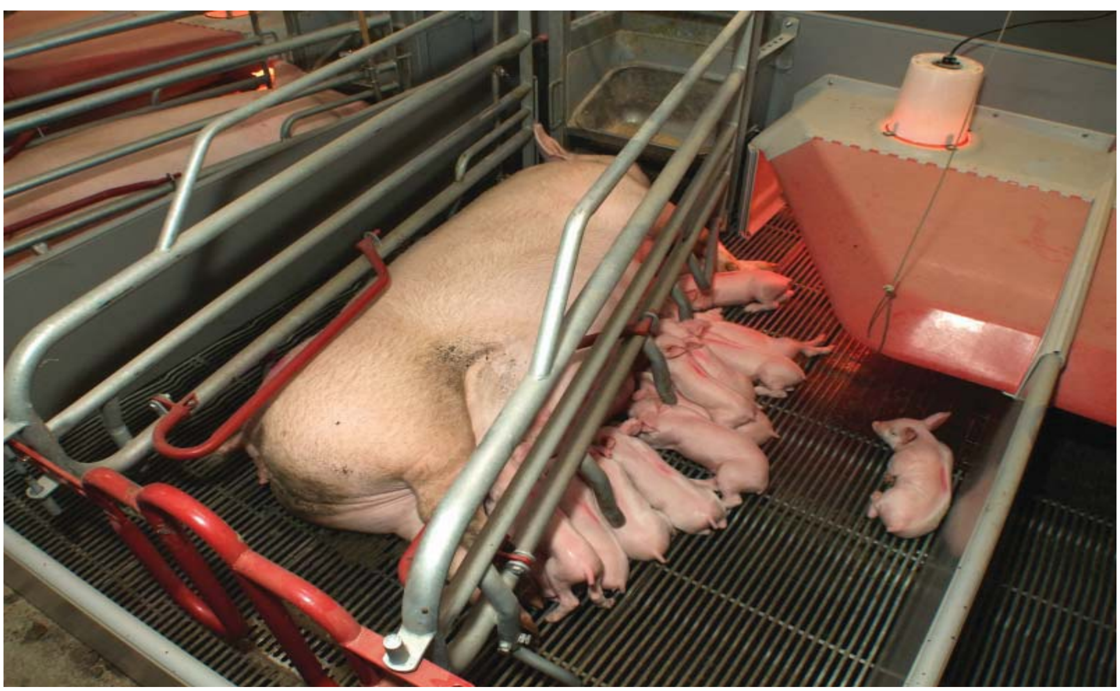
Table 1. Intake, total tract digestibility, and digestible energy of diets with and without non-starch polysaccharide enzyme addition in gilts.

	Control diet (g/t)[1]			Ref. diet (g/t)[1]				P[2]			
	0	50	500	0	50	SEM[1]	Diet	Level	D*L	SEM	P[3]
DM Intake (kg)	125	125	119	126	126	5.4	0.845	0.976	0.940	6.3	0.492
								Digestibility (%)			
DM	52.9	59.4	58.1x	55.3	58.7	1.1	0.445	0.001	0.145	0.9	0.002
Organic matter	42.6	50.7	48.6x	46.0	49.9	1.2	0.325	0.001	0.100	1.2	0.005
Gross energy	55.2	60.7	57.6	55.6	59.8	1.0	0.793	0.001	0.526	1.9	0.393
DE[4] (Mcal/kg)	2.45y	2.65	2.61x	2.37	2.55	0.004	0.056	0.001	0.720	0.03	0.003

1 Levels of Rovabio Excel enzyme in the diets, 2 Comparisons between diet (control and reformulated) and Rovabio level (0 and 50 g/t)
3 Comparisons between diets C-0 and C-500 (tolerance study), 4 DE, digestible energy content

Table 2. In vitro dry matter, crude protein, starch, and β-glucan digestibilities with (+) and without (-) non-starch polysaccharide enzyme added during pepsin and pancreatin hydrolysis (N=8).

		Component			
Composition	Ingredient	Dry matter	Crude protein	Starch	B-Glucan
-	Positive Diet	0.825 c	0.933	0.968	0.462
+	Positive Diet	0.830 bc	0.935	0.973	0.537
-	Wheat	0.839 bc	0.916	0.944	0.095
+	Wheat	0.890 a	0.936	0.989	0.112
-	Wheat bran	0.567 j	0.784	0.985	0.112
+	Wheat bran	0.607 i	0.816	0.975	0.289
-	Common barley McLeod	0.664 h	0.795	0.820	0.242
+	Common barley McLeod	0.715 f	0.845	0.870	0.475
-	Common barley AC Metcalfe	0.697 g	0.794	0.860	0.228
+	Common barley AC Metcalfe	0.749 e	0.844	0.897	0.522
-	Hulless Barley CDC Fibar	0.770 d	0.850	0.883	0.836
+	Hulless Barley CDC Fibar	0.846 b	0.889	0.939	0.896
-	Hulless barley SB94893	0.512 k	0.673	0.567	0.064
+	Hulless barley SB94893	0.613 i	0.770	0.635	0.287
	SEM	0.0115			
	Sources of Variation	**P-values**			
	Ingregient	< 0.001	-	-	-
	Enzyme	< 0.001	-	-	-
	Ingredient x Enzyme	<0.001	-	-	-



New sow research unit features 28 day weaning, removable covered creeps and crates that adjust width from 23" - 34" (57-85 cm), trough volume of 21 L