JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 01, January 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

UDC 665.335.1.

ENZYMES USED IN VEGETABLE OF OIL EXTRACTION TECHNOLOGY

Shuhrat Yunusovich Djinayev ,
Nargiza Nusratovna Sabirova,
Kakhramon Khalimovich Majidov ,
Sitora Ikhtiyarovna Usmonova
Bukhara Engineering Technological Institute,
Republic of Uzbekistan, Bukhara , st. K.Murtazaeva 15
E- mail : shuxratdjiyanov1980@gmail.com

Abstract: The characteristics of enzymes used to extract oil from plant raw materials have been studied. The conditions ensuring the extraction of oil using effective enzymes have been established, and recommendations have been given for the enzymes used in the oil and fat industry.

Key words: lipolytic enzymes, oil seeds, oil extraction, technological factors, product indicators.

Introduction. An important role in the formation and change of the quality of oilseeds and the oils extracted from them is played by the enzyme complex.Currently, enzyme technologies are widely used in the production and processing of vegetable oils [1-3]. During the storage and processing of oilseeds in the production of vegetable oils, the most important enzymes in terms of their influence on the quality of the resulting products are hydrolytic and oxidation - reduction enzymes .

Hydrolysis of triacylglycerols occurs under the action of lipases. Lipase, which hydrolyzes monoacylglycerols, is localized in the membranes of glyoxysomes of germinating seeds. It has been established that these lipases differ not only in the nature of the substrate, but also in the pH optimum and the temperature of maximum activity [4-6] .

The activity and nature of the action of lipases are of great importance in the process of preparation for storage and storage of oilseeds. The study of hydrolytic enzymes of plant raw materials and the search for ways to regulate their activity are becoming an increasingly important task from the point of view of preserving the reserve substances of seeds and, consequently, increasing the yield of food products.

Loss of seed oil content under unfavorable storage conditions reduces oil yield. Increased humidity, the presence of unripe seeds and heat transfer conditions during their self-heating contribute to an increase in the activity of enzymes that hydrolyze seed reserve substances , including lipids. In this case, lipid hydrolysis may be one of the reasons for the decrease in oil yield.

Materials and methods. For most of the studied cotton varieties, the lipase activity did not change significantly during storage at room temperature. The exceptions were pubescent varieties with a moisture content of 8.5 and 10%, the lipase activity of which increased by 43 and 64% , respectively, in the ninth month of storage and decreased to the initial level at the end of storage .

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 01, January 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

The activity of lipase in cotton seeds is also affected by such an indicator as their degree of maturity. The highest activity is in small seeds , among which there are a large number of immature seeds. The lowest activity is in large cotton seeds .

Inactive seed lipases are usually activated during seed crushing or storage.The resulting accumulation of free fatty acids may render industrially usable oils unusable or require additional processing to remove these acids . Thus , the enzyme complex of oil seeds is one of the important factors influencing the quality of their processed products in the production of vegetable oils.

In the classical technology, mechanical and heat-moisture treatment are used to destroy the cellular structures in plant raw materials, after which raw edible oil is extracted by pressing. The residual oil is extracted from the meal by extraction with hydrocarbon solvents, followed by separation of the miscella. The technology has a number of disadvantages. Edible oil (press fraction) contains by-products formed at the stage of heat-moisture treatment, which reduces the physiological value of the oil. Extraction of oil from the meal with hydrocarbon solvents creates a fire and explosion hazard in production.

Enzymatic processing of plant raw materials allows extracting oils in mild conditions, preserving the physiological and nutritional value of the oils. There is no need to use hydrocarbon solvents, and the environmental safety of production is significantly increased.

The basis of enzymatic methods for extracting vegetable oils is the hydrolytic cleavage of non-lipid components of raw materials in aqueous media, followed by the separation of oil from emulsions.

When preparing raw materials for hydrolysis, it is necessary to free the seeds as completely as possible from the covering tissues, which contain a large amount of difficult-to-hydrolyze polymers - cellulose, hemicellulose. If raw materials with a husk content of about 10% are used for the extraction of sunflower oil using classical technology, then only batches with a husk content below 1% are suitable for enzymatic processing.

The factor limiting the fermentation processes of plant raw materials is the diffusion rate of hydrolysis products. Therefore, the effective use of enzymes is possible only with a high degree of grinding of the raw materials. The degree of grinding is limited by the possibility of forming microemulsions of oil in the raw materials, which are difficult to separate. Grinding of the raw materials largely solves the problem of cell disintegration. Some cells remain intact, and their walls must be destroyed with enzymes.

If the effect of pectinase is insufficient to destroy cell walls, cellulase and semicellulases should be added to the complex of hydrolytic enzymes. These enzymes may be necessary when processing small seeds - rapeseed, poppy, and corn germs , where the cellulase content is relatively high, % of DM (Table 1).

Table 1

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 01, January 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

Types of raw materials	Oil content	Crude protein	Fats protein	Cellulose
Cotton plant, kernel	37-40	34-38	1,1	1.2-2.1
Soybeans, cotyledons	21	41	0.5	-
Sunflower, seeds	45-55	16-20	2.8	1.8-3.8
Corn Germ	55-58	12-19	3.6	15-18
Flax, kernel	59	19	3.1	1.3
Castor oil plant, kernel	68	27	2.5	0.35
Peanuts, seeds	56	25	2,2	2.0
Rapeseed without erucic varieties, seeds	42-45	23-25	1.8	8.8-9.3
Wheat germ	15	41	0.36	2.5

In the structure of the plant cell wall, three main polymers - cellulose, hemicellulose and pectin - are linked in the following way. Cellulose forms microfibrils on the surface, in which the linear parts of the hemicellulose molecules are fixed by hydrogen bonds. The lateral branches of hemicelluloses are covalently linked to pectin, with one pectin molecule linked to several surrounding hemicellulose molecules. Hydrolysis of pectin by pectological enzymes causes the wall to loosen, since a link, a binder that focuses other polymers, falls out of its structure. The wall disintegrates into cellulose - hemicellulose complexes capable of sliding relative to each other in the space freed from pectin. In thin walls, this may be sufficient for their subsequent destruction under the action of osmotic forces.

We have proposed a method for extracting oil from sunflower seeds. Seeds with a husk content of 0.3% are crushed and fermented at a hydromodulus of 1:1 or 1:2 for an hour at 40-50 ^{o} C. The enzymatic complex includes protease and cellulase at a rate of 0.1-0.5 and 1-3 units per 1 gram of raw material, respectively. Sunflower has a fat:protein ratio of 2.8 and the task of isolating oil in the form of emulsions, as well as destabilizing emulsions, in this case is much more difficult than when obtaining coconut oil.Upon completion of hydrolysis, a hot solution of table salt (final concentration 10%) is added to the reaction medium and the temperature is increased to 85-95 ^{o} C. After centrifugation, the system is divided into four phases: oil, oil-protein, aqueous protein solution, and a solid phase consisting of fragments of cellular structures of insoluble oil protein. The oil content of the sediment is 25-30%. Repeated extraction with a hot NaCl solution allows to reduce the oil content of the sediment to 10% and obtain a total oil yield of about 90% of the original oil content of the raw material.

Conclusion. Enzyme methods can be used to extract essential oils from plant materials. Extraction of essential oils from plant biomass is hindered by cell walls, therefore, preparations with cellulase and pectinase activity are used to intensify the extraction. Treatment with β-glucosidases, which include cellulases, also allows increasing the content of valuable monoterpene alcohols due to hydrolysis from glucosides. After treating essential oil rose flowers with cellulase preparations, the yield of rose oil increased by 2-2.5 times, the content of its valuable components - citronellol, nerol, hepaniol - increased. The process of isolating oil from the hydrolyzate includes hydrodistillation, sorption on activated carbon, elution with solvents and their distillation.A similar technology can be used to obtain other types of essential oils from plant materials.

References

1. Enzyme technologies - the present of the oil and fat industry. Oil and fat industry.- 2011. - №4. - p. 7

2. Livinskaya S.A. Use of enzymes in the technology of obtaining vegetable oils. S.A.Livinskaya.Oil and fat industry.–2009. – No. 5.– p.14.

3. Kazandzhan Z.M. Changes in enzymes during heat-moisture treatment of soybean petals. M.Kazandzhan , V.V.Klyuchkin.Proceedings of the All-Russian Research Institute of Plant Protection.-1974.-
issue 31. - pp. 61-64.

4. Mirzoev A.M. Electrophoretic properties of proteins during seed processing in the production of vegetable oils. A.M.Mirzoev , M.I.Dmitrichenko.Technical and technological problems of service. - 2014.-№2(27).-pp.89-91.

5. Shcherbakov V.G. Biochemistry and commodity science of oilseed raw materials. - M.: Agropromizdat.1991. - p.304

6. Brockerhoff H. Lipolytic enzymes. H. Brockerhoff , R. Jensen.- M.: Mir, 1978.-399 p.