Using alternative ingredients: flaxseeds and lentils

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The pork industry is continually seeking alternative ingredients for use in pig diets, either as a means of diversifying rations -and thus reducing cost- or to achieve a final pork product that meets certain specifications. Lentils and flaxseeds are among these ingredients.

Lentils are grown primarily in Western Canada for export and for human consumption. Each year, however, part of the production does not meet the grade for export and is used by the feed industry. The latter is attracted by the low price of the product. Lentils belong to the pulse crop family and have a chemical composition quite similar to that of peas, an ingrediant widely used in swine nutrition.

Flaxseed, for its part, possesses properties that make it unique as a feed ingredient, not the least of which is a highly desirable fatty acid profile in the lipid fraction. Possible future uses for flax include the production of omega-3 fatty acid-enriched pork, the development of alternatives to antimicrobial growth promoters and the enrichment of sow diets for essential fatty acids.

Since the use of these unconventional ingredients in swine nutrition is poorly documented, the Prairie Swine Centre carried out a series of experiments in order to determine the composition and nutritional value of lentils in pigs and to study the inclusion of flaxseed in the rations of growing pigs.

Lentils

Two lentil samples were considered for the study: a blend of brown, yellow and red lentils and frozen lentils. The two samples had similar composition, with an average of 27% of crude protein, 18% total dietary fibre and more than 40% starch. On the contrary, the ash and fat contents were very low, accounting for only 3 and 1% of the dry matter, respectively. The composition is comparable to that of peas, except that the crude protein content is higher (X% lentils vs. Y% peas) and starch (X% lentils vs. Y% peas). The amino acid profile is also typical of pulses with a high level in lysine (6.2% of the protein) and a low level in sulphur-containing amino acids (methionine and cysteine: 2%). The lysine level is lower than that of peas (17% lentils vs. 23% peas).

The digestible energy value reached 3,715 kcal DE/kg DM in both cases, which is slightly lower than the value obtained for peas (3,850 kcal/kg DM) but comparable to that of faba beans (3,750 kcal). The digestibility of the protein, measured at the end of the small intestine (ileum) reached 62% on average, which is in agreement with other studies carried out on pulses. For the frozen lentils, no definitive value of protein digestibility could be obtained, for problems encountered during the study but, according to our observations, the value was markedly lower than that obtained for the blend of lentils, which indicates that freezing conditions affect the digestibility of the proteins.

As a conclusion, lentils constitute an appreciable ingredient for the pig, with a nutritional value slightly lower than that of peas, which means that the rate of inclusion in the diet of growing-finishing pigs will probably not exceed 20% of the diet.

Table 1. Composition and nutritional value of lentils in pigs

	Blend	Frozen
Composition, g/kg DM		
Dry matter, g/kg	892	887
Ash	29	30
Crude protein	273	269
Lysine	16.7	17.0
Methionine-cysteine	5.4	5.2
Threonine	11.0	11.5
Fat	11	11
Starch	406	409
Neutral Detergent Fibre	140	145
Total dietary fibre	168	190
Digestible energy, Mcal/kg	3,718	3,712
Ileal protein digestibility (%)	62.5	-

Table 2. Average feed intake, daily gain and feed efficiency in pigs receiving increasing levels of flaxseeds and canola oil

Treatment Description	Average daily gain (g/d)	Average feed intake (g/d)	Feed-to-gain ratio
basal diet	1038	2314	2.22
5 % flaxseed	1088	2384	2.16
10 % flaxseed	1034	2173	2.10
15 % flaxseed	1029	2226	2.15
20 % flaxseed	1001	2302	2.27
1.7 % canola oil	1069	2304	2.14
3.3 % canola oil	1067	2177	2.04
5.0 % canola oil	1110	2324	2.08
6.7 % canola oil	1012	2035	1.96

Protein 27% lentils vs. 22% peas
Startch 40% lentils vs. 50% peas

Flaxseed

Flaxseed is a grain with high levels of oil (35%) and crude protein (25%). The high oil content makes flaxseed a major energy source for the pig (4,650 kcal/kg DM). However, the main interest lies in the oil composition. The oil is mainly composed of linolenic acid, which belongs to the omega-3 group. Pork producers want to know if it is possible to produce omega-3 enriched pork by supplementing the diets with flaxseed. Before any conclusion could be drawn on the quality of the end-product, it was necessary to evaluate the response of pigs to flax in their diet, to confirm the nutrient profile previously developed, and to determine if the feeding of relatively high levels of flaxseed causes changes in performance not predicted by the nutrient profile.

Therefore, a growth experiment was carried out with growing pigs fed with diets containing 0, 5, 10, 15 or 20% of flaxseed, at the expense of a control diet composed of barley, wheat and soybean meal. In order to distinguish between the effect of flaxseed and that of the oil level in the diet, four other diets were supplemented with canola oil, in order to match the amounts of oil in the flaxseed diets. The diets contained, respectively 2.2% oil (control diet), 3.5%, 5.0%, 6.7% and 8.5 oil.

There was no adverse impact of flaxseed inclusion on average daily gain, up to 15% inclusion. The highest level of flaxseed inclusion tended to reduce growth rate, something also observed at the highest canola oil inclusion. The highest level of canola oil inclusion significantly reduced daily feed intake; this was probably due to the fact that the canola oil was not completely absorbed from the diet. Intake of the high flax diet was greater than that on the high canola oil diet. There tended to be an increase in feed efficiency at the lower levels of oil inclusion, whether from flaxseed or canola oil; however, only the canola oil diets sustained this improvement at the highest levels of inclusion.

No relationship (r = 0.03) was found between digestible energy intake and average daily gain (Figure 1). This illustrates the fact that the inclusion of up to 15 % flaxseed in the diet does not affect the pig's performance.

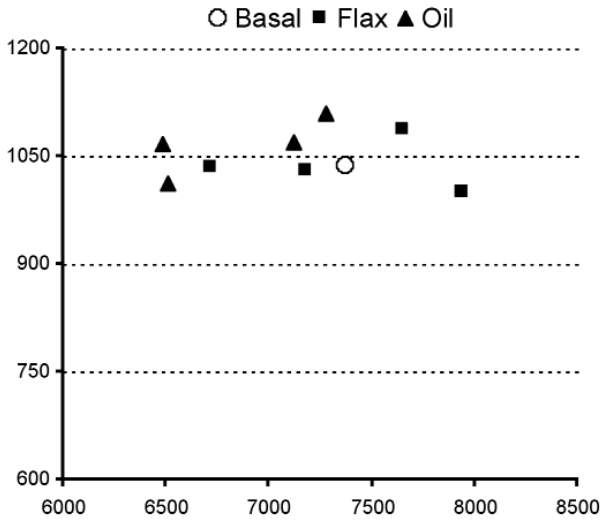

Figure 1. Relationship between average daily gain and digestible energy intake in pigs fed diets with increasing levels of flaxseed or canola oil

The Bottom Line

It can be concluded that balanced diets containing up to 15 % flaxseed will not adversely affect the average daily gain, feed intake or feed efficiency of growing pigs and that growing pigs tolerate high levels (~ 7 %) of fat in the form of flaxseed better than equivalent levels of canola oil.

Table 1. The effect of parity on the aggression at mixing, scratch score, feeder entry order and proportion of time lying against the wall and on the slats.

Behaviour	Young	Intermediate	Old
Number of Aggressive Encounters at Mixing	2.9	2.42	4.60
Scratch Score	4.01	3.61	3.55
Feeder Entry Order	0.644	0.477	0.445
Cortisol (ng/mL)	9.08	7.46	9.15
Lying Patterns (%)			
Wall	19.2	21.3	44.2
Slat	33.1	24.1	10.9
Farrowing Rate (%)	83.8	88.2	86.1

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the new feeding cycle has begun, which is a key time for aggression at the feeder. There was a tendency for the young sows to receive more scratches than the intermediate and old sows. The young sows ate significantly later in the feeding cycle and rested on the slats a greater percentage of the time than the intermediate and old sows. While the old sows laid against the wall, the more preferable area, more than the intermediate and young sows. All the data pertaining to parity is outlined in Table 1.

Of course a major concern is how do these factors examined affect the farrowing productivity of the sows. There were no statistical differences in farrowing rates between age groups. However, numerically there were some notable differences. There was a 6% higher farrowing rate in the dynamic housing system (static 83.6% versus dynamic 89.1%).The sows mixed post-implantation had a 6% higher farrowing rate (pre-implant 83.6% versus post-implant 89.95%). There was slight variation in the farrowing rates based upon parity (Table 1). Familiarity did not affect the farrowing rate (familiar 87.3% versus unfamiliar 85.2%).

The Bottom Line

Under certain management conditions [large group size(>80 sows), sufficient time between regroupings, minimal mixing during embryonic implantation] the dynamic housing system is just as effective as a static housing system in regards to the sows' productivity.

Secondly, it is best to mix sows after embryonic implantation, as the sows are more docile, thus reducing the negative consequences associated with housing sows in groups.

At low levels, familiarity does not affect the behaviour of the sow.

The parity distribution within a group of sows can influence the behaviour. The older sows underwent higher social stress due to the defending their dominant position within the hierarchy, which resulted in them having the best access to resources within the pen. While the young sows underwent more social stress due to their inability to obtain access to the resources, which relates to their subordinate position within the dominance hierarchy.

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