COMPARISON OF LOW GLUCOSINOLATE RAPESEED MEALS WITH SOYBEAN MEAL AS PROTEIN SUPPLEMENTS FOR PIGS

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Introduction

Since rapeseed became an important crop in western Canada, our Department has conducted numerous experiments comparing rapeseed meal (RSM) from both Brassica campestris and Brassica napus seed as a partial or complete replacement for soybean meal (SBM) in diets of starting, growing, finishing pigs and of sows. Present recommendations indicate that current commercial RSM of Canadian origin may be used as a portion of rations for all pigs with the general recommendation that 5 % RSM is a satisfactory level.

Plant breeding programs are constantly changing the composition of rapeseed in an attempt to produce a seed with a superior oil and providing superior meal when the oil is removed. One major objective is the production of rapeseed low in glucosinolates, which are the potential goitrogenic principles in the seed. Commercial varieties of low glucosinolate and low erucic acid seed (double-low varieties) are now being released. Up to this past winter, however, experimental studies on low glucosinolate meals had to use meal from Brassica napus cultivar Bronowski, a non-commercial variety.

This report discusses a series of studies comparing RSM from Bronowski rapeseed with SBM as protein supplements for pigs.

Objectives

The overall objectives of the three experiments were to compare low glucosinolate RSM from Brassica napus cultivar Bronowski as a partial or complete substitute for SBM in diets of market pigs and of sows. In one experiment standard commercial RSM of Brassica campestris origin was also involved in the comparison. Wheat and barley-based diets were fed in all experiments. Each of the experiments will be discussed separately.

Procedures, Results and Discussion

Experiment 1

In Experiment 1, seventy-six crossbred 3 to 4-week old weanling pigs, equalized between gilts and barrows, were fed isocaloric diets with protein supplements of either soybean meal (SBM), low-glucosinolate (RSM) or a combination of RSM and SBM. Copper and trace mineral supplements were superimposed on the basic treatments but as there were no significant interactions between protein source and mineral levels, only the data

relating to protein will be discussed. Pigs were paired on the basis of sex until they reached 40 kg liveweight at which time they were separated and fed individually to market weight. Digestibility and retention studies were conducted at an average weight of 19 kg.

Table 1: Experiment 1 - Summary of results

	Protein source		
	SBM	SBM + RSM [+]	RSM [+]
Av. protein level 'as fed' basis			
start to 40 kg	18.4	18.5	18.5
40 kg to market	14.3	14.4	14.5
Daily feed kg	1.9	1.9	2.0
Daily gain kg	0.62	0.61	0.62
Feed/kg gain kg	3.1	3.0	3.2
Digestible energy %	86.2	85.3	83.1
Digestible nitrogen %	86.9	85.2	84.5
Nitrogen retained/ digestible nitrogen %	47.4b	57.6a	46.8b
Av. backfat cm	3.2	3.2	3.1
Fatty acids Σ unsaturated	58.6a	61.0b	60.9b

[+] Rapeseed meal from Brassica napus, cultivar Bronowski seed

a,b Values in each row with a common letter or no letter are not significantly different. ($P < 0.05$)

In this experiment (Table 1) feed intake, daily gain, efficiency of feed utilization and carcass measurements were not influenced by source of protein; that is, SBM, low glucosinolate RSM from Brassica napus cultivar Bronowski seed or a combination of SBM and RSM. Digestion coefficients for energy and nitrogen were not influenced by protein source, but nitrogen retention was superior for pigs fed a combination of SBM and RSM. Proportions of unsaturated fatty acids were higher in the depot fat of pigs receiving RSM compared with those fed SBM, but differences were not sufficiently large to be of commercial importance. The results suggest that low glucosinolate RSM could replace SBM on an isonitrogenous and isocaloric basis for pigs from weaning at 3-4 weeks of age to market weight of 90 kg, but that a combination of RSM and SBM might be superior to either protein supplement alone.

Experiment 2

In Experiment 2, 18 gilts and 18 barrows were allotted to three treatment groups to compare a standard commercial Brassica campestris RSM with low glucosinolate RSM as complete replacements on an isonitrogenous-isocaloric basis for SBM in the diets for growing-finishing pigs. Lower pro-

tein diets (14 % protein in the growing period and 12,5 % in the finishing and gestation periods) were fed then in previous experiments to place a greater stress on the animals. The barrows from this experiment were marketed while the gilts were retained on the same rations for reproductive studies. Digestion and retention studies were conducted when the pigs averaged 15 and 30 kg liveweight.

Table 2: Experiment 2 - Summary of results

	Protein source		
	SBM	Bronowski RSM	Commercial RSM +
Barrows (castrate males)			
Daily feed kg	2.2	2.3	2.1
Daily gain kg	0.66a	0.65a	0.55b
Feed/kg gain kg	3.3a	3.4a	3.9b
Av. backfat cm	3.9a	4.0a	3.7b
Gilts			
Daily feed kg	2.0	1.8	1.8
Daily gain kg	0.59a	0.49b	0.49b
Feed/kg gain kg	3.5	3.8	3.7
Metabolism data			
Digestible energy %	83.2	80.4	81.5
Digestible nitrogen %	80.8	77.6	78.8
Nitrogen retained/ digestible nitrogen %	54.2	56.0	63.4

\+ Brassica campestris

a,b Values in each row with a common letter or no letter are not significantly different ($P < 0.05$)

In this experiment (Table 2) there was a marked sex difference during the growing period in response to the low glucosinolate RSM. The feed intake, daily gain and efficiency of feed conversion of barrows did not differ between those fed SBM and those fed low glucosinolate RSM. However, the commercial RSM resulted in depressed performance of the barrows in comparison with SBM. The rate of gain of growing gilts fed either low glucosinolate RSM or commercial RSM averaged 0.10 kg per day slower than those fed SBM. This slower gain was associated with lower feed intake of gilts receiving either RSM, but feed-conversion was also depressed. In this study it appeared that the removal of glucosinolates did not remove all of the potential growth depressing properties of RSM when fed to gilts. It should be noted that the Bronowski meal used in this experiment was not considered to be a good sample of meal.

Carcass data were available for barrows only. Backfat was lower for barrows fed the commercial RSM than for those fed the other meals, probably associated with the slower gain in this group. None of the other carcass characteristics varied significantly between treatments.

The gilts from this experiment were bred with breeding commencing at 7 months of age. There were no differences in conception or litter performance between treatments confirming our previous studies that Canadian RSM, whether low glucosinolate or not, does not pose a problem in gilt and sow rations. However, results suggest that complete replacement of SBM by RSM, either standard or low glucosinolate, may result in depressed rate of gain in growing gilts. The comparative results with low glucosinolate meal between Experiments 1 and 2 did not agree in this regard, with such differences possibly being associated with different sources of meal in the two experiments.

Experiment 3

In Experiment 3, 36 crossbred pigs were allotted immediately following weaning at 3 weeks of age and at a weight of 5 kg to six dietary treatments. Pigs were individually fed for a 10-week period. The objective was to study feed intake, rate of gain, efficiency of feed conversion, energy and nitrogen digestibility and nitrogen retention of young pigs when a partially dehulled fraction of low glucosinolate RSM containing 45 % protein was partially or completely substituted for SBM in the diet. The dehulling and partial removal of the hull provided a lower fiber RSM similar to SBM in composition. Comparisons were made with diets containing either 19 or 16 % crude protein.

For the 10-week experimental period, daily gain was reduced when either the RSM fraction or a mixture of RSM-SBM were substituted for SBM in diets containing similar levels of protein (Table 3). Daily feed intake was reduced at only the 19 % protein level so that efficiency of feed conversion was adversely influenced by the RSM fraction at only the 16 % protein level. Rate of gain and efficiency of feed conversion were superior for pigs fed the 19 compared with the 16 % protein diets, regardless of protein source.

Digestible energy and nitrogen determined at 11 kg liveweight did not differ between diets but nitrogen retention was superior for pigs fed the RSM fraction or a mixture of RSM-SBM.

The overall results suggest that the partially dehulled fraction of low glucosinolate RSM used in this study was not equivalent to SBM insofar as its ability to promote gain in young pigs was concerned, when fed on the basis of equalized dietary protein. This result was somewhat unexpected based on the relatively good performance obtained from normally processed low glucosinolate RSM in Experiments 1 and 2. Lysine and methionine and cystine levels (Table 3) do not seem to account for performance difference, but amino acid levels may have been a factor as indicated by diffe-

Table 3: Experiment 3 - Summary of results

Protein level %	19			16		
Protein source	SBM	SBM + RSM	RSM	SBM	SBM + RSM	RSM
Treatment no.	1	2	3	4	5	6
Determined values on 'as fed' basis						
Lysine %	0.92	0.89	0.86	0.74	0.69	0.66
Methionine and cystine %	0.66	0.72	0.82	0.63	0.60	0.64
Performance						
Feed intake kg	1.4a	1.1b	1.1b	1.1b	1.0b	1.0b
Daily gain kg	0.53a	0.47b	0.46b	0.42b	0.33c	0.33c
Feed/kg gain kg	2.5a	2.3a	2.4a	2.6a	2.9b	2.9b
Digestible energy %	84.6	80.9	83.7	84.3	83.5	84.3
Digestible nitrogen %	83.7	78.1	81.2	81.6	79.6	80.6
Nitrogen retention/ digestible nitrogen %	58.2a	63.8 ab	69.2b	60.6a	67.7b	64.6ab

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rences between 19 and 16 % protein diets. Absolute levels of the RSM fraction in the diet was not a major factor in performance as pigs in Treatments 5 and 6 where RSM was 6.6 and 13.2 % of the diet respectively, did not differ in performance. Similarly, pigs in Treatments 2 and 3 where RSM was 11.0 and 22.0 % of the diet did not differ in performance, but performance from these treatments was superior to Treatments 5 and 6.

Summary

The general results of studies with RSM from Bassica napus cultivar Bronowski seed indicate that a low glucosinolate RSM could partially or completely replace SBM on an isonitrogenous, isocaloric basis for starting, growing, finishing pigs or for sows. However, one experiment suggested that gilts may be depressed in gain where high levels of low glucosinolate RSM are fed. Partially dehulled RSM containing 45 % protein and only 8.3 % crude fiber depressed performance of young growing pigs when substituted on an isocaloric and isonitrogenous basis in partial or complete replacement for SBM in diets containing either 19 or 16 % crude protein. The reason for the poorer performance of this product compared with normally processed low glucosinolate RSM cannot be explained. It is probable that the current recommendations that 5 % RSM be the upper limit in pig diets can be increased when production of low glucosinolate rapeseed becomes widespread.

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