COMPOSITION OF THE MAJOR PHOSPHOLIPIDS OF RAPESEED

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Technical rapeseed lecithin contains about 40 per cent neutral oil and about 60 per cent phospholipids. The phospholipids are surface active, which means that they consist of a polar and a non-polar part. Due to this property rapeseed lecithin is used as an emulsifier.

A number of different phospholipids occur, for example phosphatidic acid (PA), phosphatidyl inositol (PI), phosphatidyl choline (PC), phosphatidyl ethanolamine (PE) and phosphatidyl serine (PS). The main difference between those lies in the polar part of the molecule. The non-polar part consists of two fatty acid chains. The resp. differences in the fatty acid compositions of different rapeseed phospholipids, which have been published (1, 2), are of secondary importance for our study, because differences between the physico-chemical properties of the phospholipids are determined by the charge and the structure of the polar part. PA and PI are negatively charged while PC, PE and PS are amphoteric. The isoelectric point is about pH 7 for PC and PE. PS has a lower isoelectric point. This means that at pH 7 PC and PE are neutral but PS, PA and PI are negatively charged.

Results of studies at our institute concerning soy lecithins have shown that there is a correlation between the amount of negatively charged phospholipids in the soy lecithin and its ability to stabilize a model emulsion. The purpose of this study was to investigate the proportion of the major phospholipids in different rapeseed varities and how this proportion varies during processing with the same application in mind.

MATERIALS AND METHODS

Rapeseed (B. napus) of the following varieties: Brink and Sinus (winter type) and Oro (summer type).

Wet rapeseed gum, processed of Brink and Oro, on industrial scale.

Technical rapeseed lecithin from Brink and Oro.

Rapeseed lecithin processed on pilot-plant scale from Erglu (summer type) and WW 748 (winter type rapeseed).

The rapeseed products were supplied by the Swedish Oil Extraction Company, Karlshamn, Sweden, 1976.

The phospholipid compositions were analyzed by means of a two dimensional TLC-separation on silica gel plates; the spots were then quantitatively analyzed for phosphorus (3).

The phospholipids in seeds were extracted with hot acetone in the laboratory.

RESULTS

The phospholipid fraction in rapeseed of the varieties Brink, Oro and

Sinus contains very small amounts of the negatively charged phospholipid phosphatidic acid. The amount of the other analyzed phospholipids, PC, PE, PI and PS varies according to rapeseed varieties (Fig. 1).

Oro-seed was peeled by hand. The seed-coat fraction contains a higher proportion of PC but less PE than the peeled seed fraction. However, both fractions contain very small amounts of phosphatidic acid (Fig. 2).

During the process on industrial scale the phospholipid composition is markedly changed. Analyses were performed in the seeds, in the wet gums and in the dried rapeseed lecithin products obtained from the rapeseed varieties Brink and Oro, respectively. The greatest changes are in the amounts of phosphatidic acid and phosphatidyl choline. The proportion of phosphatidic acid increases from less than 5 mole per cent to about 20 mole per cent, while the amount of phosphatidyl choline decreases from 42 and 56 mole per cent, respectively, to 26 and 26 mole per cent, respectively in Brink and Oro-lecithin, during the industrial process. The reason for this is that the choline group is detached from the phosphatidyl choline molecule, the residual forming a phosphatidic acid molecule. The changes in the amount of phosphatidyl ethanolamine vary, and no explanation has been found for this. The amount of phosphatidyl inositol does not change during the process (Fig. 3).

When the phospholipid composition was analyzed in lecithin fractions processed from the new varieties Erglu and WW 748 in a pilot-plant equipment we found that the compositions were similar to the phospholipid fractions which were extracted in the laboratory from Oro and Brink seed (Fig. 4). The compositions were characterized by small amounts of phosphatidic acid and high amounts of phosphatidyl choline. In the pilot-plant process the seeds are subjected to heat treatment with steam for about 2 minutes before the oil is extracted. In the industrial process, however, the seeds are crushed, treated with steam and kept at a high temperature for 30-40 minutes and then pre-pressed before the extraction. The phospholipids are removed from the extracted oil in the degumming process by swelling in water. The wet gums are dried in a film evaporator in vacuum at 110°C. In the pilot process there is no drying of the wet gums. The water is separated from the wet gums in the laboratory at 105°C.

CONCLUSIONS

From the analyses and experiments that have been performed, the following conclusions can be drawn:

a) The heat-treatment with steam in the industrial process is of great importance for the phospholipid composition in the technical rapeseed lecithin product. In this process the neutral phosphatidyl choline is decomposed to the negatively charged phospholipid phosphatidic acid.

b) lecithin made in the laboratory by extraction from seeds or made in a pilot-plant equipment has not been decomposed to the same extent and has therefore a smaller amount of negatively charged phospholipids. Due to this the results of emulsion studies with this phospholipid mixture can be misleading. The reason for this is that the emulsifying properties of a lecithin product depend on the amount of negatively

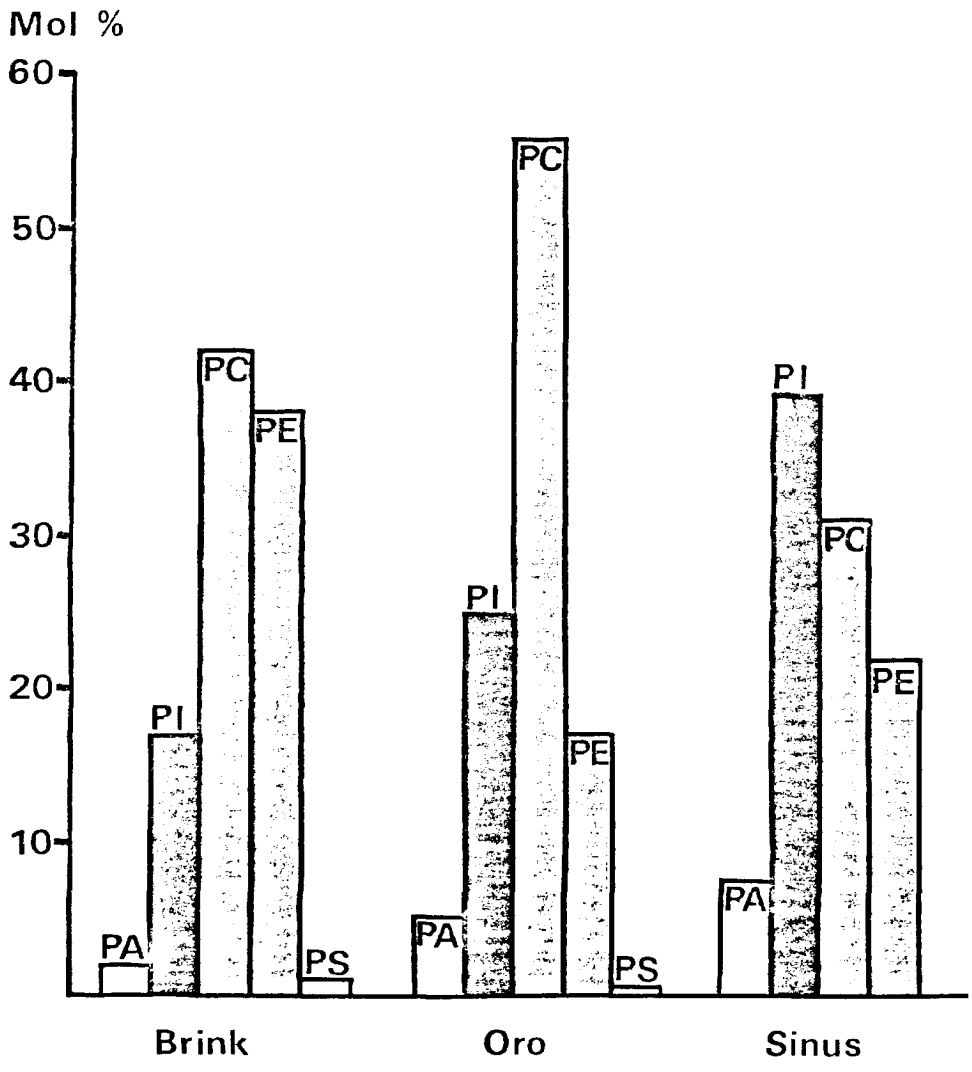

Figure 1. The phospholipid compositions in laboratory extracted lecithin fractions: Brink, Oro and Sinus.

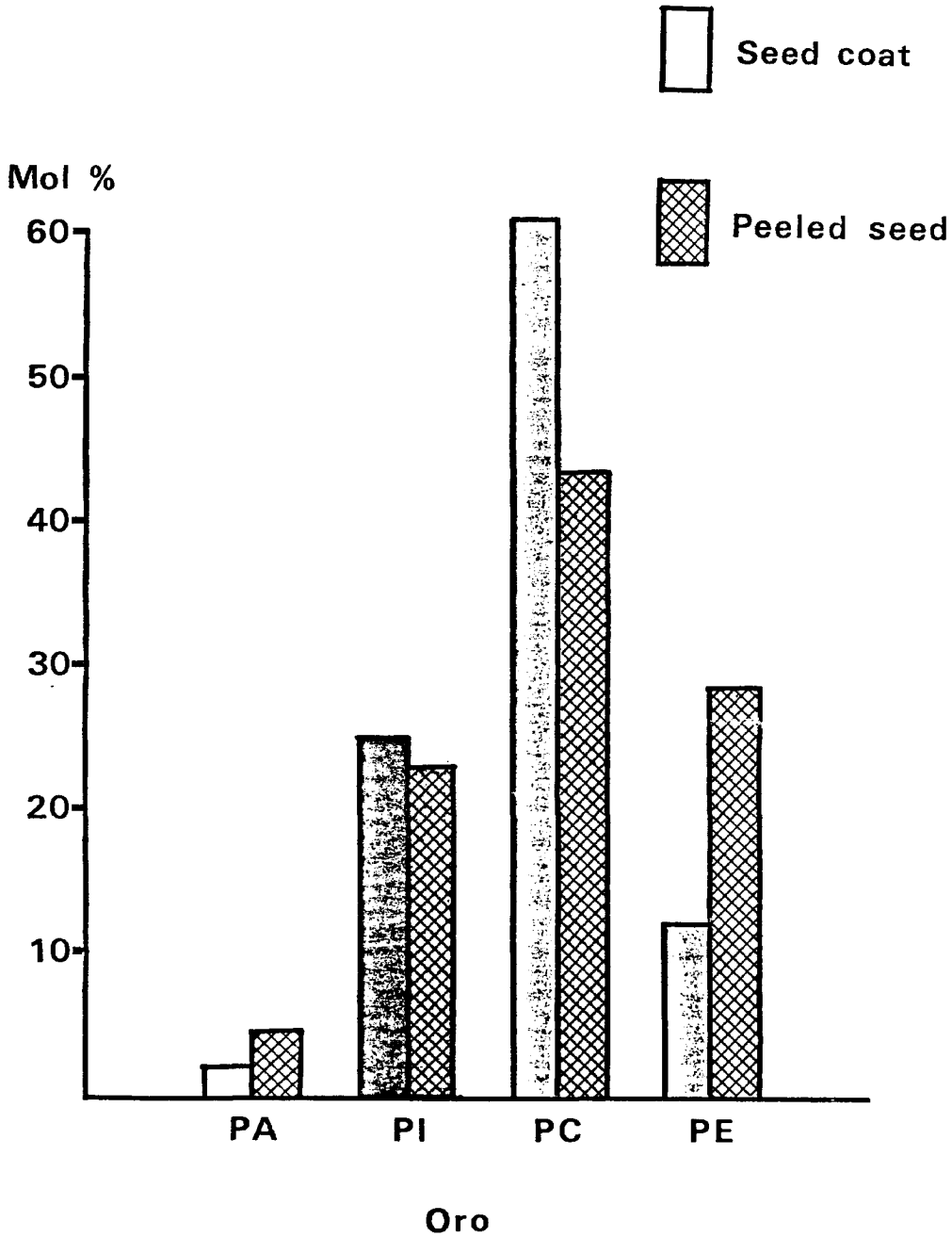

Figure 2. The phospholipid compositions in the seed coat fraction and in the peeled seed fraction; Oro

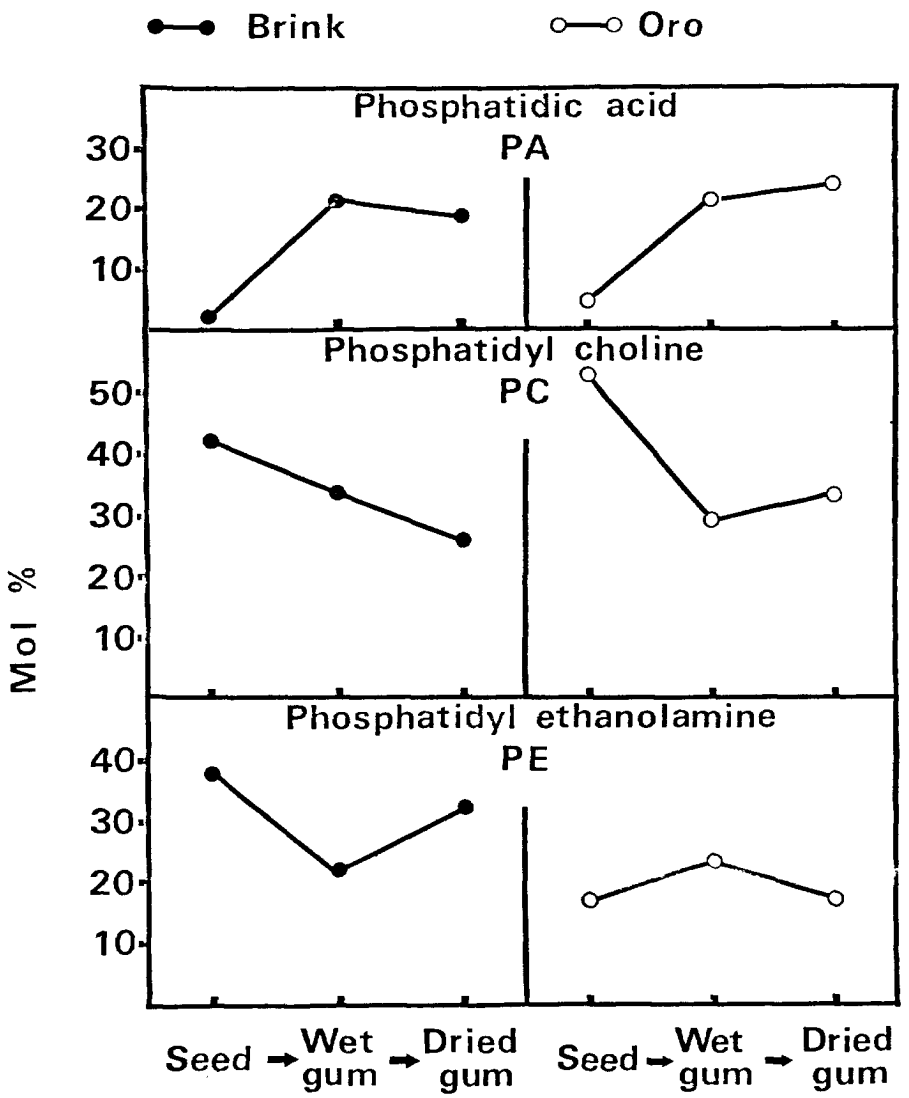

Figure 3. Changes in the phospholipid composition during processing: Oro and Brink.

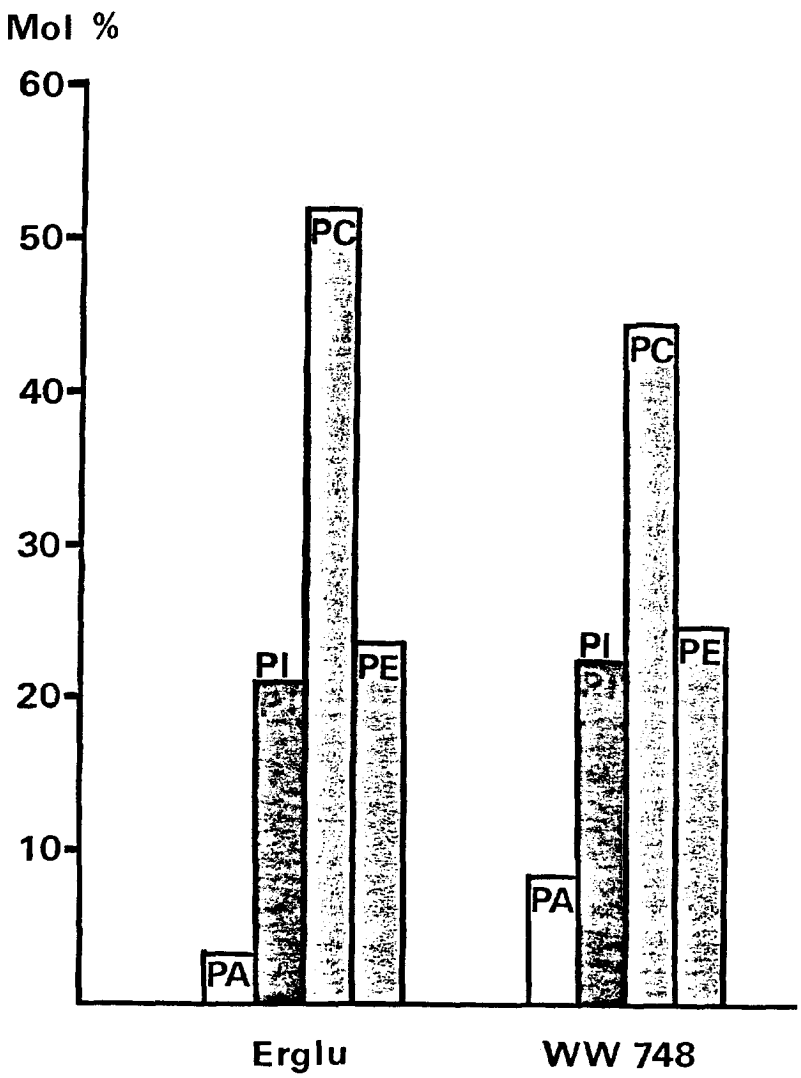

Figure 4. The phospholipid compositions in pi plant processed lecithin fractions: Erglu and WW 748.

charged phospholipids. Results from the investigations at our institute into the emulsifying properties of different soy lecithin products have shown that with increasing amount of negatively charged phospholipids the emulsion stability is enhanced.

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