

Successfully Feeding Lentils to Finishing Pigs

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Saskatchewan is the world's leading exporter of lentils, and the world's second largest producer (Government of Saskatchewan, 2014). In 2014, approximately 1.64 million tonnes of lentils were produced in Saskatchewan, which was 87% of the previous year's production (Stats Canada, Sept 2014). Lentil production in Saskatchewan is nothing short of a success story, increasing production more than 100% since 2008 has provided valuable jobs throughout the province.

Lentils, primarily grown for export (mainly to India), can be downgraded due to chipping, wrinkling or staining, which may be a result of adverse growing conditions. As of November, it was estimated that 40% of the 2014 Saskatchewan lentil crop, or 0.66 mmt, will be graded as sample salvage quality. If 10% of lentil production in Canada is considered unacceptable for export, 0.19 million tonnes would be available for feed each year. If included at 10% of the diet, this would feed more than 4.5 million pigs from weaning to market.

However, information on the feeding value of lentils, regardless of quality, is sparse. A study conducted at PSC was designed to characterize the nutritive composition, including digestibility and energy concentration, of feed-grade (cull) lentils for growing pigs. We conducted two studies at PSC. The first study determined the amount and digestibility of energy and amino acids in two samples of lentils. In the second study we used these values to formulate diets for growing and finishing pigs. We assume that if the pigs grow as expected, then the nutrient values determined in the first experiment are correct for that category of pig.

Table 1: Ingredient composition of experimental diets for the growth validation trial

Ingredient, % as fed	Grower ¹		Finisher ¹	
	0%	30%	0%	30%
Feed lentils (grade 3)	0.00	30.00	0.00	30.00
Wheat	71.15	42.13	15.20	45.60
Barley	0.00	4.53	61.02	9.78
Soybean meal	25.00	17.90	19.00	9.60
Canola oil	1.40	3.00	3.00	3.00
Mono-dicalcium P	0.80	0.93	0.43	0.53
Limestone	0.93	0.83	0.70	0.83
Salt	0.40	0.40	0.40	0.40
Mineral and vitamin premix	0.25	0.25	0.25	0.25
L-Lysine	0.07	-	-	-
DL-methionine	-	0.03	-	-

¹ Diets formulated with lentils included at 10 and 20% were intermediate.

Nutrient Digestibility

Ten barrows (initial weight 35 to 40 kg), were surgically fitted with T-cannulas at the terminal ileum. Two lentil samples (feed grade 2 (red) and 3 (feed)) were incorporated at two inclusion levels (15 and 30%) into a wheat/barley-based control diet. Five treatment diets (2 lentil samples at 2 inclusion levels, plus 1 control diet) were randomly assigned to 2 pigs in each of three replicates, providing 6 pigs per treatment overall. Each replicate lasted 9 days and consisted of 4 days of dietary adaptation, followed by 3 days of faecal collection and 2 days of digesta collection.

Growth Validation In this experiment, 200 growing (initial weight, 35 kg) and 200 finishing (initial weight, 90 kg) pigs received a diet with feed lentils (grade 3) included at 0, 10, 20 or 30%. All diets were wheat and barley based, and formulated to be isocaloric and isonitrogenous, based on the results of the digestibility experiment (Table 1) and met all the nutrient requirements of growing and finishing pigs (NRC, 2012). Growth rate, feed intake and feed efficiency were measured throughout the trial, which lasted for 4 weeks..

Results

The chemical composition and determined DE and NE values are shown in Table 2. Crude protein content was comparable between these two samples; however the red lentils sample contained 25% more crude fibre and 45% less total fat than the sample of feed lentils. Values from the NRC (2012) are provided for reference. The lack of data on lentils is evident as the NRC (2012) bases their data on a single sample. This sample was lower in fibre, higher in fat, protein and energy relative to those tested in the current trial. The calculated DE and NE content of the feed lentils was slightly higher than the red lentils, while both are lower than the sample described in the NRC (2012), a reflection of the lower fibre content of that sample.

Table 3 shows the measured amino acid content two lentil samples. This table also shows the amount of apparently digestible amino acids based on digestibility coefficients obtained in the first experiment. Ileal amino acid digestibility of the red lentils sample was 60 to 70% of the feed lentils, possibly a reflection of the higher fibre content of the red lentil sample.

Overall, we observed no adverse effects of including up to 30% feed lentils (feed grade 3) into the diets of growing or finishing pigs, when the diets were balanced properly to meet the nutrient requirements of the animals. In fact, we saw an increase in ADG in finishing pigs as dietary inclusion of feed lentils increased. As expected, we did observe gender differences, with barrows having greater ADG and ADFI, but gilts and barrows responded similarly to the inclusion of lentils in the diet.

Discussion

In these trials, the maximum inclusion level was 30%. We did observe a potential effect of inclusion level. Amino acid digestibility was decreased at the 30% level relative to 15% inclusion. For this reason, we would caution the inclusion of cull lentils beyond 30% of the diet, but with properly formulated diets, 30% can be used without adversely affecting performance.

“Lentils can be included up to 30% in grower-finisher diets”

Table 2: Chemical and nutritive composition of red and feed lentils (as fed)

	Feed Grade 2	Feed Grade 3	NRC 2012 (n=1)
Moisture, %	11.5	11.0	10.0
Dry matter, %	88.5	89.0	90.0
Crude protein, %	21.8	23.3	26.0
Crude fibre, %	4.0	3.2	ND ²
Fat, %	0.6	1.1	1.3
Ash, %	2.2	2.6	2.8
Starch, %	40.7	37.5	4.2
Acid detergent fibre, %	5.7	5.5	3.0
Gross energy, kcal/kg	3458.0	3516.0	4483.0
Digestible energy, kcal/kg ¹	2895.0	2990.0	3540.0
Net energy, kcal/kg ¹	2021.0	2086.0	2437.0

¹Values calculated from experimental determination of digestibility.

²Not determined.

Table 3: Amino acid composition of Red and Feed lentils (g AA/100 g, all as fed basis)

	Feed Grade 2 ¹		Feed Grade 3 ²	
	Total	AID3	Total	AID3
Dry Matter	88.5		89.0	
Aspartic Acid	2.74	0.85	2.61	1.65
Threonine	0.85	0.35	0.80	0.61
Serine	1.05	0.56	0.93	0.77
Glutamic acid	3.68	1.98	3.55	2.54
Proline	0.87	0.39	0.86	0.56
Glycine	0.97	0.27	0.94	0.42
Alanine	0.99	0.28	0.99	0.64
Cysteine	0.23	0.06	0.22	0.15
Valine	1.14	0.28	1.14	0.52
Methionine	0.19	0.10	0.18	0.14
Isoleucine	0.98	0.26	0.99	0.46
Leucine	1.74	0.60	1.68	1.06
Tyrosine	0.70	0.23	0.67	0.42
Phenylalanine	1.15	0.31	1.14	0.68
Lysine	1.65	0.52	1.61	1.01
Histidine	0.65	0.29	0.61	0.40
Arginine	1.83	0.90	1.88	1.34
Tryptophan	0.14	0.05	0.15	0.05

¹Red lentils were classed as feed grade 2

²Feed lentils were classed as feed grade 3

³AID = apparent ileal digestible

Differences between the two lentils samples are interesting. We only had one sample of each type, therefore **we can't conclude from this study if differences between varieties exist, or just a sample difference**. However, it is apparent, that fibre analysis will assist nutritionists with an estimation of the energy content.

In a previous study (Landro et al., 2012), human grade green lentils were included into the diets of starter pigs (9 to 20 kg). They observed that inclusion levels beyond 22.5% had negative effects on growth, without impacting feed intake. In our study, pigs were older, and appear to be able to tolerate larger amounts of lentils without impacting performance. The lentils used in our study were feed grade (cull) lentils, not human food grade lentils. The lentils, however, are down-graded for appearance, which does not necessarily impact nutritive value.

Improved growth of the finishing pigs as lentil inclusion (into their diets) increased may indicate that the nutritive value of the lentil sample was under-estimated for this class of pig. Digestibility coefficients were obtained in younger pigs and it has been shown in other studies that these values under-estimate digestibility in older pigs

The Bottom Line:

Results from this project provide the hog industry with information needed to properly formulate diets using feed grade lentils. The full nutritive value, including DE, NE, and amino acid digestibility, of the samples used in this study allows producers to include cull lentils into rations with confidence. As evidenced in the validation study, when diets were formulated using the nutritive value information, and were balanced to meet the requirements of the age of the pig, no adverse effects were observed on performance.

