Influence of Microwave Treatment on the Quality of Rapeseed Oil

Sir:

We have recently described the influence of microwave treatment on enhancing the rate of rapeseed oil extraction along with significantly positive effects on the usual quality parameters of crude extracted oil (1). General aspects and advantages of dielectric heating processes in the pretreatment of oilseeds compared to conventional treatment were compiled and published by Oberndorfer *et al.* (2). Here we present our findings concerning the quality of oil obtained by cold pressing of microwave-treated seeds compared to conventional heating of mechanically crushed seeds (flakes). Flakes are the usual starting material for the industrial processing of plant oil, which is pressed and extracted by organic solvent (*n*-hexane).

Seeds of the winter rape plant (*Brassica napus,* low content of glucosinolates and zero erucic acid), harvested in the year 2000, were flaked at Setuza Ltd. (Czech oil company). Both seeds and flakes were sampled the same day. The seeds and flakes were stored at room temperature in metal cans. Microwave treatment was performed by using a laboratory line MW LABNK1-5 kW microwave (Romill, Brno, Czech Republic). The mass of the seeds on the belt was 4.5 kg/m, the flow rate was 0.53 kg/min, and the seed layer was 35 mm high and 195 mm wide. The treatment was performed at 1.2, 1.9, 2.2, 2.5 and 2.8 kW, and 2450 MHz.

Cold pressings of the seeds and flakes (3-kg portions) were performed using the laboratory equipment DD 85 G FARMET (Research Institute of Agricultural Engineering, Prague, Czech Republic) at 55°C operating temperature. The first set of seed samples was pressed immediately after microwave treatment and a second set of oils was obtained from seeds stored at room temperature for 6 wk after treatment.

Quality parameters of pressed oils were evaluated. PV and acid value were determined according to procedures given by IUPAC (2.501 and 2.201, respectively) (3). Total phosphorus content was determined by a spectrophotometric method as phosphomolybdenum blue using dry ashing and magnesium nitrate as an ashing aid. The completeness of phosphorus recovery was verified by adding a known amount of PC to the phosphorus-free oil. Phospholipid composition was determined by high-performance TLC (HP-TLC).

Characteristics of crude oils obtained immediately and after 6 wk of seed storage after microwave heating are summarized in Table 1. The yield of cold-pressed oil increased with increasing doses of irradiation up to about 40% (w/w) while the amount of oil obtained from the flakes was about 33% (w/w).

The degree of lipid oxidation was significantly lower after treatment by doses up to 1.9 kW, with higher doses remaining approximately at the same level. The PV for oils obtained after seed storage were much lower even for control seeds. Both findings were possibly due to the inactivation of oxidative enzymes, peroxidases, and lipoxygenases (4,5) either by heat treatment (first pressing) or during storage (second pressing). Significantly increased oxidative stability of rapeseed oil after microwave treatment was also observed by Veldsink *et al.* (6). The contents of FFA were similar (1 mg/g of oil) in all samples tested compared to the flakes, where the content was higher. We did not find any increase in FFA contents during the storage of treated seeds, as was previously observed for soybean and rapeseed oils (6,7). This result was probably due to the less destructive conditions used in our experiments (lower power resulting in lower temperature of seeds after treatment).

Total phosphorus contents were higher in the oils from treated seeds, but significantly lower than in oil from flakes. Phospholipids present in oils were analyzed by HP-TLC and results are shown in Figure 1. PA was found to be a major phospholipid in oils obtained with lower doses of treatment (1.2 and 1.9 kW), other lipids (PC, PE) most probably being hydrolyzed by phospholipase D, which is very active and stable in rape seeds. The content of PA in oil from flakes was approximately 10 times higher.

We concluded that irradiation of rape seeds by microwaves is gentler with respect to final oil quality compared to conventional heat treatment before oil processing.

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TABLE 1
Characteristics of Cold-Pressed Rapeseed Oil from Microwave Pretreated Seeds

Sample	Control	Flakes	1.2 kW	1.9 kW	2.2 kW	2.5 kW	2.8 kW
Oil yield (%)							
1st pressing[a]	31.1	32.8	33.7	38.8	39.1	39.8	41.2
2nd pressing[b]	34.2	—	37.3	40.2	38.7	40.7	43.4
PV (meq O/kg of oil)							
1st pressing	4.8	4.0	3.8	2.8	2.7	2.4	2.9
2nd pressing	0.9	—	1.2	0.9	0.7	0.7	0.3
Content of FFA (mg KOH/g of oil)							
1st pressing	1.1	1.6	0.9	0.8	0.9	0.9	1.0
2nd pressing	1.3	—	1.0	0.9	0.8	1.0	1.2
Total phosphorus content (mg/kg of oil)							
1st pressing	13.5	174.6	20.9	—	32.5	—	—
2nd pressing	20.6	—	25.2	37.7	45.3	—	—

[a]Pressing was done within 12 h after microwave treatment.
[b]Pressing was done after 6 wk of storage at room temperature of treated seeds.

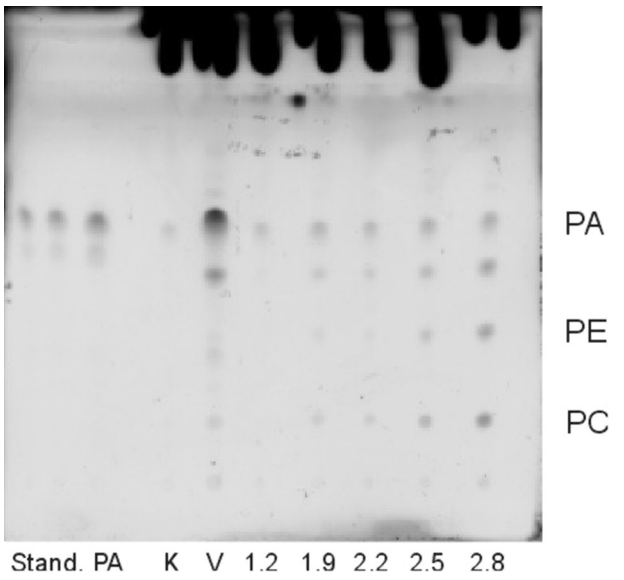

FIG. 1. Phospholipid composition of oils. Oil (2 μL) was spotted on the high-performance TLC plates (Silica gel 60; Darmstadt, Merck, Germany) and TAG were washed out by running acetone. Separation of phospholipids was then performed in the mixture chloroform/methanol/acetic acid/acetone/water (40:25:7:4:2, by vol) with copper detection. K = control seeds, V = flakes; 1.2, 1.9, 2.2, 2.5, and 2.8 are samples of pressed oils from seed samples treated at different outputs (kW).

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