Feeding Value of Cull Lentils

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SUMMARY

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.

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. The production of lentils in Saskatchewan has increased by more than 100% since 2008 (Stats Canada, 2014), and the accompanying increase in marketing and the processing industry 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. Approximately 40% of the 2014 Saskatchewan lentil crop (0.66 million tonnes) was graded as salvage quality. On average, if just 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.

MATERIAL AND METHODS

Experiment 1: Nutrient Digestibility

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

"Lentils can represent up to 30% in growing - finishing pig diets without compromising performance."

RESULTS AND DISCUSSION

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% 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 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% 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% feed lentils (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.

In these trials, the maximum inclusion level was 30%. We did observe an interaction between digestibility and inclusion level in the first trial. 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.

The improved growth of the finishing pigs with increased inclusion of lentils into their diets indicates 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 under-estimate digestibility in older pigs.

CONCLUSION

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 this 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 1. Ingredient composition of experimental diets for growth validation trial.

	Grower		Finisher	
Ingredient, % as fed	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	-	-

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

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

	Red Lentils	Feed Lentils	NRC 2012 (n=1)
Composition, % as fed			
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	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.

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

[1]Red lentils were classed as feed grade 2

Feed lentils were classed as feed grade 3

[3]AID = apparent ileal digestible

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%	10%	20%	30%	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				