HYDROTHERMAL TREATMENT OF WHOLE RAPESEEDS AS A METHOD OF IMPROVING THE OIL QUALITY

M.K. Piskuła, H. Kozłowska

Centre for Agrotechnology and Veterinary Sciences
Polish Academy of Sciences, Plac Cieszyński 1,
10-718 Olsztyn, Poland

INTRODUCTION

Excessively long thermal treatment of rapeseeds during their technological processing results in a drastic loss of value of such seed components as oil and protein. Considering hydrothermal treatment (HT) of whole rapeseeds as a promising process aplicable in idustrial practice, investigations were undertaken in order to explain its influence on the oil quality.

MATERIALS AND METHODS

HT of double-improved whole rapeseeds was conducted in an experimental periodic device, capacity of 12 kg, with direct water steam at pressure of 0.2 MPa. Next the seeds were dried with warm air (temp. 40°C). Pressed oil was obtained in a laboratory worm press, KOMET 59 CA (FRG) witout heating. Extracted oil was obtained by extracting crushed seeds with hexane in a glass column (Tubulenci 1986) with water jacket at temp. 50°C. Activity of myrosinase (Youngs and Wetter) and glucosinolates content (Helboe et al. 1980) were determined in meal, whereas total sulfur content (Bailey and Gehring 1961) Raney sulfur (Baltes 1967), phosphorus content (Polish Standard 1988) and colour (Jerzewska and Płatek 1986) - in oil. Pressed oils were rafinated in a lab simulated process including desliming, neutralization, and bleaching (Coks and van Rede 1966).

RESULTS AND DISCUSSION

On the basis of the results concerning myrosinase activity and changes of glucosinolates content (Table 1) 10 minutes was regarded

Table 1. Changes in myrosinase activity and amount of individual glucosinolates during HT.

Time of HT	Myrosinase activity	Glucosinolates umoles/d.d.m.				
min	%	PROG(1)	NAP(2)	GLNAP(3)	4-OH(4)	Total
0	100	22.8	4.1	14.1	8.2	49.5
3	68					
6	36					
9	8					
10	0	14.7	2.4	7.9	3.2	28.2
30	0	12.6	0.8	9.0	0.6	23.2

(1) Progoitrin
(2) Napoliferin
(3) Gluconapin
(4) 4-hydroxyglucobrassicin

both as a sufficient time of HT for enzyme inactivation and causing high,

i.e. ab. 45% loss of glucosinolates of which 4-hydroxyglucobrassicin turned out the least lasting (62% loss during 10 minutes of HT).

Analysing the influence of HT on the yield of oil obtaining it was revealed (Fig. 1) that in the case of pressing method the optimal moisture content, at which the best results were obtained, shifted

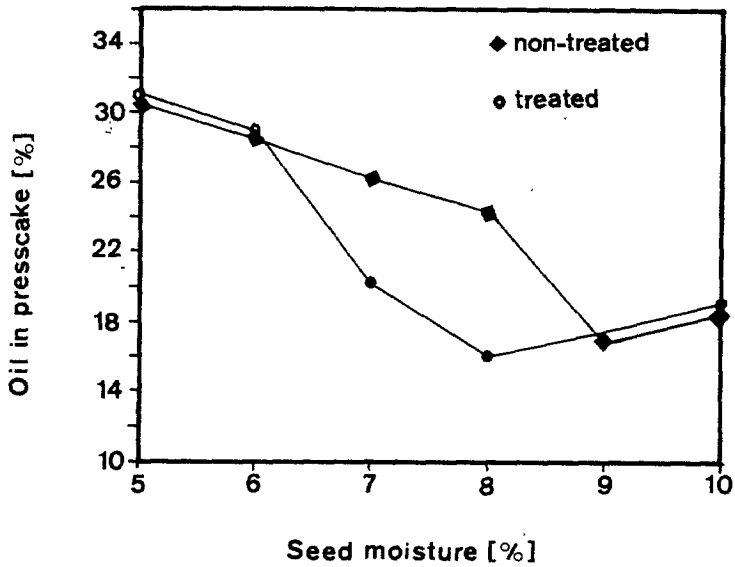

Fig. 1. Influence of HT and moisture of seeds on oil yield with pressing method.

from 9% for non-treated seeds to 8% after HT and improved pressing efficiency within the moisture range 6%-9%. In the case of extraction method (Fig. 2) the amount of oil obtained from non-treated rapeseeds

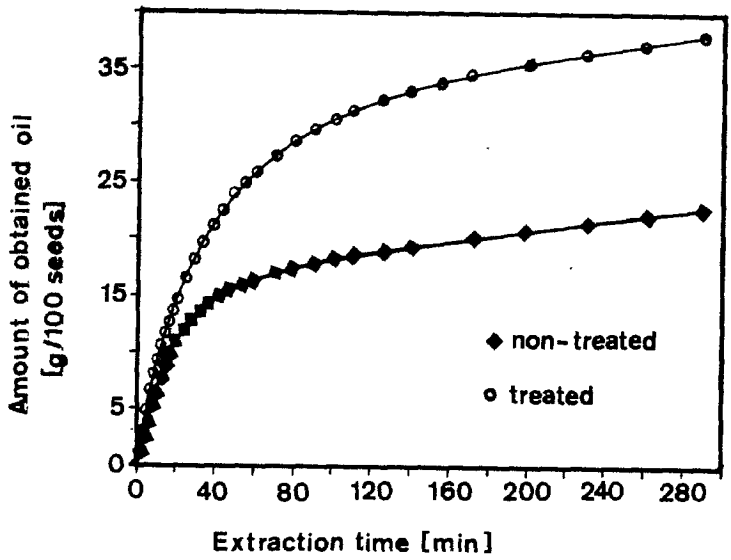

Fig. 2. Influence of HT on oil yield with extraction method.

after each controled time was considerably smaller. After 290 minutes of extraction of non-treated rapeseeds ab. 51% of oil was obtained while after applying HT - 85%.

During HT and processes accompanying obtaining oil from rapeseeds it may be affected by various compounds deteriorating its quality such as sulfur and phosphorus compounds as well as pigments.

The amount of total sulfur in extracted oil exeeded more than twice that in pressed oil (Table 2). Loss of Raney sulfur content

Table 2. Changes of some quality factors during HT.

Kind of oil	Time of HT min / Quality factor	0	3	6	9	12	15	20
pressed	total sulfur	11	13	14	16	16.5	17	17
extracted	µg/g oil	25	26	26.5	27	29	35	39
pressed	Raney sulfur	1.2	0.5	0.5	0.8	0.8	1.6	1.8
extracted	µg/g oil	2.8	2.3	1.7	2.7	2.9	3.2	6.8
pressed	phosphorus	9	53	57	55	44	35	37
extracted	µg/g oil	131	132	132	218	210	207	190
pressed	chlorophylls	127	603	716	795	906	951	1056
extracted	units	322	643	696	843	819	822	826
pressed	carotenoids	424	1022	1032	1073	1143	1155	1150
extracted	units	1368	1340	1352	1334	1324	1264	1184

during the first 6 min. of HT was accompanied by a constant growth of total sulfur content. This suggests that during HT there are made advantageous conditions for the transfer of compounds of sulfur non adsorbed by nickel catalyst into oil.

HT caused a disadvantageous growth of phosphorus content (Table 2). The level of phosphorus was observed to drop from 9 min of HT both in extracted and in pressed oil which was probably related with the hydratation of some phospholipids in seeds during HT.

The most dramatic growth of pigments from the chlorophyll group was observed during first 3 min of steaming and it raised by 475% in pressed oil (Table 2) and by 200% in extracted oil compared with the oils obtained with the same methods from non-steamed seeds. The colouring coming from carotenoids remained in extracted oil for first 12 min of HT on an unchanged level, and next it diminished to reach 86% of the initial value after 20 min. In pressed oil already during the first 3 min of steaming there was observed intensity of colouring growing by 241% at the same wave length. Elongation of HT time was accompanied by further growth of colour intensity by next 28% until the twelveth minute and by keeping at a more or less constant level until 20 min.

From comparison of raw pressed oils (Table 3) it follows that they did not differ significantly as to acid value (AV), Raney sulfur content and pigments. The greatest diversification between the investigated oils was found for phosphorus content. Comparing oils laboratorily obtained from hydrothermally treated rapeseeds and from flakes after industrial cooking pressed at the same moisture, HT was observed to result in a better oil quality, i.e. oil with phosphorus content lower by 28% and coming mainly from non-hydratable phosphorus compounds.

The worst quality was found for industrial oil which was undoubtedly related with more drastic conditions (mainly temperature)

Table 3. Changes of some quality factors of raw pressed oils during laboratory rafination.

Kind of oil	Acid Value mgKOH/g	Phosphorus µg/g	Sulfur µg/g	Chlorophylls units	Carotenoids units
		Oil from hydrothermally treated seeds			
Raw	1.9	56	5.5	288	633
Hydrated	1.9	48	4.3	271	624
Neutralized	0.2	6	2.3	173	503
Bleached	0.2	3	1.2	5	13
		Oil from flakes conditioned in industrial cooker			
Raw	1.8	78	5.6	280	583
Hydrated	1.8	72	4.5	262	571
Neutralized	0.2	12	3.0	208	471
Bleached	0.2	4	1.5	10	14
		Oil from industry			
Raw	2.1	297	5.8	299	690
Hydrated	2.0	79	4.4	282	647
Neutralized	0.2	6	2.4	178	540
Bleached	0.2	5	1.2	5	13

in the industrial process of pressing. Observed initial differences in the quality of analysed raw oils did not affect the course of laboratory rafination process which produced rafined oils with comparable quality factors.

CONCLUSIONS

Following conclusions may be drawn from the results obtained in this study :

1. HT of whole rapeseeds lasting for 10 minutes (time necessary for myrosinase inactivaction) conducted on a laboratory scale caused following effects (compared with non-treated seeds) :

   positives - easier oil obtaining, especially with extraction method;
   - lowering glucosinolate content in meal;
   - decrease of Raney sulfur content in pressed oil;

   negatives - increase of total sulfur content, especially in pressed oil;
   - increase of phosphorus compounds and pigment (especially chlorophylls) content in pressed and extracted oils.

2. HT of whole rapeseeds conducted on a laboratory scale, when compared with conditioning of flakes in industrial conditions :
   - did not affect Raney sulfur content in raw pressed oil;
   - caused loss of phosphorus content in pressed oil coming mainly from non-hydrating compounds;
   - did not have any influence on the course of laboratory

rafination process of pressed oils.

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