ЎЗБЕКИСТОН РЕСПУБЛИКАСИ ОЛИЙ ВА ЎРТА МАХСУС ТАЪЛИМ ВАЗИРЛИГИ
ИСЛОМ КАРИМОВ НОМИДАГИ ТОШКЕНТ ДАВЛАТ ТЕХНИКА УНИВЕРСИТЕТИ

МИНИСТЕРСТВО ВЫСШЕГО И СРЕДНЕГО СПЕЦИАЛЬНОГО ОБРАЗОВАНИЯ РЕСПУБЛИКИ УЗБЕКИСТАН
ТАШКЕНТСКИЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ ИМЕНИ ИСЛАМА КАРИМОВА

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STUDY OF WATER TECHNOLOGICAL PARAMETERS INFLUENCE ON THE EFFICIENCY OF VEGETABLE OIL REFINING

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Annotation. *Experimental methods have been used to study the effect of process water quality indicators on the efficiency of phospholipid hydration and neutralization of free fatty acids in the industrial refining of vegetable oils in order to create new emulsion products of improved quality.*

Keywords: *vegetable oil refining, hydration of phospholipids, neutralization of free fatty acids, emulsion products.*

Introduction

Currently, the quality and safety of the consumption of fatty foods is one of the paramount issues of the innovative development of the oil and fat industry. In this regard, complex scientific research aimed at improving and optimizing the technological parameters of the processes of hydration of phospholipids and neutralization of free fatty acids is especially relevant and in demand [1].

Improvement of physical-chemical parameters and maximum preservation of biologically active substances in refined oils contribute to their oxidative stability and long-term preservation of qualitative and quantitative properties. Solutions to this problem, which do not require significant capital investments, are especially relevant for small and medium-sized businesses, allowing the latter to be more variable. High-quality refined vegetable oils are the basis for obtaining emulsion food products with rational properties that contribute to maintaining health and optimizing the fat diet of the population [2].

Study of the effect of water quality indicators on the efficiency of phospholipid hydration and neutralization of free fatty acids of vegetable oil

A review of the scientific and technical literature on the topic of the dissertation work made it possible to identify trends in the development of vegetable oil refining technology, where special attention is paid to the study of scientific and practical problems of the processes of hydration of phospholipids and the neutralization of free fatty acids, as well as the analysis of the influence of technological parameters, schemes and methods on the effectiveness of these processes. The prospects for the creation of new emulsion products for a healthy diet and their innovative attractiveness for fat-and-oil enterprises have been identified based on the systematization and analysis of scientific and practical research data. It is shown that the production of a new generation of fatty food products is possible based on the use of efficient methods for processing vegetable oils, which make it possible to obtain high-quality refined oils [3]. For this, new research aimed at: improving the technological processes of hydration of phospholipids and neutralization of free fatty acids of vegetable oils in order to improve the quality indicators of hydrated and neutralized oils, the preservation of biologically active substances; increasing its oxidative stability; improving the quality indicators of water used in the technological processes of refining vegetable oils and in formulations of emulsion food products; development of formulations of emulsion products with functional properties to optimize the fat diet of the population [4].

The study used standard generally accepted methods for studying physical and chemical parameters characterizing the quality and composition of vegetable oils and emulsion products, which were carried out in accordance with the VNIIJ Guidelines to research methods, technical and chemical control and accounting of production in the oil and fat industry. In addition, standard methods for the analysis of concomitant substances and impurities of vegetable oils, as well as by-products of refining, were used [6].

One of the most important factors affecting the quality of refining processes is water, since its quality, i.e. the values of hardness, alkalinity and the active reaction of the medium pH, depend on the temperature of the processes and the doses of the introduced reagents. Therefore, studies have

been carried out to improve the quality indicators of water used in oil and fat production in the refining of vegetable oils. Under laboratory conditions, insoluble hydroxides of oxidized iron and manganese were removed from water taken from a central water supply using a mechanical filter with a catalytic load of manganese zeolite. The removal of hardness and alkalinity salts (Ca^{2+}, Mg^{2+}) was carried out on an ion-exchange unit by the Na-cationization method. As a result, purified, transparent, soft, weakly acidic, low-mineralized water was obtained, the quality indicators of which in terms of total hardness, alkalinity, mineralized, active reaction of the medium pH and transparency are shown in Table 1. The implementation of the proposed technology for softening water from central water supply sources at medium and small businesses does not require special equipment and can be easily adapted to their conditions [5].

Table 1.

Prepared water quality indicators

The name of indicators	Content in water	
	initial	prepared
Total hardness (mg• eq/l)	5.0	0.1
Total alkalinity (mg•eq/l)	2.9	0.4
Total mineral content (mg/l)	500	200
Active reaction medium (pH)	6.5	5.5
Transparency	Transparency	Transparency

The quality of water, its micro and macro component composition is the most important condition for the efficiency of the process of hydration of phospholipids, due to the physical-chemical and chemical effects of water on the hydrated oil. Table 2. shows the results of studying the effect of water quality on the efficiency of extracting phospholipids from sunflower oil.

Table 2.

Influence of water quality on the efficiency of extraction of phospholipids from sunflower oil

The name of indicators	Unrefined oil	Hydrated with water	
		tap water at hardness 4.0 mg•eq/l and alkalinity 2.9 mg•eq/l	prepared at hardness 0.1 mg•eq/l and alkalinity 0.4 mg•eq/l
Mass fraction of phospholipids, %	0,9	At a temperature of 50°C	
		0,45	0,33
Hydration, %	-	50	64
Mass fraction of phospholipids, %	0,9	At a temperature of 53°C	
		0,41	0,31
Hydration, %	-	55	66
Mass fraction of phospholipids, %	0,9	At a temperature of 56°C	
		0,41	0,31
Hydration, %	-	55	66

An analysis of the data obtained shows that the hydration of the oil with preliminarily prepared water is at the level of 60 ± 6%, which exceeds this indicator by the traditional method by 11 ± 2% [6]. This fact is explained by the fact that some groups of phospholipids, which include phosphatidic and polyphosphatidic acids, are resistant to water and remain in the oil. Therefore, to improve the efficiency of the hydration process and deeper extraction of phospholipids, a reagent

was developed, consisting of a mixture of citric and malic acids with preliminarily prepared water, which helps to reduce the aggregative stability of phospholipids, their coagulation and excretion in the form of a phospholipid emulsion [7].

In order to determine the optimal parameters of the process of hydration of phospholipids, laboratory studies of the influence of the process temperature, composition and amount of the reagent, as well as the duration of exposure on the efficiency of phospholipids extraction were carried out. For this, unrefined sunflower oil after primary purification by settling was hydrated according to the standard method, including: heating to the required temperature; adding the reagent and mixing to obtain a homogeneous mixture and maximum dispersion of the reagent; mixing for aggregation (P-%) of the resulting flakes of phospholipids; decanting the hydrated oil.

The temperature of the process was changed in the range of 50-80°C due to the fact that at temperatures below 50°C the separation of the "oil-water" system is difficult due to high viscosity properties, and at temperatures above 80°C the degree of solubility of phospholipids increases, and the efficiency of their removal during the separation of the system decreases (Fig. 1). The range from 65 to 700 C is recognized as the optimal value [7].

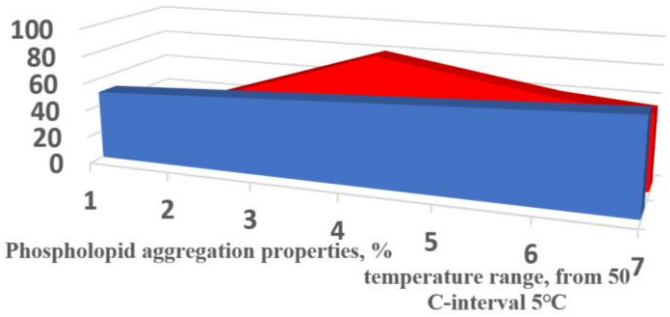

Fig. 1. Changes in the aggregative ability of P1 phospholipids depending on temperature

The optimal amount and composition of the hydrating agent - a 2.5% aqueous solution of a mixture of citric and malic acids was determined at their ratios, respectively, 2:1; 1:1; 1: 2 and an amount of 0.05-0.20% by weight oils. The influence of the exposure time of hydrated oil on the efficiency of phospholipid extraction was studied in the range of 20-35 minutes (Fig. 2÷4).

As a result of the research, it was found that the maximum efficiency of extracting phospholipids of 83% is achieved at a temperature of 68°C, a mixture of citric and malic acids in a ratio of 1: 1 in an amount of 0.1% by weight of the oil, together with pre-treated water with improved quality indicators. The exposure time required for the formation of stable phospholipid complexes and transition to the aqueous phase was 30 minutes.

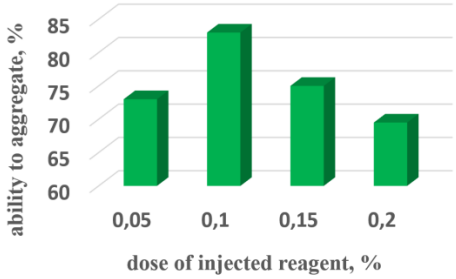

Fig. 2. The ability to aggregate phospholipids with the introduction of citric: malic acids in a ratio of 1÷1

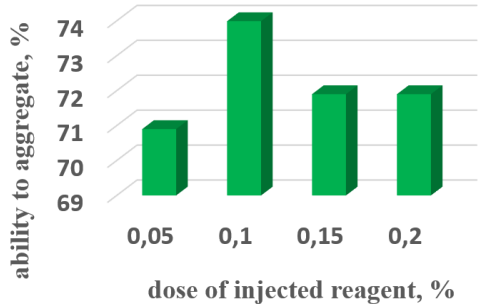

Fig. 3. The ability to aggregate phospholipids with the introduction of citric: malic acids in a ratio of 1÷2

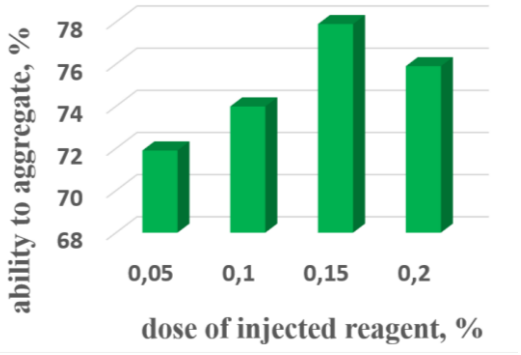

Fig. 4. The ability to aggregate phospholipids with the introduction of citric: malic acids in a ratio of 2÷1

The quality indicators of sunflower oil hydrated according to the developed and traditional technologies are shown in Table 3.

Table 3

Comparative characteristics of the indicators of sunflower oil obtained by developed and traditional technologies

The name of indicators	Initial oil	hydrated oil	
		according to the developed technology	according to traditional technology
Mass fraction of phospholipids, %	0,9	0,15	0,27
Acid number, mg KOH/g	2,0	1,91	1,96
Color number, mg of iodine in 100 sm^3	20	12	15
Peroxide value, mmol 1/2 O/kg	6,2	1,9	3,0
Moisture and volatile substances, %	0,2	0,1	0,15
Content of tocopherols, mg/100g	60	60	54
Hydration, %	-	83	70
Metal content, mg/kg Fe Cu	 2,5 4,1	 1,0 2,2	 1,3 2,3

Mg	10,9	4,9	5,2
Na	15,8	7,8	11,0
Ca	11,9	6,8	8,1

Based on a comparative analysis of the data, it was found that the developed technology was used to obtain hydrated sunflower oil with improved quality indicators due to a more complete removal of phospholipids, a decrease in the content of metals, the preservation of tocopherols to the maximum extent in general, and also due to the intensification of the hydration process.

Thus, the considered technology made it possible to increase the efficiency of the hydration process and the quality of the hydrated oil.

Conclusion

Thus, the work obtained and investigated water with improved indicators for technological processes of fat preparation and substantiated proposals, directions for improving the technology of phospholipid vegetable oil hydration. Theoretically substantiated and experimentally confirmed the expediency of using softened water in the processes of fat processing. The purified, clear, soft, slightly acidic, low-mineralized water with a hardness of 0.1 mg• eq/l and an alkalinity of 0.4 mg-eq/l can increase the efficiency of phospholipids hydration and neutralization of free fatty acids in vegetable oils and improve the quality of refined oils.

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ИНТЕЛЛЕКТУАЛЬНАЯ МЕТРОЛОГИЯ. МИРОВОЙ ОПЫТ В ВОПРОСАХ МЕТРОЛОГИИ И ВЫСОКОТОЧНЫХ ИЗМЕРЕНИЙ