AMINO ACID PROFILE OF BRASSICA NAPUS SEED WITH VARYING CRUDE PROTEIN CONTENT

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INTRODUCTION

In a number of cereals the profile of amino acids (AA) of the protein varies as the crude protein (CP) content changes. With increasing CP the content of a number of essential AA 16 g^{-1} N has been shown to decrease in barley (Eggum, 1970; Thomke, 1970), wheat (Bushuk, 1983) and triticale (Rundgren, 1988). This is true also for other cereals. There is very limited information on the effect of varying CP content on the AA pattern of rapeseed (RS). The large variation in CP content of RS between species (Br. napus or campestris), winter and summer types as well as by cultivars, is well established (Bengtsson, 1985). Growing conditions also affect the CP content significantly. According to the literature review of Bengtsson (1985) the AA content 16 g^{-1} N in RS varies considerably. For different RS meals this author reported a range of e.g. lys of 3.5-6.3; thr 3.5-5.6; met 1.1-2.2 and trp 0.9-2.0 g 16 g^{-1} N. Differences in analytical procedures and also in the processing technique of the RSM may be plausible explanations for this variation (Wetter, 1965). Furthermore, the variation in CP content could also be a contributing factor to differences in the AA profile of the protein. However, in the literature so far we have not come across any systematic investigation on the effect of the variation of the CP content on the AA pattern in the protein of RS. The present investigation is a contribution to this area.

MATERIAL AND METHODS

On delivery 60 batches from South Sweden (Skåne) and 60 batches from Middle Sweden (Västmanland) were sampled according to the procedure prescribed by the Swedish Oil Seed Corporation (SOI). This company organized and financed the present investigation. The batches, grown in 1987, were of double-zero type of the two summer cultivars Hanna and Topas (Br. napus). The batch size varied between 0.3 and 24 tonnes (average 5.5 tonnes). The samples (0.5 kg) were cleaned prior to analysis (upper screen 2.75 mm round openings, lower screen 0.8 x 20 mm). On average the percentage of dockage was 3.8% (0.5-21.0%). The moisture content of the batches varied greatly (between 5.1 and 37.6%, average 24.2%), the variation being very similar for the two growing areas. The CP content of the samples from South and Middle Sweden averaged 38.8 and 36.3%, respectively. The mean contents of oil, chlorophyll and glucosinolates (and $\pm$ S.D.) were 45.8% (2.2), 34.0 ppm (17.4) and 12.1 µmol g^{-1} of fat free DM (4.2), respectively. The 1987 growing season was less favourable than 1986 and 1988 resulting in higher moisture contents. The moisture content of the 1987 year's RS exceeded that of these years on average by 6.5 and 4.0 percentage units, respectively.

The chemical analyses were performed according to the official Swedish standards, which are similar to the AOAC methods. The AA content was determined according to a HPLC-method after hydrolysis with 6 n HCl (Uppström, pers. comm.) at the Cereal Laboratory, Svalöf AB, Svalöv, Sweden.

RESULTS

The CP content of the RS samples varied between 31.3 and 42.3% of the oil free dry matter ($\bar{x}$ 37.5%). As demonstrated in Table 1, all AA increased significantly as the CP content increased. The highest regression coefficient was found for glu (b 2.22), which also had the highest mean value ($\bar{y}$ = 68.7 g kg^{-1} oil free DM). Low regression coefficients were found for cys, his and met. The sum of the AA given in Table 1 is 37.4% of the oil free DM, which corresponds to 99% of the CP (Nx6.25) content.

Table 1. Amino acids in rapeseed (y in g kg^{-1} oil free dry matter) related to the percentage of crude protein content (x) on an oil free dry matter basis ($\bar{x}$ = 37.5%;n=120)

	Intercept	$b_{y/x}$	$\bar{y}$	R^2
Ala	3.26	0.372	17.2	0.854[a]
Arg	0.93	0.784	30.3	0.899
Asp.	- 1.81	0.846	29.9	0.708
Cys	3.55	0.172	10.0	0.361
Glu	-14.61	2.224	68.7	0.907
Gly	- 0.77	0.568	20.5	0.962
His	4.51	0.175	11.1	0.430
Ile	- 2.59	0.506	16.4	0.931
Leu	0.38	0.772	29.3	0.932
Lys	5.43	0.474	23.2	0.705
Met	0.71	0.198	8.1	0.473
Phe	- 0.70	0.444	15.9	0.929
Pro	1.90	0.688	27.7	0.849
Ser	1.54	0.457	18.7	0.899
Thr	2.47	0.390	17.1	0.828
Tyr	0.77	0.304	12.2	0.525
Val	- 0.93	0.589	21.1	0.943

[a] Values > 0.085 significant at P < 0.001

In Table 2 the content of the individual amino acids (y) is given in g 16 g^{-1} N in relation to the CP content of RS (x in percent of the oil free DM). For some of the essential AA there seem to exist slight negative interrelationships between their content in the RS protein and the CP content of the RS, as is demonstrated by the statistically significant negative regression coefficients, e.g. for lys and thr.

DISCUSSION

The background of the samples analysed varied considerably which might explain the variation in the CP content of the RS batches, varying between 31 and 42% of the oil free DM. Usually in RSM of a particular type of seed - summer or winter types of Br. napus or campestris - the variation is much more limited. Plausible reasons for the greater variation in the present material are its type and all local differences in the field and growing conditions and also the limited size of the individual batches. Obviously, the variation in 1987 was not specifically different from other years e.g. 1988 with better growing conditions than 1987. Unpublished Swedish data from SOI demonstrates a generally higher variation in the CP content of the summer types of Br. napus (00-type, S.D. ± 2.5) and campestris (0-type, S.D. ± 2.4) versus winter Br. napus (S.D. ± 1.7).

By studying protein fractions in RS with varying CP content Uppström & Johansson (pers. comm.) found an increase in the globulin fraction as the CP content increased. This finding is in line with the decreasing lys content of RS protein with increasing CP content, since the globulin fraction according to these authors contains less lys than other protein fractions.

Comparing the mean AA profile of the RS protein ($\bar{y}$ in Table 2) with results from the literature shows fairly good agreement with data from Bengtsson (1985), and also to those of Just et al. (1983), particularly when considering the differences in the sum of AA between authors. However, our results for lys and arg (6.2 and 7.6 g 16 g^{-1} N, respectively) are higher than those given for RSM by e.g. Just et al. (1983) and Thomke et al. (1983). The reason for these differences seems to be that commercial processing conditions affect the content of AA, as has been pointed out by e.g. Wetter (1965).

A systematic difference of 2.5 percentage units in the CP content of the RS from South and Middle Sweden was noticed. The RS grown in South compared with Middle Sweden showed on average a 2.5 percentage units higher CP content. This could systematically have influenced the interrelationship between AA and CP content of RS. However, within South and Middle Sweden there were statistically significant relationships for e.g. lys and the CP content of RS as well as for the entire material.

Table 2. Amino acids in rapeseed (*y* in g 16 g^{-1} N) related to the percentage of crude protein content (x) on an oil free dry matter basis ($\bar{x}$ = 37.5;n=120)

	Intercept	$b_{y/x}$-	$\bar{y}$	R^2
Ala	5.48	-0.0237	4.59	0.247[a]
Arg	7.32	+0.0072	7.59	0.011
Asp	7.46	+0.0137	7.97	0.010
Cys	3.64	-0.0257	2.68	0.153
Glu	14.36	+0.1060	18.34	0.237
Gly	5.27	+0.0056	5.48	0.033
His	4.18	-0.0325	2.96	0.264
Ile	3.67	+0.0187	4.37	0.206
Leu	7.52	+0.0027	7.62	0.002
Lys	7.68	-0.0395	6.20	0.194
Met	2.36	-0.0052	2.16	0.009
Phe	4.07	+0.0048	4.25	0.021
Pro	5.85	+0.0139	6.37	0.031
Ser	5.41	-0.0115	4.98	0.064
Thr	5.23	-0.0179	4.56	0.122
Tyr	3.47	-0.0054	3.27	0.005
Val	5.39	+0.0068	5.65	0.030

[a] see footnote in Table 1.

The variation in CP content observed in single batches on delivery is greatly erased by commercial storing the RS prior to processing in big silos with a capacity of thousands of tonnes. However, there could be CP differences between types of RS and which are traded separately, e.g. between winter and summer types of on average 4-5 percentage units. Applying the regression equation for two batches with CP contents of

33 and 38%, respectively, results in lys contents of 6.38 and 6.18 g 16 g^{-1} N, respectively, which corresponds to a calculated difference of 2.4 g lys kg^{-1} DM. The difference in CP content between 33 and 38% corresponds to 13%, whereas that in lys content corresponds to 10%. This shows that the lower protein quality of RS with higher CP content would partly be counterbalanced by the higher protein quality at the lower CP content. This calculation also shows that the variation in CP content of RS with a few percentage units has a limited effect on the content of essential AA, and that from a practical point of view other factors such as processing conditions may be of greater importance for the nutritional quality of RSM.

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