TRUE AMINO ACID AVAILABILITY OF WHOLE OR FLAKED, RAW OR COOKED FULL-FAT OR EXTRACTED CANOLA SEED

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INTRODUCTION

The effect of feeding diets containing up to 328 g/kg of canola seed processed by different methods on the performance of growing turkeys has been reported (Salmon et al. 1988). Cooking had no effect, but both flaking and extrusion increased live weights and improved feed efficiencies of birds fed diets containing full-fat canola seed. Steam pelleting was even more effective, resulting in feed efficiencies for diets containing whole or flaked seed that were similar to those of birds fed diets containing equivalent levels of fully extracted canola meal plus oil.

True metabolisable energy (TME) assays confirmed the effects of processing on the bioavailability of energy. However, differences in final live weights indicated that none of the processing procedures made canola seed fully equal in nutritional value to extruded seed or to canola meal plus oil. Processing methods might lead to differences in availability of the protein component of the seed. Therefore the effect of processing on the true available amino acids (TAAA) of canola seed was examined. Results of those assays are presented. The TAAA of extruded seed is not shown because satisfactory extrusion required that the canola seed be blended with another feedstuff. Analyses of prepress oilcake are shown, however, because of its potential use as a dietary protein and energy source.

MATERIALS AND METHODS

All canola products were produced at the POS Pilot Plant, Saskatoon, Saskatchewan, from seed of a Brassica napus cultivar that contained 245 g protein/kg, 406 g oil/kg, 76 g moisture/kg, 0.93 mg glucosinolates/g, and erucic acid 0.59% of fatty acids. Cooking was for 30 min in a Simon Rosedowns two-stage laboratory cooker, with top and bottom trays maintained at 60 and 80C, respectively. Flaking was accomplished with a Turner Ipswitch roller mill with a roll clearance of 0.2 mm and rotative speed of 300 rpm. Expelling employed a Simon Rosedowns laboratory screw press, and extraction a Crown Iron Works six stage counter-current solvent extractor. The TAAA value of each product was determined using five replicate adult White Leghorn cockerels for each sample (Sibbald 1986; Salmon et al. 1987). Five unfed cockerels provided an estimate of metabolic plus endogenous losses. Amino acids were determined with a Beckman 121 amino acid analyser on 24-hr hydrolysates of duplicate feed samples and individual excreta samples in 6 N HCl. Methionine and cystine assays of those samples using performic acid oxidation were lost; the values reported for those amino acids are those determined on similarly prepared material using another batch of seed, except that only uncooked whole and flaked seed were analysed.

RESULTS AND DISCUSSION

Amino acid compositions of whole and flaked canola seed were similar, but cooking appeared to increase amino acid recovery from both whole and flaked seed (Table 1). Relative amino acid availability of flaked seed was markedly improved over that of whole seed (Table 2). Cooking had no consistent effect on availability. The amino acid availability of prepress oilcake was similar to that of flaked seed, except that the availabilities of lysine, histidine, arginine, cystine and proline were slightly lower in oilcake than in flaked seed. Availabilities of those amino acids were further reduced in fully extracted and desolventised-toasted canola meal (DT meal). The beneficial effect of flaking on amino acid availability may be attributed to the physical disruption of the seed coats and/or cell walls by the action of the rollers, thereby rendering the enclosed nutrients more readily accessible by the birds' digestive enzymes. The small reductions in availability of some amino acids in prepress oilcake and DT meal may have resulted from the heat generated by pressure in the expeller and in the desolventising-toasting process. Protein damage is known to occur during those procedures, lysine being the amino acid most severely affected (Clandinin 1986).

The absolute levels of TAAA show clearly the improvement in nutritive value of flaked as compared with whole seed, whether raw or cooked (Table 3). However, diets containing flaked seed produced smaller birds than those fed diets containing DT meal, despite the superior amino acid availability of the former. The comparative TAAA of canola in pelleted versus mash form was not determined; thus we cannot explain the improved rate of growth and feed efficiency achieved with pelleted diets, except to speculate that the crushing, shearing and pressurising forces imposed may have rendered the energy and other nutrients more readily available to the birds. The beneficial effect of pelleting on the bioavailability of energy was confirmed by comparative TME assays of mash versus pelleted diets (Salmon et al. 1988). However, growth performance of poults fed diets containing whole or flaked seed, even in pelleted form, was not equal to that of poults fed diets with equivalent levels of DT meal plus oil.

CONCLUSIONS

The data presented show that the nutritional value of canola seed for poultry may be markedly improved by processing the seed in such a way as to disrupt its structure, rendering its nutrient contents more readily accessible to digestion. Flaking the seed in a roller mill effectively improved amino acid availability, although poult performance was superior with completely extracted meal. Heating the seed in a steam cooker was of little benefit in improving either TAAA or the performance of growing turkeys. Prepress canola oilcake appears to have potential as a relatively high-energy source of available nutrients. Steam pelleting diets containing either whole or flaked canola seed was previously shown to improve both growth and feed efficiency, but its effect on the TAAA of the individual feedstuffs could not be determined.

REFERENCES

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Table 1. Amino acids in variously processed canola seed (% as fed)

	Whole seed		Flaked seed		Prepress	DT[1]
	Raw	Cooked	Raw	Cooked	oilcake	meal
Aspartic acid	1.91	2.15	1.92	2.10	2.91	3.59
Threonine	1.23	1.33	1.22	1.34	1.77	2.12
Serine	1.12	1.22	1.12	1.20	1.67	2.12
Proline	1.27	1.37	1.26	1.36	1.90	2.40
Glutamic acid	4.15	4.46	4.30	4.52	6.38	8.21
Alanine	1.10	1.20	1.12	1.20	1.65	2.07
Valine	1.15	1.28	1.19	1.27	1.71	2.17
Cystine	0.58	0.58	0.58	0.58	0.77	0.95
Methionine	0.54	0.54	0.53	0.53	0.71	0.91
Isoleucine	0.89	0.96	0.90	0.97	1.34	1.67
Leucine	1.75	1.90	1.78	1.92	2.66	3.35
Tyrosine	0.69	0.76	0.72	0.75	1.06	1.32
Phenylalanine	0.96	1.05	0.99	1.05	1.46	1.83
Lysine	1.39	1.40	1.39	1.42	1.96	2.35
Histidine	0.57	0.59	0.58	0.59	0.81	1.19
Arginine	1.55	1.64	1.60	1.64	2.27	2.87
Totals[2]	20.82	22.41	21.19	22.45	31.01	39.11
Prot.(N X 6.25)	23.6	24.0	24.1	24.0	32.9	40.9
Oil	40.6	(3)	(3)	(3)	17.0	2.7
Dry matter	92.0	(3)	92.7	93.9	90.6	89.0

(1) Desolventiser-toaster.
(2) Tryptophan and glycine not included.
(3) Not determined.

Table 2. Availability of amino acids in variously processed canola seed (%)

	Whole seed		Flaked seed		Prepress	DT
	Raw	Cooked	Raw	Cooked	oilcake	meal
Aspartic acid	68.0	64.9	87.7	90.0	88.5	85.5
Threonine	66.2	61.8	85.5	87.6	85.2	83.5
Serine	65.5	60.7	85.3	87.9	85.4	83.6
Proline	62.2	57.0	86.0	86.0	81.5	79.3
Glutamic acid	74.0	71.4	93.3	94.0	92.8	91.2
Alanine	66.4	64.4	87.6	89.1	88.0	86.7
Valine	66.2	61.4	85.9	87.7	85.7	85.3
Cystine	73.7	74.6	91.0	94.1	83.3	69.1
Methionine	70.2	65.0	92.4	92.9	92.8	85.5
Isoleucine	65.6	59.3	85.9	87.5	86.8	86.3
Leucine	67.1	61.5	88.2	89.8	89.3	88.6
Tyrosine	67.5	63.1	86.7	88.5	87.4	86.7
Phenylalanine	68.2	63.2	90.1	91.2	89.3	88.5
Lysine	65.7	63.7	85.5	86.6	82.5	79.6
Histidine	68.5	65.7	89.6	91.6	88.1	87.4
Arginine	71.1	67.1	94.0	94.7	90.8	88.2
Means	67.88	64.05	88.42	89.95	87.34	84.69

Table 3. True available amino acids in processed canola seed (% as fed)

	Whole seed		Flaked seed		Prepress	DT
	Raw	Cooked	Raw	Cooked	oilcake	meal
Aspartic acid	1.30	1.39	1.69	1.89	2.57	3.07
Threonine	0.81	0.82	1.04	1.18	1.51	1.77
Serine	0.73	0.74	0.95	1.06	1.43	1.77
Proline	0.79	0.78	1.08	1.17	1.55	1.90
Glutamic acid	3.07	3.19	4.01	4.25	5.92	7.49
Alanine	0.73	0.77	0.98	1.07	1.45	1.79
Valine	0.76	0.78	1.02	1.11	1.46	1.85
Cystine	0.43	0.43	0.53	0.54	0.64	0.66
Methionine	0.38	0.35	0.49	0.50	0.66	0.78
Isoleucine	0.58	0.57	0.77	0.85	1.16	1.44
Leucine	1.17	1.17	1.57	1.72	2.38	2.97
Tyrosine	0.47	0.48	0.62	0.67	0.92	1.14
Phenylalanine	0.65	0.66	0.89	0.96	1.30	1.62
Lysine	0.91	0.89	1.19	1.23	1.62	1.87
Histidine	0.39	0.39	0.52	0.54	0.71	1.04
Arginine	1.10	1.10	1.50	1.55	2.06	2.53
Totals	14.27	14.52	18.86	20.28	27.34	33.69