EFFECTS OF AMMONIA AND STEAM TREATMENT OF LOW GLUCOSINOLATE RAPESEED SCREENINGS ON THEIR NUTRITIVE VALUE

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The efficiency of feed utilization by pigs was adversely affected by the inclusion of fine screenings obtained from low glucosinolate rapeseed (Bell and Shires, 1980). The screenings included weed seeds containing glucosinolates and myrosinase. Kirk et al. (1966) found reduced concentrations of glucosinolate and sinapine after ammoniation of crambe meal. Coxworth and McGregor (1980) reported similar results upon ammoniation of mustard seeds.

The objectives of these experiments were to determine the effects of (a) wet cooking (WC) with and without ammonia (NH_3) on the composition of screenings processed in a pilot plant, (b) uncooked (UC), WC and WC + NH_3 treated screenings on performance of growing-finishing pigs and (c) processing on digestibility of screenings from low glucosinolate rapeseed (canola).

MATERIALS AND METHODS

Two lots of fine canola screenings were used. One contained 13.6% lamb's-quarters (*Chenopodium album*, L.) and 7.2% stinkweed (*Thlaspi arvense*, L.). The other lot contained 20.3 and 14.7%, respectively. Several other weed species were present in very small amounts but the screenings were composed predominantly of small and broken rapeseeds.

The screenings were flaked in a roller (0.15 mm gap). The WC sample was cooked one hour at 95 to 100°C, then 15% water was added in a Simon-Rosedowns cooker (two-tray) followed by one hour cooking, then drying for 35 min at 70 to 80°C. The WC + NH_3 sample was processed similarly except that 3.2% NH_3 and 5% water were added before drying.

A feeding trial of 2 x 2 x 2 x 3 factorial design and involving 96 pigs was used to determine the effects of processing of screenings on growth and feed utilization. Each lot of screenings was fed at 10 and 20% of the diet, for each of the three processing methods, to gilt and barrow three-way-cross pigs over the 23 to 57 kg weight range. A control diet containing no screenings was included in the experiment.

The diets were based on barley and wheat (2:1) and contained 5% soybean meal, 3.6% mineral-vitamin premix, 4 to 10% canola meal and 0, 10 and 20% screenings such that the dietary protein was held constant.

A digestibility experiment involved testing 15 and 30% levels of the six screenings samples, a basal diet of grain, minerals and vitamins, and the basal diet supplemented with casein to obtain 16% crude protein. The 14 diets were each fed to four barrows allotted randomly within collection periods, using chromic oxide as a fecal marker. Digestibility coefficients for dry matter, crude protein and energy were determined for the diets and subsequently for the screenings fractions.

RESULTS AND DISCUSSION

The screenings contained about 28% ether extract (Table 1) which was reflected in the relatively high gross energy values of about 25 MJ/kg. Ammoniation increased the crude protein content by 4.3 percentage units, equivalent to about 0.7% NH_3 remaining in the treated screenings.

Crude fibre levels in screenings were similar to those of canola meal, when adjusted to a fat-free basis but the acid and neutral detergent fibre values appeared to be higher than in canola meal.

The amino acid contents of screenings may have been adversely affected by processing (Table 2). The total lysine as well as its availability were reduced more severely than in the case of the other essential amino acids. The amount of available lysine was reduced by 25% by ammoniation.

Ammoniation markedly reduced the glucosinolate contents of screenings (Table 3), nearly eliminating the allyl and indolyl compounds. Cooking had intermediate effects on glucosinolates but WC or WC + NH_3 screenings contained substantially lower levels of glucosinolates than occurred in the canola meal used.

In the feeding trial, pigs fed the screenings with the higher weed seed and glucosinolate contents grew more slowly (583 and 611 g/day) than the others ($P>0.05$). Likewise pigs fed the 10% level performed slightly better than those fed 20% (612 and 583 g/day) ($P>0.05$).

The feeding of diets containing screenings resulted in smaller daily gains (Table 4) than with the control diet but feed efficiency was improved which may reflect the higher energy content of screenings than of canola meal. Processing showed that WC screenings gave better daily gain than either UC or WC + NH_3 screenings. The latter resulted in poorer feed conversion. The adjusted gains indicate that the slower growth of pigs fed the WC + NH_3 screenings was not due to reduced daily feed intake. It is possible that the benefit from reduced glucosinolate content was counterbalanced by the reduction in essential amino acids, especially available lysine.

Increasing the level of screenings in the diet from zero to 15 and 30% resulted in decreasing dietary digestibility of energy (80, 78, 75%, respectively) and similarly with protein digestibility (78, 75, 72%, respectively). The digestibility coefficients of protein and energy in screenings per se were lower than those found in canola meal (Table 5). Cooking, with or without NH_3, had no effect on energy digestibility but may have depressed the digestibility of protein, which concurs with the reduction observed in availability of lysine.

CONCLUSIONS

Wet-cooking of screenings reduced glucosinolates by over 60% and reduced the availability of lysine by 25% but permitted better growth rates in pigs. Wet-cooking with ammonia reduced glucosinolates by 95%, reduced protein and lysine digestibility, and adversely affected efficiency of feed utilization. The digestible energy content of screenings averaged 14.4 MJ/kg (3440 kcal/kg) and was not affected by processing. Pigs fed diets containing screenings had daily gains equal to 94 to 97% of those fed the control diet and showed 4 to 5% improved efficiency of feed utilization, depending on the processing method used.

REFERENCES

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Table 1. Gross energy and chemical composition† of screenings, compared to commercial canola meal

Component	Processing method			Canola meal
	Uncooked	Wet-cooked	Wet-cooked + NH_3	
Gross energy, MJ/kg	24.87	24.30	24.90	20.59
Crude protein, %	22.15	21.94	26.23	41.15
Ether extract, %	28.01	28.45	28.36	4.14
Crude fibre, %	7.88	8.92	8.71	13.37
Neutral detergent fibre, %	25.28	29.47	31.68	26.13
Acid detergent fibre, %	22.53	19.36	21.09	22.24
Ash, %	7.26	7.36	7.34	7.11

† Dry matter basis.

Table 2. Amino acid composition of canola screenings (% of dry matter)

Component	Processing method		
	Uncooked	Wet-cooked	Wet-cooked + NH_3
Total essential amino acids	8.85	8.34	8.06
Lysine	1.34	1.25	1.24
Available lysine	1.25	0.97	0.93

Table 3. Glucosinolate content of canola screenings and canola meal (μmole/g oil extracted dry matter)

	Processing method			
Glucosinolate	Uncooked	Wet-cooked	Wet-cooked + NH_3	Canola meal
Allyl	19.34	3.66	0.14	1.96
3-butenyl	3.16	0.70	0.17	4.85
4-pentenyl	1.37	0.25	trace	1.46
2-hydroxy-3-butenyl	6.65	1.58	0.50	10.86
Hydroxypentenyl	0.46	0.13	0.17	0.80
Hydroxybenzyl	0.53	0.10	trace	0.58
3-indolylmethyl	0.53	0.07	trace	0.60
Methoxy-3-indolylmethyl	6.55	0.22	trace	4.41
Total	38.59	6.71	0.98	25.52

Table 4. Effects of method of processing screenings on daily gain and efficiency of feed utilization

Treatment	Gain/day g	Feed/gain ratio	Adjusted gain/day g
Uncooked	576*b*	2.62*b*	605*ab*
Wet-cooked	625*a*	2.57*b*	617*a*
Wet-cooked + NH_3	588*b*	2.72*a*	584*b*
Control	614*a*	2.76*a*	
Screenings	597*b*	2.64*b*	

Table 5. Apparent digestibility of crude protein and energy in canola screenings according to source and processing methods

Treatments	Apparent digestibility, %	
	Crude protein	Energy
Screenings 1	65.7	67.6
2	65.0	63.1
Uncooked	67.4	64.8
Wet-cooked	63.6	65.6
Wet-cooked + NH_3	65.0	65.6
Canola meal (Bell et al.,1981)	81	71