METHODS FOR OPTIMIZING EXTRACTION TECHNOLOGY OF UNCONVENTIONAL VEGETABLE OIL COMPOSITIONS AND INCREASING FATTY ACID YIELD

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Vegetable oils are today a strategically important raw material widely used in the food industry, pharmaceuticals, cosmetology and biofuel production. Although traditional oilseeds - sunflower, cotton, soybean, safflower - remain market leaders, economic and environmental factors are making oil extraction from unconventional, unprocessed or poorly studied plants a pressing issue. Plants such as sesame, flax, pumpkin, amaranth, safflower, basil, black sesame are sources of lipids with high biological value.

The study of unconventional vegetable oils is associated not only with the uniqueness of their chemical composition, but also with the medical and industrial potential of their fatty acid spectrum. However, the extraction processes of such plants do not always give optimal results; The physicochemical properties of the raw material, moisture content, grinding state, interaction with solvents, temperature-pressure parameters have a significant impact on the yield. Therefore, improving and optimizing extraction technologies is an important scientific and technological direction for increasing the yield of fatty acids.

This thesis widely covers modern technological and scientific approaches to increasing the extraction efficiency of non-traditional oil plants, optimizing process parameters, and producing high-quality fatty acids.

The fat content of non-traditional oil plants varies from 20 to 60 percent. For example, flax contains 40–45% fat, black sesame 35–38%, sesame up to 50%, and pumpkin seeds 30–35%. These indicators make it possible to obtain high-quality lipids from them.[1]

Their advantages:

1. A large number of biologically active components: tocopherols, phospholipids, sterols, omega-3 and omega-6 acids.

2. High market demand due to lack of research: black sesame, flax, amaranth oils are in increasing demand in cosmetology.
3. Ecologically clean and inexpensive raw materials: most plants grow in rural areas in natural conditions without much expense.[3]
Also, the composition of fatty acids of non-traditional plants differs sharply from traditional oils. For example, linseed oil contains linolenic acid up to 55–65%, which is the highest indicator.
The extraction process depends on the following factors:
degree of grinding of the raw material
moisture content
chemical nature of the solvent
temperature
pressure
extraction frequency
mechanical mixing intensity
To improve the process on a scientific basis, calculations are made according to Fick's law of dispersion, Nernst distribution law and metabolic kinetics.
Solvents determine the solubility of the oil.
The most effective solvents are:
n-hexane
isopropyl alcohol
ethanol
supercritical CO_2[4]
Ethanol and CO_2 are environmentally friendly. CO_2 extraction is carried out at high pressure, giving very pure and high biological value fatty acids.
As the temperature increases, the extraction accelerates. However, very high temperatures can oxidize polyenoic acids. The optimal temperature is considered to be 45–60°C.
Disadvantages of existing processes
high energy consumption;
high solvent consumption;
accelerated oxidation process;
fatty acids decompose.
Therefore, new technological solutions are needed.
Supercritical CO_2 extraction
This method is considered ecological, safe and highly efficient.

Advantages:
high selectivity
high yield at low temperatures
no oxidation
no solvent residue
High-frequency waves break the cell wall and ensure rapid oil release.
Advantages:
process time is reduced by 2–3 times
solvent consumption is reduced
energy is saved
Enzymatic extraction
In this method, special enzymes break down plant cells and accelerate oil separation.
Advantages:
no chemicals are required
the biological value of the oil is preserved[5]

In conclusion, optimizing extraction technologies for obtaining fatty acids from unconventional vegetable oils is a very urgent issue from a scientific and practical point of view. Modern approaches — supercritical CO_2 technology, ultrasound, enzymatic and microwave extraction — significantly increase productivity, make the process environmentally friendly and preserve the biological value of fatty acids. Mathematical modeling of process parameters provides a solid scientific basis for increasing efficiency.

Obtaining high-quality, stable and energy-efficient fatty acids using optimized technologies creates great opportunities for industry and science.

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