New research to improve production of high oleic sunflower oil

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Sampling sunflowers. Credit: Provided by the researchers/Skolkovo Institute of Science and Technology

Researchers from Skoltech, Pustovoit All-Russian Research Institute of Oil Crops, OilGene—a startup launched in Skoltech—and other organizations have found new markers that will accelerate the breeding of high oleic sunflowers and improve the production of healthy oil with high oleic acid content. The study is published in *PLOS ONE*.

Sunflower oils divide into several types. The high oleic oil is more resistant to thermal oxidation and is low in saturated fatty acids. It is good for frying because it has a neutral taste and does not contain harmful trans fats. Oleic acid reduces the risk of heart disease. In its properties, the high oleic sunflower oil is similar to the olive oil.

"Raw materials for the high oleic oil result from the breeding process. Normally, sunflower breeders start with crossing the high oleic parent with the nucleic one to introduce the trait. At the next stage, they plant seeds at the experimental fields and select a progeny of high oleic seeds after performing difficult biochemical tests at the laboratory. It is a time-consuming process.

"We developed two sets of markers for the accelerated breeding of high oleic sunflowers. They will help to find the high oleic progeny while the achene (seed) is forming in the parent anthodium. Now, with the help of these markers, the high oleic trait is easier to find and select through the rapid DNA test," first author and Skoltech graduate Rim Gubaev explains.

Researchers crossed two sunflower lines—with the high oleic mutation and without it—and cut every seed in half. They extracted a little oil

from the first half and determined the content of oleic acid through gas chromatography with flame ionization detection. The other half with the embryo was used to grow a new plant, from which the scientists extracted the DNA and decoded it with the help of high-performance sequencing.

"Using sequencing data, we constructed genetic maps and performed mapping, which returned genetic markers associated with oleic acid content. Skoltech and OilGene will file a patent for these markers. Our results lay the foundation for developing rapid DNA tests for companies specializing in breeding," study co-author, CEO of OilGene, and Skoltech graduate Alina Chernova explains.

The study also produced new fundamental results. It discovered translocation in the genome of the cultivated sunflower—a displacement of large plant's chromosomal regions. Previously, translocation was described only while crossing different types of wild sunflowers.

"Apart from translocation, we showed that the high oleic gene can be represented by two alleles—recessive and dominant. Earlier, it was assumed that the high oleic gene can be only dominant. We discovered its recessive version," study co-author, a junior research scientist from the Skoltech Project Center for Agro Technologies Stepan Boldyrev concludes.

Researchers effectively use their results in business. Born in Skoltech and founded by the authors of the study, the company OilGene supports the agricultural sector through genetic technologies.

"Our collaborative results with Pustovoit All-Russian Research Institute of Oil Crops will be the core for developing new solutions to accelerate the sunflower breeding. They will reduce financial and time costs for creating its new varieties and hybrids. On the one hand, our markers will

help develop a rapid DNA test for identifying the high oleic trait in sunflowers directly in the field.

"On the other hand, these markers can be included in the NGS-panel to determine the quality of sunflower oil by a number of characteristics—similar to panels used for diagnosing human's genetic diseases. We are planning to commercialize our results in the OilGene startup set up in Skoltech," Chernova concludes.

The OilGene company is searching for genetic markers of agriculturally important traits of cultivated plants, develops approaches for accelerated breeding, provides genetic and bioinformatic support for breeding processes and pioneers genomic selection approaches. To that end, it uses next-generation sequencing technology and high-performance genotyping. The team has competencies in plant genetics, marker-assisted breeding, phytopathology, molecular biology, and bioinformatics.

As part of their previous projects, the team found genetic markers of useful agricultural traits for accelerated breeding of sunflower, rapeseed, and soybeans, as well as developed test systems to determine the hybridity of soybeans resistance of sunflower to contagion. The target market of OilGene is breeding companies and agricultural holdings.

More information: Rim Gubaev et al, QTL mapping of oleic acid content in modern VNIIMK sunflower (Helianthus annuus L.) lines by using GBS-based SNP map, *PLOS ONE* (2023). DOI: 10.1371/journal.pone.0288772

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