Feeding value of cull lentils for growing swine

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Introduction

Saskatchewan is the world's leading exporter of lentils, and the second largest producer (Government of Saskatchewan, 2014). In 2014, approximately 1.64 million tonnes of lentils were produced in Saskatchewan, which was 87 per cent of the previous year's production (Stats Canada, Sept 2014). The production of lentils in Saskatchewan has increased by more than 100 per cent since 2008 (Stats Canada, 2014), and the marketing and processing industry accompanying this increased production provides valuable jobs throughout the province.

Lentils, primarily grown for export (mainly to India), are often downgraded due to chipping, wrinkling or staining, which may be a result of heavy rains late in the growing season, which occurred in 2014. As of November, it was estimated that almost 40 per cent of the 2014 Saskatchewan lentil crop, or 0.66 million tonnes, will be graded as sample salvage quality. On average, if just 10 per cent 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 per cent 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. The current study was designed to characterize the nutritive composition, including digestibility and energy concentration, of feed-grade (cull) lentils for growing pigs. We conducted two studies. 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 growth validation trial

Ingredient, per cent as fed	Grower[1]		Finisher[1]	
	0 per cent	30 per cent	0 per cent	30 per cent
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 per cent were intermediate.

Experimental. Materials and Methods

Experiment 1: 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 two (red) and three (feed)) were incorporated at two inclusion levels (15 and 30 per cent) into a wheat/barley-based control diet. The five treatment diets (two lentil samples at two inclusion levels, plus 1 control diet were randomly assigned to two pigs in each of three replicates, providing six pigs per treatment overall. Each replicate lasted nine days and consisted of four days of dietary adaptation, followed by three days of faecal grab-sampling and two days of digesta collection.

Experiment 2: 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

CONTINUED ON PAGE 60

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

	Red Lentils	Feed Lentils	NRC 2012 (n=1)
Moisture, per cent	11.5	11.0	10.0
Dry matter, per cent	88.5	89.0	90.0
Crude protein,	21.8	23.3	26.0
Crude fibre, per cent	4.0	3.2	ND[2]
Fat, per cent	0.6	1.1	1,3
Ash, per cent	2.2	2.6	2.8
Starch, per cent	40.7	37.5	4.2
Acid detergent fibre, per cent	5.7	5.5	3.0
Gross energy, kcal/kg	3458	3516	4483
Digestible energy, kcal/kg[1]	2895	2990	3540
Net energy, kcal/kg[1]	2021	2086	2437

[1]Values calculated from experimental determination of digestibility.
[2]Not determined.

(grade 3) included at 0, 10, 20 or 30 per cent. 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 four weeks.

Results

The chemical composition and determined DE and NE values are shown in Table 2. The crude protein content was comparable between these two samples; however the red lentils sample contained 25 per cent more crude fibre and 45 per cent 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 of the red and feed 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 is 60 to 70 per cent of the feed lentils, which is most likely due to the high fibre content of this sample of red lentils.

The results of the validation experiment are shown in Table 4. Overall, we observed no adverse effects of including up to 30

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

	Red Lentils[1]		Feed Lentils[2]	
	Total	AID[3]	Total	AID[3]
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

per cent 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 per cent. We did observe an interaction between digestibility and inclusion level in the first trial. Amino acid digestibility was decreased at the 30 per cent level relative to 15 per cent inclusion. For this reason, we would caution the inclusion of cull lentils beyond 30 per cent of the diet, but with properly formulated diets, 30 per cent can be used without adversely affecting performance.

The difference between the red and feed lentils samples is interesting. Because we only had one sample of each, we can't conclude from this study if this really is a difference between these lentil varieties, 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 (Landero 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 per cent had negative effects on growth, without impacting feed intake. In our study pigs were older and appear to have been 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.

The 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. The digestibility coefficients were obtained in younger pigs, and it has been shown in other studies that these values underestimate 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

CONTINUED ON PAGE 62

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.

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Table 4: Growth (ADG), feed intake (ADFI) and feed efficiency of growing and finishing pigs fed diets with graded levels of feed lentils (feed grade 3) for a 4 week trial

	Treatment					P Values		
	0 per cent	10 per cent	20 per cent	30 per cent	SEM	Diet	Linear	Quadratic
	Growing pigs							
Initial BW, kg	41.30	41.00	40.62	41.11	0.213			
ADG, kg/d	1.04	1.03	1.03	1.05	0.014	0.60	0.41	0.28
ADFI, kg/g	2.05	2.03	2.03	2.06	0.041	0.90	0.85	0.47
Gain:Feed,	0.51	0.51	0.51	0.51	0.011	0.99	0.92	0.93
Feed: Gain	1.96	1.96	1.96	1.96				
	Finishing pigs							
Initial BW, kg	91.17	89.99	89.52	90.98	0.550			
ADG, kg/d	1.02	1.02	1.03	1.07	0.017	0.10	0.02	0.30
ADFI, kg/d	2.83	2.82	2.84	2.92	0.069	0.22	0.09	0.22
Gain:Feed	0.36	0.36	0.37	0.37	0.007	0.80	0.33	0.96
Feed:Gain	2.78	2.78	2.70	2.70				