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SUNFLOWER SEED PHOSPHATIDS AND SOME TECHNOLOGICAL REGULARITIES OF THEIR EXTRACTION

Sunflower breeding for a high fat content has evoked considerable changes in oil-accompanying substances such as phospholipids whose content in the seeds of high oil sunflower varieties selected by the VNIIMK varies from 0.5 to 0.8% of the seed mass. The amount of phosphatids extracted is less than 50% of their content in the seeds. This is explained by various features of a complex group of phospholipids and by differences in the energy of line of some representatives of this group as compared to other seed components.

Vegetable oil phosphatids are physically valuable material, and their maximum extraction from seeds is therefore a very important problem which should be solved together with improvements in the oil obtaining technology. This task is made even more difficult owing to the problem of so-called unhydrated phosphatids. The maximum phosphatids extraction from high oil seeds sunflower should therefore be accompanied by improving their hydrophylic properties and hydrating rate.

One of the possible ways aimed at solving this problem is to improve the technology of sunflower seed preparation for processing.

Experiments showed that of all the factors studied the thermal effect on the seeds during drying is of decisive importance for the formation of the phosphatids hydrophylic property in oil. Seeds heating to 70-75°C during their drying to 7.0-7.2% of humidity leads to an increased transformation of phosphatids into oils, coupled with a considerable improvement of their hydrating properties.

results, technologically and economically, than periodic or separation refinement.

At the present stage, cere cannot yet be fully removed from sunflower seed. The shell and cere are removed by hulling only partially, and a considerable portion of waxy substances is preserved in oil.

Wax drops out of oil at low temperatures, which quality is used in industry. Refined oil is cooled alternately with fresh and salted water, until it gets the temperature of 10°-12°C, then, after four hours, at least, in this temperature, it is filtered. The All-Union Research Institute of Fats has recommended substances that aid filtration - filter-perlyte and kiselgur K-700. Transparent oil, that does not turn turbid even at 5°C, completely void of wax and phosphorus-containing substances, is obtained as the result of that process, called freezing. Besides, the oil acid number diminishes, and the quantity of non-alkalized substances, too.

Deodorizing helps extract substances that lend oil a taste and a smell, and implies treatment of oil with steam at 210°-230°C and the pressure of 1-2 mm, which makes the last operation in oil refinement.

The Research Institute of Fats has also worked out a technology of non-alkali neutralisation of hydrated sunflower oil by treating it with a solution of citric or phosphoric acid, with subsequent removal of metal catalyzers by adsorption and neutralisation of unbound fatty acids by distilling the oil which is also deodorized at the temperature of 220°-230°C and residual pressure of not more than 2 mm. This technology excludes formation of soapstock, so lessening neutral fat losses, and has been successfully employed by a number of factories thanks to its expediency.

It has been also found that the ripening rate, initial humidity and other factors considerable affect seeds during drying, since in the process of ripening seeds properties are changing in a large measure. That is why the optimal heating temperatures assuring an increased transformation of phosphatids into oil and improving their hydrating rate were determined differentially for seeds of different quality: unripe, ripe field-fresh and ripe seeds under storage. Thermal treatment has been effected in two ways: heating in a drying case and treating by saturated steam.

The data obtained prove that there is a general tendency for all the specimens investigated: the higher the temperature of seed heating the higher is the general phosphatids extraction and the better their hydrophylic properties. However, to obtain one and the same effect stored seeds should be heated to higher temperatures than ripe field-fresh and unripe seeds.

It has been established that to form the optimal phosphatids quality the lower temperature limit must be 70-75°C for unripe seeds which reached physiological ripening (the 26th day from the end of flowering or harvest ripening (the 35th day from the end of flowering), 75-80°C for ripe field-fresh seeds (the 56th day from the end of flowering), and 85-90°C for stored ripe seeds.

Humid heating, if saturated steam is used as heat carrier, is even more effective in the formation of the phosphatids hydrophylic properties. In such conditions of thermal treatment minimum heating makes it possible to increase phosphatids converting into oil and improve their hydrating ability shifts to lower temperatures. This goes to show that the complex effect of two factors (humidity plus heating) provides for a better effect as compared with that of a dry heating. It has been proved that the seeds preserve their properties acquired under the action of thermal treatment during 5-7 months.

These phenomena can be explained by changes in the resistance of certain phospholipid protein complexes under the input of thermal. The increase of heating temperature to 70-80°C results in firmer tying of polar unhidrated forms of phosphatids largely represented by phosphatidic and polyphosphatidic acids. Their bonds are so firm that they cannot be broken even by the humous thermal treatment, and these groups of phosphatids do not convert into oil.

At the same time the bonds of less polar hydrated forms of phosphatids weaken, enabling them to convert into oil.

We believed that these changes take place thanks to the redistribution of the basic composite phospholipids between "free" and bound lipids and that more lable are complexes formed with the help of sorbitioned and hidrogen bonds. Accordingly, we studied the fraction content of "free" lipids which are present in oil and also "bound" lipids which are nevertheless released from oil cake after its standard treatment.

The fraction content of studied phospholipids in Fig. 1 shows that the total content of phosphatidic acids in the lipids isolated from heated and unheated seeds has slightly changed, but their content is almost three times less in free phosphatids isolated from oil. The basic quality of phosphatidic acids after seed heating is determined in the "bound" lipids fraction.

Preliminary seeds heating to 70-90°C is accompanied by an increased proportion of the most valuable fraction of phosphatidyl cholines and a decreased sum of phosphatidic and polyphosphatidic acids in the phosphatids isolated from oil. Thus phosphatids obtained by means of a direct extraction of sap by benzene from initial seeds contain 23.5% phosphatidyl cholines while heated seeds give up to 46.2% of phosphatids and at the same time the total content of phosphatidic and polyphosphatidic acids decreases from 28. 2 to 5.8%, respectively. This undoubtedly improves the quality of phosphatid concentrate (market lecithin) to a considerable extent.

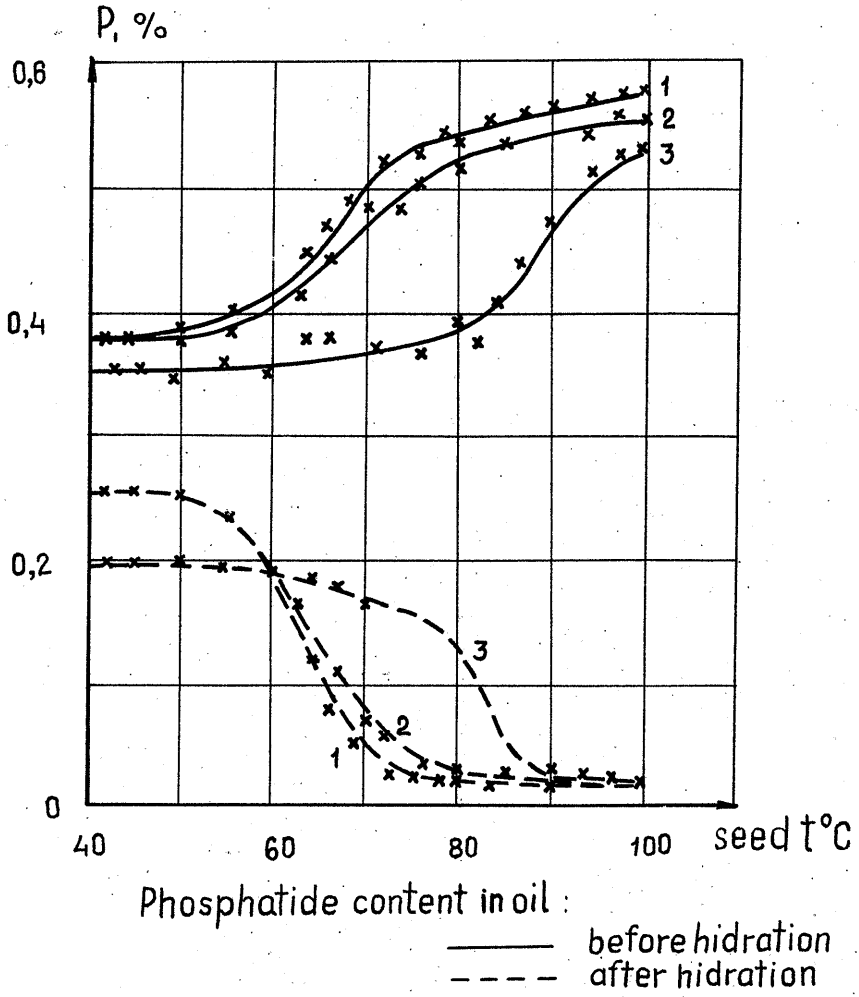

Fig. 1. Influence of heated seed temperature on hydration ability of phosphatides (P):
1 - from immature seeds; 2 - from mature seeds after harvesting; 3 - from mature stored seeds

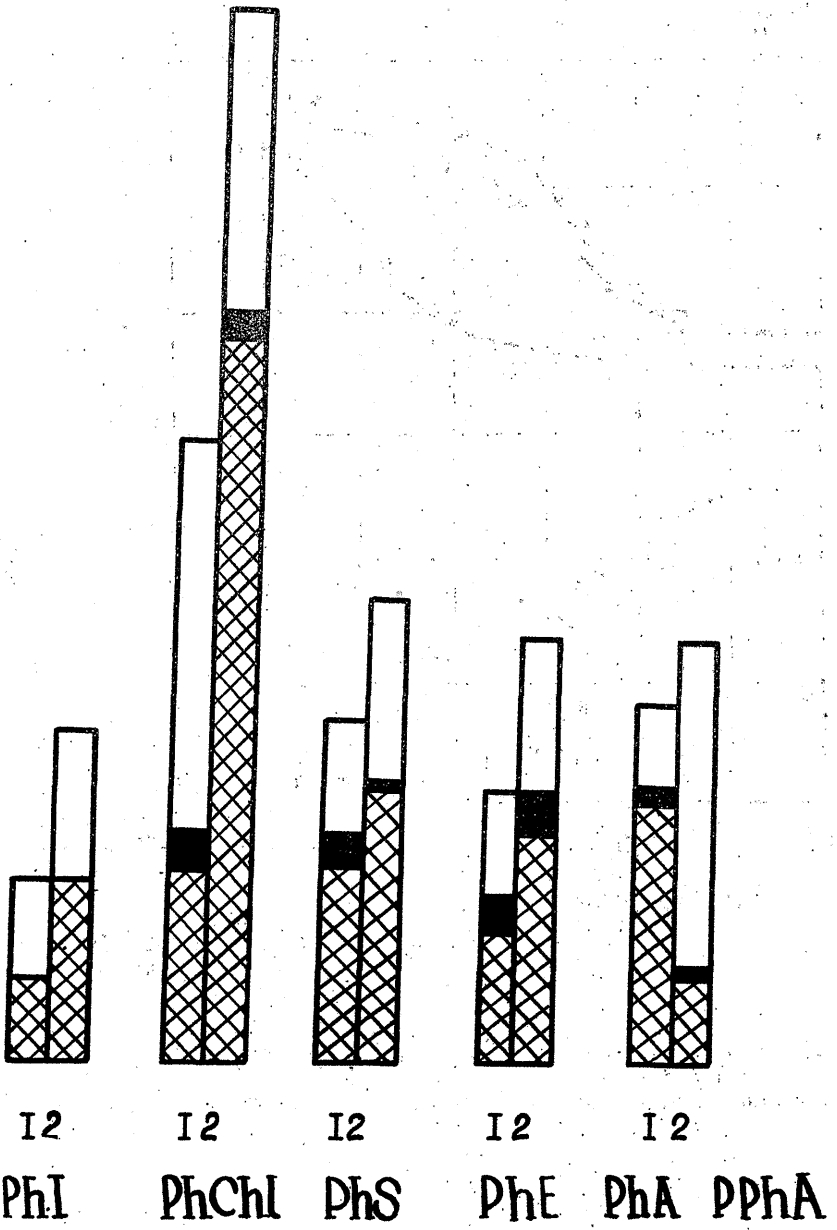

Fig. 2. Relative content of some phospholipids (PhI) extracted from seeds
1 - from initial seeds without previous heating; 2 - from seeds previously heated up to 80-85°C

Thus our experiments have proved that the thermal effect strengthens the bonds of phosphatidic and polyphosphatidic acids with seed substances, whereas the phosphatidyl cholines bonds weaken. Moreover, the latter processes prevail over the first, which is expressed in the increased transformation of total phosphalipids into extracted oils.

Experiments have also showed that the heating of seeds to above-mentioned temperatures promotes an increased conversion into oil of other accompanying materials, particularly, of the saponifiable. Taking into account that oil enriching by substances such as sterins and tocopherols relating to a saponifiable group is a positive factor increasing oil food quality, it is essential to make deeper research in this direction.

The experimental results made it possible to formulate the following recommendations for production.

To increase phosphatids extraction and improve their quality it is necessary to heat field-fresh with high initial humidity to 75-80°C during their drying. Since it has been established that properties acquired by them do not disappear at storing during 7 months they can be sent both to overwork and to storing.

Saturated steam should be used to heat dry field-fresh or stored seeds to 75-85°C designated for production (provided that earlier they did not undergo thermal treatment).

These recommendations have been checked at different times in production conditions at the Nevinnomyssk Oil Extracting factory and Beltsy Oil and Fat combine and their effectivity has been confirmed.