CHANGES OF CHEMICAL COMPOSITION DURING THE PROCESSING OF DOUBLE-LOW RAPESEED IN CZECHOSLOVAKIA

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Introduction

Double-low winter rapeseed has been introduced in Czechoslovakia since 1983 in field experiments; various West European varieties were tested. In 1986 the crop of double-low rapeseed was more than 6 000 T. Rapeseed crops of the same year from the whole test area were collected, and processed in one plant by combination of pressing and extraction. During the processing of double-low rapeseed, changes of the chemical composition were found slightly different from those of zero-erucic high-glucosinolate rapeseed. Because of limited space, only a few components will be discussed here, namely changes of glucosinolates, phospholipids, Maillard products, and the content of mineral substances.

Processing Conditions

The processing conditions were essentially the same as in case of high-glucosinolate zero-erucic rapeseed (1). Seeds were transported from elevators, crushed in two-high-rolls, cooked in a sevenhigh stack conditioner SKET (Magdeburg, GDR) heated from 60 °C to 90-110 °C, jacketted for steam heating, and with direct steam injected in-

to the second and the seventh kettles; the conditioning time was about 35-60 min, and the final moisture content 6 - 7 %. The conditioned meal was expressed in continuous worm expellers Krupp SVP-3 or SKET HSP-18; the oil temperature reached 85-90 °C, the maximum temperature of material in the expeller 95-100 °C. Expeller cakes were crushed on four-high rolls to produce flakes smaller than 5 mm. The flakes were extracted in a carrousel-extractor Extraktionstechnik (diameter 6.25 m; layer of the material 1.8 m deep; 18 cells in the carrousel). The material was countercurrently extracted at 50 °C, using extraction hexane (boiling range 60-80 °C). The capacity ranged between 500-700 $T.d^{-1}$. The five-high tray toaster had a diameter of 3.5 m, was jacketted, with direct steam inlets into the two highest trays. The bed depth varied between 300-350 mm, the toasting temperature 100-110 °C; the average toasting time 35-40 min. Extracted meals were crushed, transported with hot (100 °C) air into dryers, and cooled.

Analytical Methods

Glucosinolates were determined by gas chromatography after desulphatation and silylation (2); isothiocyanates and vinyloxazolidinethione using the ISO methods. Lipids were isolated by Soxhlet extraction (3), and phospholipids determined with the same method as in oils (4); lipoproteins were determined by extraction after destruction of hydrogen bonds (5). The extent of Maillard reactions was determined by reflectometric measurements (Spekol 21) of finely ground material in the region of 400-500 mm. The content of mineral substances was determined by AAS and by spectrophotometric methods (6).

Results and Discussion

Several series of samples were taken during rapeseed processing in 1983-1986, and analyzed; the average oil con-

tent was 41-44 %, 17-23 %, and 1,5-2,7 % in seeds, cakes, and meal, respectively.

An example of changes in the glucosinolate content is given in Tab. 1; the calculation on the oil-free dry-matter basis has shown slight increase of both glucosinolates and isothiocyanates during conditioning of rapeseed flakes, followed by a moderate decrease during pressing, and further decrease during the extraction. The absolute values of losses of glucosinolates and their degradation products were observed during the processing of high-glucosinolate rapeseed but the relative losses were higher in low-glucosinolate rapeseeds.

Changes of the phospholipid content are given in Tab. 2. The content of hexane-extractable phospholipids increases during the conditioning because of the decomposition of lipoproteins (decrease by about 0.3-0.5 % of dry matter). Further phospholipids were released from lipoproteins during pressing, but they were partially removed in pressed oil. The amount of phospholipids left in extracted meal depended on the residual lipid content; the residual lipids usually contained 5-15 % phospholipids; in case of low residual content (1.5 % of dry matter), even 26 % were left as phospholipids. The content of glycolipids was moderately lower than that of phospholipids, and slightly higher in low-glucosinolate than in high-glucosinolate rapeseeds. As evident from Tab. 2, double-low rapeseed contained higher levels of phospholipids tha high-glucosinolate rapeseed.

Table 1. Changes of glucosinolates and their degradation products ($g.kg^{-1}$) during rapeseed processing (1986 crops)

Material analyzed	Isothiocyanates	Gluconapin	Glucobrassicanapin	Progoitrin	Goitrin
Double-low rapeseed: original seeds	0.85	2.6	0,46	3.90	1.18

crushed seeds	0.89	2.7	0,48	4.07	l.23
conditioned flakes	0,94	2.8	0,54	4.l4	l.25
expeller cakes	l.ll	3.4	0.62	4.63	l.40
toasted meal	l.03	3.l	0.55	4.60	l.39
cooled extracted meal	0.96	2.8	0.5l	4.53	l.37
High-glucosinolate rapeseed:					
original seeds	2.7l	8.0	l.7	l6.5	5.0
crushed seeds	2.47	7.2	l.6	l7.5	5.3
conditiones flakes	2.89	8.5	l.6	l8.2	7.0
expeller cakes	3.43	lO.2	2.l	22.5	6.8
toasted meal	3.4l	9.9	2.0	28.l	8.5
cooled extracted meal	4.l4	l2.l	2.5	29.8	9.0

Table 2. Changes of extractable phospholipid content ($g.kg^{-1}$) during rapeseed processing

Material analyzed	Double-low rapeseed in oil phase	Double-low rapeseed in the material	High-glucosinolate in oil phase	High-glucosinolate in the material
Original seed	0.45	0.l9	0.29	0.lO
Crushed seed	0.55	0.24	0.54	0.20
Conditioned flakes	0.78	0.29	0.70	0.26
Expeller cakes	l.04	0.24	l.22	0.28
Toasted meal	4.40	0.08	2.4l	0.03
Cooled extracted meal	4.92	0.08	2.43	0.03

Table 3. Content of mineral substances ($mg.kg^{-1}$) in Czechoslovak rapeseed (average values of l984 crops)

Type of rapeseed	K	Ca	Mg	Cu	Fe	Ni	Zn	Mn
High-glucosinolate	952	2062	2640	3.4	40.0	2.05	40.8	l5.l
Low-glucosinolate	722	3l0l	l760	2.6	39.0	l.00	23.2	l0.l

Glucosinolates behave as reducing sugars on heating, producing brown pigments. Low-glucosinolate rapeseeds contain less reducing sugars (including glucosinolates), therefore the extent of browning during the processing was substantially lower in spite of similar toasting conditions. Loss of available lysine (determined after Carpenter) was also lower at the same processing conditions.

Contents of mineral substances are important both from the standpoint of oil contamination, and of feeding value of meals. The content in seeds is shown in Tab. 3 (an example of the 1984 crop). There are significant differences between low and high glucosinolate rapeseeds as evident from the Table, however, they may be due to other factors, as low-glucosinolate rapeseed was never grown in the same area as the high-glucosinolate cultivars. Changes during rapeseed processing (when the results were based on the oil-free dry-matter content) did not show any significant differences between the seeds and the meals, therefore, mineral substances pass into oil phases in only very small amounts.

Summary

Relative losses of glucosinolates and their degradation products during the processing of low-glucosinolate rapeseed were higher compared to the high-glucosinolate rapeseed; the content of phospholipids, glycolipids and lipoprotein-bound lipids was lower in high-glucosinolate rapeseeds, the extent of Maillard reaction products was lower in low-glucosinolate rapeseed meal. Differences were observed in the content of mineral substances which may be due to other factors.

References

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