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RESEARCH NOTE

Insensitivity of the amino acids of canola and rapeseed to methanol–ammonia extraction and commercial processing†

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Amino acid composition of rapeseed meals treated with ammonia in absolute or 95% methanol was compared to those of their hexane-extracted counterparts as well as a commercially processed meal. Meals of Altex canola, Midas rapeseed, and Hu You 9 Chinese rapeseed were used. Few differences were found in the essential amino acid contents due to these treatments. Partial extraction of non-protein nitrogen compounds may be responsible for the observed differences. Protein efficiency ratio (PER) values of meals, calculated on the basis of the content of selected amino acids, varied from 1·7 to 2·4, depending on the seed variety. The processing conditions did not affect the calculated PER values to any great extent.

INTRODUCTION

It has generally been recognized that major variations in protein quality are caused by differences in the amino acid composition of food proteins. Thus, proteins of plant origin of various types are usually combined to obtain blends with a well-balanced amino acid profile to support an adequate protein nutritional status. Nutritional quality of proteins may further be affected by processing. Therefore, it is of prime importance to first consider the essential amino acid content of proteins and then to evaluate processing factors which may affect them. This should facilitate an evaluation of the nutritional significance of dietary protein quality and may also allow prediction of protein efficiency ratio (PER).

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Canola and rapeseed are among the world's most important oilseed crops and have a well-balanced amino acid composition (Ohlson, 1978; Shahidi, 1990). However, unrestricted use of canola and rapeseed meals in animal feeds, and possibly in human food formulations, has been thwarted by the presence of glucosinolates and other undesirable constituents. Removal of glucosinolates from canola by methanol–ammonia processing has recently been reviewed (Shahidi *et al.*, 1988; Shahidi, 1989). Methanol-ammonia processing was also effective in removing phenolic acids (Naczk & Shahidi, 1989), condensed tannins (Shahidi & Naczk, 1989) and soluble sugars of rapeseed and canola (Shahidi *et al.*, 1990).

This study was undertaken to evaluate the effect of methanol–ammonia processing on the amino acid composition of the meals so produced. Protein efficiency ratio values of treated meals were then estimated from their amino acid composition using existing prediction equations (Alsmeyer *et al.*, 1974).

MATERIALS AND METHODS

High-glucosinolate rapeseed varieties of Hu You 9 (Chinese cultivar) and Midas as well as double-zero canola variety of Altex were used in this study. A commercially processed meal was used as a reference. All

chemicals and solvents used in this work were reagent-grade.

Hexane-extracted rapeseed meals were prepared by extraction of ground samples (60 g) for 12 h, using a Soxhlet apparatus. Residual oil (~1·0–1·5%) in a commercially processed meal was also extracted with hexane. Defatted meals were then dried at 40°C in a vacuum oven. In other experiments, ground seeds (60 g) were blended at approximately 15 000 rpm in a Waring blender for 2 min with 400 ml 10% (w/w) ammonia in absolute or 95% (v/v) methanol. After standing for 15 min, 400 ml hexane was added and the mixture was again blended for 2 min. The meal was separated by filtration, rinsed three times with a total of 100 ml methanol and dried at 40°C in a vacuum oven. The meal was further deoiled with hexane using a Soxhlet apparatus, and it was dried as before.

The amino acid composition of the meals was determined by hydrolysing them with 6N HCl for 24 h at 110°C (Blackburn, 1968) and then separating the amino acids on a Beckman 121MB amino-acid analyser. Cysteine and methionine were determined as cysteic acid and methionine sulphone, respectively, by performic acid oxidation prior to their digestion in 6N HCl (Blackburn, 1968). Analysis of tryptophan was performed by hydrolysis of the samples under vacuum with 3N mercaptoethane sulphonic acid at 110°C as described by Penke *et al.* (1974).

The predicted PER values of rapeseed meals were calculated from their amino acid composition based on three equations developed by Alsmeyer *et al.* (1974), as given below.

$$PER = -0{\cdot}684 + 0{\cdot}456\,(LEU) - 0{\cdot}047\,(PRO) \quad (1)$$

$$PER = -0{\cdot}468 + 0{\cdot}454\,(LEU) - 0{\cdot}105\,(TYR) \quad (2)$$

$$PER = -1{\cdot}816 + 0{\cdot}435\,(MET) + 0{\cdot}780\,(LEU) + 0{\cdot}211\,(HIS) - 0{\cdot}944\,(TYR) \quad (3)$$

RESULTS AND DISCUSSION

The amino acid composition of rapeseed meals are shown in Table 1. These meals had an abundant content of glutamic acid (16·77 – 18·63 g/100 g protein). Tyrosine, methionine and cysteine were present in

Table 1. Amino acids composition of processed canola and rapeseed meals (g/16gN).

Amino acid	Hu You 9			Midas			Altex			Commercial meal
	A	B	C	A	B	C	A	B	C	A
Alanine	4·29	4·28	4·15	4·34	4·21	4·06	4·04	3·96	3·91	4·33
Arginine	5·88	5·90	5·70	5·60	5·66	5·50	5·64	5·41	5·38	5·29
Aspartic acid	6·19	6·42	6·18	6·75	6·28	6·13	7·21	7·20	6·64	7·17
Cysteine	1·63	2·13	2·07	1·57	1·71	1·99	1·65	1·77	1·74	2·27
Glutamic acid	17·92	18·63	16·91	17·65	16·85	16·75	16·77	16·84	17·02	13·48
Glycine	4·97	5·05	5·03	4·93	4·65	4·53	4·75	4·69	4·56	4·78
Histidine	2·74	2·83	2·72	2·75	2·60	2·58	2·53	2·45	2·43	2·84
Isoleucine	3·98	4·09	3·93	3·99	3·89	3·82	3·82	3·84	3·84	4·49
Leucine	6·79	7·03	6·79	7·07	6·81	6·71	6·72	6·57	6·40	6·69
Lysine	5·81	5·72	5·71	5·82	5·61	5·48	5·30	5·04	5·02	5·67
Methionine	1·77	1·80	1·96	1·93	1·54	1·37	1·53	1·63	1·50	1·43
Phenylalanine	3·82	3·89	3·75	3·84	3·67	3·67	3·72	3·64	3·69	4·32
Proline	6·28	6·38	6·11	6·25	5·88	5·88	5·50	5·36	5·22	5·46
Serine	4·66	4·60	4·43	4·58	4·38	4·29	4·45	4·38	4·22	4·32
Threonine	3·99	4·45	4·14	4·44	4·37	4·52	4·49	4·28	4·37	3·48
Tyrosine	2·76	2·84	2·87	3·07	2·88	2·86	3·02	2·92	2·83	2·28
Valine	4·99	5·15	4·86	5·04	4·96	4·89	4·93	4·86	4·85	5·76

A, Hexane-extracted; B, $MeOH/NH_3$–hexane extracted; C, $MeOH/NH_3/H_2O$–hexane extracted.
Results are mean values of three replicates.
Standard deviations were ≤0·05 in each case.
Presence of hydroxyproline was noticed in the non-protein fraction of the meal.

TABLE 2. Predicted PER values of preocessed canola and rapeseed meals

Rapeseed variety	Extraction method	Predicted PER values using equation[a]		
		1	2	3
Commercial Meal	A	2·11	2·33	2·47
Hu You 9	A	2·12	2·33	2·22
	B	2·22	2·43	2·37
	C	2·13	2·31	2·20
Midas	A	2·25	2·42	2·22
	B	2·15	2·32	2·00
	C	2·10	2·28	1·86
Altex	A	2·10	2·27	1·77
	B	2·05	2·19	1·75
	C	2·00	2·14	1·79

[a]Alsmeyer *et al.* (1974).

A, Hexane-extracted; B, $MeOH/NH_3$-hexane extracted; C, $MeOH/NH_3/H_2O$-hexane extracted.

lower concentrations. The two-phase solvent extraction process did not alter the amino acid composition of rapeseed meals to any great extent. However, a trend showing a decrease in the content of proline could be observed (Table 1).

Of the essential amino acids, cysteine, methionine, isoleucine and leucine were present at somewhat lower concentrations in these meals than those required by the 1985 standards of FAO/WHO. The two-phase solvent extraction process slightly increased the cysteine content in meals obtained from Hu You 9 and Midas varieties of rapeseed. A slight reduction in the concentration of lysine may possibly be due to the formation of lysinoalanine in the basic extraction solutions employed. In fact some 78–150 ppm (0·0078–0·0150 g/16gN) lysinoalanine was produced in methanol-ammonia-treated meals (unpublished observations).

Alsmeyer *et al.* (1974) developed three regression equations for the prediction of PER. The calculated PER values of rapeseed meals, using these equations, are shown in Table 2. The predicted PER values based on leucine and proline content or on leucine and tyrosine content (eqs (1) and (2)) gave PER values which were closer to the actual values of 2·19–2·64 reported by Delisle *et al.* (1984). Equation (3) proved to be inadequate for calculating the PER values of rapeseed protein meals. The commercial processing of seeds and the two-phase solvent extraction process did not alter the amino acid compositions and hence the calculated PER values (eqs (1) and (2)), to any great extent (Table 2).

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