V.G. Shcherbakov,
V.G. Lobanov, USSR

DISPLACEMENT OF LIPIDS IN SUNFLOWER SEED CELLS DURING INDUSTRIAL TREATMENT

The question of the place of lipid supplies in the cells of seeds of oil crops goes together with that of the place of their synthesis in the all. Stumpf (1961) produced the hypothesis of triglyceride synthesis taking place in mitochondria and microsomes, but, though of much interest, it does not provide an answer to many questions. Triglyceride molecules cannot penetrate mitochondria membranes and, consequently, can be synthesized only within the mitochondria, which limits the quantity of triglycerides in a cell by the volume of its mitochondria. At the same time it is known that triglyceride supplies take up the major part of oil crops' cells.

I.I. Sveshnikova (1955) proved that fat appears first in endosperm laminae of ripening seeds' cells. As stated by V.S. Petibskaya (1972), drops of synthesized fat are always bound with endoplasmic bubbles, so the idea seems well grounded that only fatty acids are synthesized in mitochondria. A.G. Vereshchagin (1972) also believes triglyceride synthesis in mitochondria to be hardly probable and places it in ribosome-rich membranes of the endoplasmic reticulum.

We studied lipid supplies in ripening seeds with an electronic microscope and saw but a negligible quantity of lipids in nuclear cells on the first day after flowering. The cell walls with the adjacent protoplast, and juice-filled vacuole were very distinct in the microscope. We could make out many mitochondria in the protoplast whose form and dimensions were similar to those defined by other methods,

which fact indirectly proves that we did not damage the structure of the cells during our investigation.

Small clusters of lipids were clearly seen in the protoplast on the fourth day after flowering. At the time lipid content in the seed was 12–15% in terms of dry substance.

On the eighth day after flowering the number of lipid clusters in a cell is considerably greater, though vacuoles are still to be seen, and the oil content in the kernel rises up to 25–28%. Vacuoles disappear by the fifteenth day, lipid clusters become numerous, and oil content reaches 34–36%. Spheromes fill the entire cell by the 18th–22nd day, and lipid content reaches its climax, 63–64%, after which the lipid synthesis practically comes to an end.

The aim of our investigation was a study of the structure of products got from oilseed and of displacement of oil in these so as to define more accurately the basic demands of the technology of oil production.

Scanning electronic microscopy, so popular lately, makes it possible to study the inner structure of a cell as a three-dimensional image, thanks to the great sharpness of the image produced and a strong resolving power of scanning microscopes. Besides, preparations need not be treated with organic and other chemically active substances that can influence, to a certain degree, the delicate structure of the cell's protoplasm.

Cross and longitudinal microscopic sections of samples under study were prepared and fixed on the table with colloid silver by their reverse side.

A layer of gold was sprayed on the sections before work, in accordance with the existing recommendations.

We used the scanning microscope CWIKSAN-100.4 designed at the University of

California, with magnifying power from 500 to 7,000 times. Four replications were used.

Our investigation showed that when the seed was first worked up by rollers, lipid and aleuronic clusters were not much destroyed. The structure of the cells was but partially violated. So, our observations confirmed the opinion of an inferior quality of the VS-5 rolling machine used for oil extraction from seed.

Only after a second rolling did we observe the destruction of cell structures and, partially, that of lipid and aleuronic clusters.

After the third rolling the cells were almost fully destroyed, and the received product corresponded to the theoretical requirements as formulated in 1958 by A.M. Goldovsky. However, lipid clusters were still not fully destroyed, which held true even after the fourth rolling.

When the seed is wetted in the first deck of the oven, its structure does not noticeably change from that before frying.

When the seed is taken from the lowest deck of the oven, all the cell structures are dipped in deep layers of oil.

Pressing continues the process of changing the structure of the seed. Oil cake does not contain intact lipid clusters, and the bulk of the oil is kept in "secondary structures" formed under pressure. The fragments of cell walls and capsules of lipid clusters were extended in the direction of the seed's movement through the screw channel of the press.

The oil location in a seed after pressing and before it are similar, but much less oil is found on the surface of the seed as its bulk has been pressed out.

Sunflower meal contains only negligible quantities of oil and is friable and fibrous.