Feeding Co-Extruded Flaxseed to Pigs: Effects of Duration and Feeding Level on Growth Performance and Backfat Fatty Acid Composition of Grow-Finish pigs

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SUMMARY

A co-extruded flaxseed:field pea product was fed to growing pigs for 4, 8 or 12 weeks to determine which combination of duration of feeding and dietary level would provide optimal enrichement of the backfat with 18:3 n-3 (an omega-3 fatty acid). The inclusion of 15% flaxseed in the diet decreased feed intake; there was no effect on average daily gain, and feed efficiency was improved. If 2.5 grams of backfat was incorporated into a serving (100 g) of processed pork, then feeding 10% flaxseed for 8 weeks or 15% for 12 weeks would achieve the n-3 fatty acid levels required for an enrichment claim in Canada.

INTRODUCTION

Flaxseed is the richest oilseed source of 18:3 n-3 (omega-3) fatty acids and feeding flaxseed to pigs has been used to increase the levels of n-3 fatty acids in pork. Consuming n-3 fatty acids may provide health benefits by reducing the risk factors for several diseases. Thacker, Racz and Soita (2004) from the University of Saskatchewan reported that feeding flax co-extruded with field peas (LinPro, O&T Farms, Regina, SK) could avoid the grinding and storage problems which occur with flaxseed, also a collaborative study with PSCI and the University of Alberta optimized the extrusion conditions for 18:3 availability in pigs.

"Feeding a co-extruded flaxseed: pea mixture can be used to optimize enrichments of n-3 fatty acids in the back fat of pigs"

Incorporation rates of 18:3 n-3 into pork fat with flaxseed feeding have been variable. Therefore the overall objectives of this study was to feed a flaxseed:field pea blend (LinPro®; O&T Farms, Regina, SK) extruded using conditions which optimized 18:3 availability for various durations and at different levels in the diet to determine which provided optimal and consistent elevated 18:3 n-3 levels in pork fat.

MATERIALS AND METHODS

Four barrows and four gilts, with an initial body weight of 31 ± 3 kg were randomly assigned to one of ten dietary treatments. Treatments were 3 levels of extruded flaxseed (5, 10 and 15%; Table 1) and 3 durations of feeding (4, 8 and 12 weeks) arranged as a 3 x 3 factorial, plus a control (0% flaxseed). Diets were formulated and adjusted every 4 weeks to meet the nutrient requirements of the growing pig. Field peas were added to the diets at a constant level to compensate for the peas in the co-extruded product. Tallow was used to balance energy levels among diets within phases. A backfat biopsy was collected from each pig the day prior to slaughter and analyzed for fatty acid concentrations.

RESULTS AND DISCUSSION

The inclusion of up to 30% (15% flaxseed) of a co-extruded flaxseed:pea mixture for 12 weeks in the diet of growing pigs had only modest effects on performance (Table 2). Feed intake decreased from 2.60 to 2.47 kg/d ($P<0.01$; Table 2) but ADG was unaffected ($P=0.40$) and therefore feed conversion improved ($P=0.01$) as the amount of flaxseed in the diet increased from 5 to 15%. Feed intake on the control diet was similar to the 15% flaxseed diet; there is no obvious explanation for this.

Backfat obtained from gilts had less saturated fatty acids and more n-6 fatty acids ($P<0.04$; data not shown), however the actual differences between genders is small and probably of limited practical significance. Both the amount of flaxseed in the diet and duration of feeding impacted fatty acid composition of the backfat. Increasing flaxseed in the diet resulted in increases in the percentage of n-3 fatty acids in backfat , including 18:3 (Figure 1A), 20:3, 20:5 n-3, and 22:5 n-3. Although, not as dramatic, the proportion of n-6 fatty acids also increased (Figure 1B) due to increases in 18:2 n-6 ($P<0.01$) and 20:2 n-6 ($P<0.05$). Conversely 20:4 n-6 declined from about 0.19% to 0.12% as the flaxseed concentration of the diet increased from 5 to 15%. As the level of flaxseed in the diet increased, the percentage of 18:2 n-6 fatty acids decreased, however, because of the greater amount of fat in the diets with added flaxseed the absolute amount of 18:2 n-6 consumed increased, leading to the enrichment of these fatty acids in the backfat. Overall, the ratio of n-3/n-6 fatty acids in backfat increased (Figure 1C; $P<0.05$). Generally, when 5% flaxseed was included in the diet, a plateau in total n-3 fatty acids was observed if it was fed for longer than 8 weeks. Conversely, when the diet contained 10 or 15% flaxseed, the level of n-3 fatty acids did not plateau and continued to increase between 8 and 12 weeks ($P<0.01$). The consistent production of pork with enriched levels of n-3 fatty requires a balance between high levels of flax for short durations, which provides efficient rates of deposition, and feeding higher levels for longer durations, which allows for a more consistent rate of deposition.

The Canadian government requires 300 mg n-3 fatty acids per 100 g serving for an enrichment claim. In the present study, 2.5 g of backfat from pigs fed 10% flaxseed for 8 weeks or 15% for 12 weeks would achieve the n-3 fatty acid levels for a claim. Additionally, if 15% flaxseed was fed for 12 weeks, 2.0 g of backfat would achieve the required levels of n-3 fatty acids (assuming 85% fat in backfat). The backfat could potentially be used to manufacture pork products enriched in n-3 fatty acids.

Additionally, commercial lean meat form pigs fed flax co-extruded with field peas would probably have sufficient fat (subcutaneous, inter- and intramuscular) in retail cuts to achieve the required enrichment levels.

CONCLUSION

Feeding flax co-extruded with field peas can be used to optimize consistent enrichments of n-3 fatty acids in back fat of pigs. Relatively small amounts of this fat used to manufacture pork products would be required to meet the Canadian standard for a n-3 enrichment claim.

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Table. 1 Ingredient and nutrient composition of experimental diets. Weeks 1 to 4.

Ingredients, % as fed	Flaxseed, %			
Wheat	53.4	39.0	24.5	10.0
Barley	10.0	21.6	33.1	44.6
Soybean Meal	17.0	15.3	13.5	11.8
Field Peas	15.0	10.0	5.0	0.0
Lin Pro[2]	0.0	10.0	20.0	30.0
Tallow	1.03	0.68	0.34	0.0
DiCalcium phosphate	0.85	0.83	0.82	0.80
Limestone	0.80	0.78	0.77	0.75
Vitamin premix	0.50	0.50	0.50	0.50
Mineral premix	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50
L-lysine HCL	0.23	0.25	0.28	0.30
L-threonine	0.10	0.10	0.10	0.11
DL-methionine	0.06	0.07	0.07	0.08
Calculated nutrient content, as fed				
DE (Mcal/kg)	3.38	3.39	3.40	3.42
Dig lys/Mcal DE	2.80	2.80	2.80	2.80
Calcium, %	0.82	0.82	0.82	0.87
Phosphorus, (total) %	0.61	0.56	0.57	0.61

[1] Diets were reformulated for weeks 5 to 8 and 9 to 12 to meet the changing nutrient requirements of the pigs as they grew.

[2] Co-extruded 50% flaxseed and 50% field peas (LinPro; O&T Farms, Regina, SK

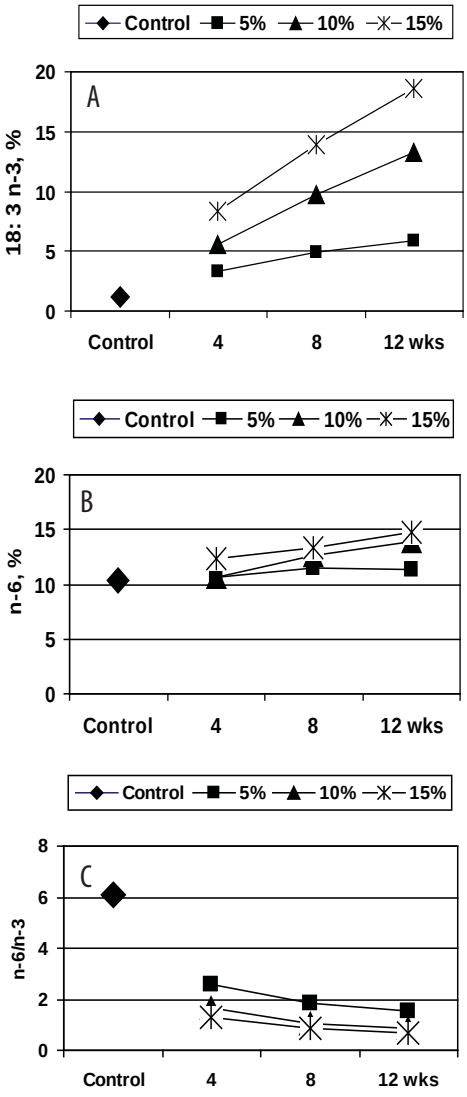

Figure 1. The influence of flaxseed in the diet on the percentage of 18:3 n-3 (A), sum of n-6 (B) and the n-3/n-6 (C) ratio in the backfat of growing swine when fed for either 4, 8 or 12 weeks. The control pigs were fed a diet containing 0 flaxseed for 12 weeks. Effect of diet, week, and diet by week interaction ($P < 0.05$).

Table 2. The Performance of grow-finish pigs fed different levels of extruded flaxseed for different durations

		Diet			Weeks				
Variable	Control	5	10	15	4	8	12	SEM	P Value
Initial BW, kg	31.1	30.8	30.9	31.4	30.9	31.2	31.0	1.48	0.31
Final BW, kg	109.7	114.6	112.9	115.2	115.6	115.7	111.4	2.09	0.36
ADG, kg/d	0.94	1.00	0.98	1.00	1.01	1.01	0.96	0.01	0.42
ADFI, kg/d	2.46	2.60	2.50	2.47	2.58	2.55	2.45	0.03	0.01
Gain:feed	0.38	0.39	0.39	0.41	0.39	0.40	0.39	0.01	0.01