Impact of feeding diets containing extruded flaxseed meal and vitamin E in finishing swine

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SUMMARY
Previously we have shown that pork from pigs fed high flaxseed containing diets can be subject to rancidity. The objective of this experiment was to determine if added vitamin E could mitigate this problem. A total of 96 growing pigs were fed one of 3 different diets for 11 weeks prior to slaughter. The diets contained either 0 or 5 % flaxseed or 5% flaxseed plus 200 mg/kg vitamin E. As expected feeding flaxseed increased the omega-3 fatty acid content of the pork, especially high fat pork products. This was accompanied by the detection of off-flavours such as rancidity. The added vitamin E lessened these negative side-effects although this pork still did not score as high as that from animals fed no flaxseed.

"A diet containing 5% flaxseed, fed as a 50:50 co-extruded pea/flaxseed blend increased the omega-3 content of pork fat"

INTRODUCTION
Successful marketing of pork enriched with omega-3 fatty acids requires that other pork attributes are not reduced. We have conducted a series of experiments and shown that the inclusion of 5 % extruded flaxseed in the diet of finishing pigs for 11 weeks prior to marketing enriched some cuts of pork sufficiently to allow a claim of "omega-3 enriched" (300 mg omega-3 per 100 grams). At the high levels of enrichment there was some indication of "off-flavours" noted by the taste panels.

Vitamin E (DL-a-tocopherol acetate) is a natural fat-soluble vitamin which has been used in high-fat diets to prevent the oxidation of unsaturated fatty acids which can cause rancidity. The objective of this experiment was to determine the impact of added dietary vitamin E on the incidence of rancidity or off-flavours in omega-3 enriched pork products.

MATERIALS AND METHODS
The experiment required 96 pigs and was conducted utilizing a completely randomized block design with a 3 x 2 x 2 factorial arrangement of treatments: Treatments were 3 dietary treatments: a) Control, b) 5% flaxseed and c) 5% flaxseed plus 200 mg (IU)/kg diet Vit. E by 2 initial weight groups: a) 30 ± 4 kg and b) 44 ± 4 kg by 2 genders.

Diets were based on wheat, barley and soybean meal and fed for 3 phases of growth. The flaxseed was added as Linpro®, an extruded 50:50 pea/flaxseed blend using extrusion conditions optimized in a previous experiment (Htoo et al. 2008) and supplied by O & T Farms, Regina, SK. Field peas were added to the diets to compensate for the peas added in the Linpro and thus equalize pea content in all diets.

Diets a) and b) contained 11 mg (IU) /kg Vit E, , meeting the requirement (NRC 1998) for pigs of this age, but providing no "safety margin". Diets were fed for 11 weeks prior to slaughter.

Pigs were shipped to the Agriculture and Agri-Food Canada, Lacombe Research Centre, and were slaughtered in a simulated commercial manner. Sensory analysis of fresh, cooked pork and burgers was conducted by a trained taste panel.

Flax

Table 1. Omega-3 concentration (mg/100 g tissue) and fat hardness of commercial cuts.

	Treatments			SEM	P-value
	Control	5% Flaxseed	5% Flaxseed plus Vit. E[1]		
Omega-3, mg/100g					
Loin Primal[2]	127.6[b]	887.9[a]	870.5[a]	28.3	<0.001
Loin Commercial[3]	343.6[c]	2154.2[b]	2302.8[a]	55.7	<0.001
Burger[4]	777.9[b]	3285.7[a]	3252.3[a]	96.4	<0.001
Ham Primal[2]	106.1[b]	521.5[a]	558.4[a]	18.8	<0.001
Fat Hardness[5]	67.0[a]	56.1[a]	56.6[b]	4.6	<0.001

[1]200 IU vitamin E (DL-α-tocopherol acetate) per kg of diet.

[2]Primal contains all muscle, plus seam fat (loin) or no seam fat (ham)

[3]Commercial cut contains loin primal plus ¼ inch of backfat. (Effect of gender (P<0.001); males 14% higher than females)

[4]Loin muscle plus 20% subcutaneous added fat.

[a,b]. P < 0.05.

[5] Durometer units, 0-100

Table 2. Sensory analysis of fresh cork pork and burgers.

	Treatments			SEM	P-Value
	Control	5% Flaxseed	5% Flaxseed plus Vit. E.		
		..... Fresh Pork.....			
Pork Flavour Intensity[1]	5.09[a]	4.88[b]	4.87[b]	0.12	0.01
Stale Flavour[2]	1.67[a]	0.00[b]	0.00[b]	0.49	0.02
Spongy texture[2]	2.30[a]	0.44[b]	0.00[b]	0.60	0.02
Cook Time, sec/g	7.25[a]	6.51[b]	6.83[ab]	0.25	0.04
		..... Burgers.....			
Initial Tenderness[1]	7.65[b]	7.73[ab]	7.76[a]	0.06	0.02
Initial Juiciness[1]	5.62[b]	5.98[a]	6.07[a]	0.13	<0.001
Flavour desirability[1]	5.39[a]	4.85[c]	5.12[b]	0.13	<0.001
Pork Flavour Intensity[1]	5.21[a]	4.87[b]	5.02[b]	0.14	<0.001
Off Flavour Intensity[1]	7.83[a]	7.08[c]	7.44[b]	0.10	<0.001
Sustained Juiciness[1]	5.82[b]	6.06[a]	6.10[a]	0.13	0.001
Overall Palatability[1]	5.12[a]	4.62[c]	4.85[b]	0.15	<0.001
Rancid Flavour[2]	0.00[b]	6.29[a]	1.44[b]	1.24	<0.001
Other Flavours[2]	3.43[b]	15.33[a]	6.38[b]	1.71	<0.001
Unidentified Flavours[2]	23.15[b]	26.90[ab]	33.39[a]	4.29	0.01x
Typical Pork Flavour[2]	42.63[a]	22.48[b]	28.48[b]	3.14	<0.001
Mushy Texture[2]	83.69[a]	78.78[ab]	71.81[b]	2.82	0.008

[1] Measured on a 9-point scale where 1=extremely undesirable and 9=extremely desirable
[2] Percentage of panelists reporting the listed attribute
[ab] P<0.05

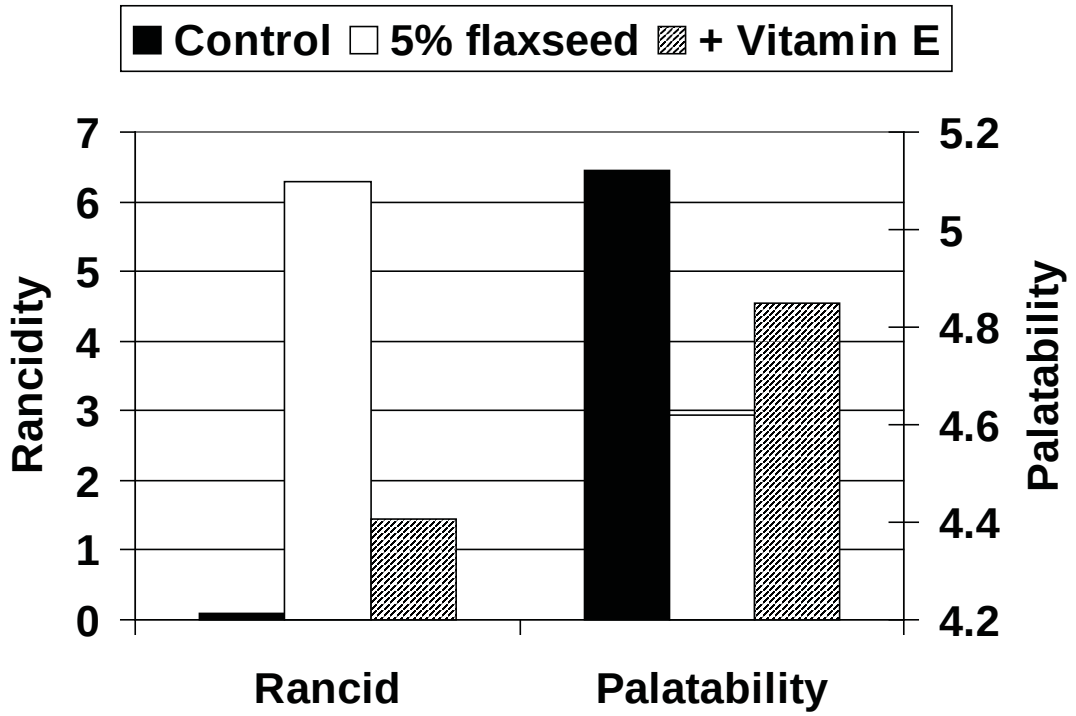

Figure 1. Sensory analysis of burgers. Rancidity is reported as the percentage of panelists reporting meat with this attribute. Palatability is measured on a 9-point scale where 1 = extremely undesirable and 9 = extremely desirable (a, b. $P < 0.05$)

RESULTS

As expected, a diet containing 5 % flaxseed, fed as a 50:50 co-extruded pea/flaxseed blend increased the omega-3 content of pork fat, and thus of pork commercial cuts containing fat regardless of the content of Vitamin E (Table 1). Omega-3 fatty acids are highly unsaturated which results in a decreased fat hardness.

Feeding 5 % flaxseed to pigs for 11 weeks had minimal or no effect on flavour, including rancidity, in low-fat cuts of pork. Ground pork, containing 20% fat, from pigs fed 5% flaxseed had slightly, but significantly, decreased pork flavour, desirability and palatability. A greater proportion of panelists reported pigs fed flaxseed have a rancid or "other flavour" (Table 2). Supplemental Vitamin E mitigated the effect of the flaxseed on rancidity, and the other negative attributes.

CONCLUSIONS

Although supplementing the diet of finishing swine with 5% flaxseed for 11 weeks will have minimal or no effects on off-flavours in low-fat cuts of pork, cuts containing a higher content of fat (ie. ground pork) will be negatively affected. Supplementing the diet with 200 IU/kg vitamin E will mitigate these negative effects (Figure 1).

IMPLICATIONS

It is well recognized that the production of pork with enchanced nutritional attributes, such as omega-3 enriched, must not compromise pork quality. The rancidity and off-flavours which may accompany increased levels of omega-3 fatty acids in pork can be mitigated by feeding high levels of vitamin E. Further research is required to determine if there are other, more efficient methods,(i.e. post-harvesting technologies) which could alleviate this problem.

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