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Processing Of Milled Cotton Seeds In An Electric Magnetic Field Of Extremely High Frequency Laboratory Device And Experimental Analysis

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Abstract:
In this article, the laboratory device for processing milled cotton seeds in an electric magnetic field with an extremely high frequency and the results of the experiment obtained are described. The volume of macro pores of the gourmets (from 1875 to 7500), processed at 2450 MGs, 300 W, at 12-14% humidity for 13-15 minutes, increased by an average of 2.0 – 2.2 times after ultra-high-frequency processing, and when comparing the acid and perekis number indicators of high gossipol cotton oil with oil obtained using traditional technology, compared with processing using frequency Beams has been shown to be more efficient than in the traditional method

Keywords: milled cotton seeds, acid number, perekis number, macro pore, gossipol, extremely high frequency, humidity, roasting.

Introduction.

In the change of structural substances in heat treatment of raw materials, the time-wise gradient of the temperature in exposure to microwave rays, the effect of which is high compared to conventional thermal processing, plays a role. The course of chemical reactions that take place in the material at different constants of the rate of rise in the temperature of the material when processing the formation of one or another intermediate products occurs at very low temperature intervals. This situation is explained by the shortness of the intermediate temperature intervals in microwave processing.

The case also applies to balanced processes with different constants of the rate of direct and inverse reactions [1]. It is known that the dielectric properties of food carcasses are similar to ice-for it, the dielectric constant at a frequency of 2450 MGS is ε^'=3",2" , the dielectric factor of losses is ε^"="0.00229" and the tangent of losses is 0.0009. Roasting oils have been found to have a dielectric constant of less than 3.0 and a loss factor of less than 0.11. I.A. Rogov and S.V. Nekrutman notes that the internal fat for ε^ " ="5 and tg" δ="0.10;" ε^'=3",2" for lard ; ε^"="0.233 and tg" δ="0.09" [2].

The absorption depth of light obeys Lambert's law of absorption. These magnitudes are functions of basic dielectric properties (ε^' " and " ε^") [3, 4]. For free water, the depth of absorption of light is 2.3 cm at 2450 MGs, with a doubling of energy, while at 915 mgs this figure is 20, for olive oil, the absorption depth of light is 67 sm.

The efficiency of the energy change between the generating unit and the product also depends on the dielectric nature of the product, its nature, and mainly on the density and specific heat capacity of the object being processed, as well as the size [5].
The energy uptake property of oil materials and oils is very high. For them, the nominal values ε^' " and " ε^" do not correspond. According to the results of studies, the mechanism of interaction of oils with the electric field is much different from the circulation of water dipoles or the conductive movement of dissolved ions, and oils are inert on ε^' " and " ε^" per electric within microwaves [6].
A.N. Lysisin and A.G. Gasparyants believe that [7, 8] ultra-high-frequency rays usually do not significantly affect the heat treatment of biological objects, depending on the specific heat capacity, but can seriously affect the heating of materials with a relatively low performance in some cases. For example, in the production of vegetable oils, the specific heat capacity in the preparation of porridge by roasting milled seeds. While 2.0 kdj/kg is* °C, the specific heat capacity of the water is -4.2 kdj/kg* °C.
The microwave energy absorption indicator is different in different objects and varies depending on the temperature: at 20 °C, the energy absorption of the oil is 30-40 times less than that of water (at 60 °C – 5 times), while the rate at which the oil temperature rises during the frying process-0.8 °C/s, the volume of water per liter would be 0.4 °C/S, while the volume of half - liter would be -0.63 °C/S.
The advantage of high-frequency and extremely high-frequency processing to the material over convective and conductive methods is that the electromagnetic field energy is converted directly into heat within the material and ensures that the heat is evenly distributed and heated throughout the material volume, regardless of the material's specific heat capacity. This provides an opportunity to increase the intensity of the thermal processing process [9].
Extremely high frequency generators can be classified into two main groups: electronic and quantum. Electronic ultra-high frequency generators occupy a leading position in the technique. The current Quantum Ultra - High Frequency-generators are not yet, as far as they go beyond the range of optical frequencies. Therefore, they are called optical quantum generators, that is, lasers.

Electronic ultra-high frequency equipment has a wide frequency range covering radio waves with a wavelength of tens of meters to millimeters. Their differentiation from each other depends on the type of equipment and is divided into electrovacuum and semiconductor types. While this equipment covers the entire range of ultra-high frequency waves, it differs from each other in its generating capacity. While Elektrvakuum is produced on ultra-high-frequency equipment, from milliwatts to tens of megawatts, the output of semiconductor generators does not exceed several hundred watts so far and is produced only for special types of ultra-high-frequency transistors [10, 11].

Studies have been carried out on the preparation of compote from grape fruit using an electric magnetic field with an extremely high frequency. The results of the study showed that with an electric magnetic field with an extremely high frequency, a reduction in sterilization time was achieved due to the fact that when the jars were initially sterilized at 60-120 seconds, the sterilization temperature was 20-22 °C higher than traditional technology [12].

E.A.Bryukhnova, S.K.Mustafaev and others conducted research on the effect of ultra-high frequency suppression on the protein complex of soybeans during storage [13]. The results of the study showed that the albumin content of soybeans decreased from 7.31 to 6.55 compared to control when treated with extremely high frequency, while the globulin content increased by 0.5%, the gluten by 0.1%, and the proportion of non-protein nitrogenous substances increased by 0.15%. It has also been found that the activity of the urease enzyme decreases from 2.44 to 1.63.
Research has been carried out by scientists from the Kuban State University of technology on the use of ultra-high and low-frequency electric magnetic fields in vacuum drying of Food [14]. According to the results of the study, treatment with an electric magnetic field of extremely high and low frequencies in vacuum was studied to make it possible to carry out the drying process in a "soft" mode and obtain high-quality Fast renewable products.

V.V.Kasatkin and his students conducted experiments on the use of their extremely high frequency energy in the production of food products. With an extremely high frequency, the processing of raw materials has been found to be possible to carry out the process in a "soft" mode, intensify the technological process, reduce energy consumption in production, neutralize products and improve product quality, and positively affect product output [15].

Methodology.

From the above Research, a laboratory device for processing milled cotton seeds in a large high-frequency electric magnetic field was developed, and the results of the experiment were analyzed. The laboratory device for processing milled cotton seeds with high-frequency rays is shown in Figure 1.
Laboratory device: includes electronic scales, electromagnetic radiation generator (magnetron), wave propagator, heat chamber (resonator), magnetron and chamber ventilation and cooling system, over-radiation protection system, measuring instrument system and control unit.

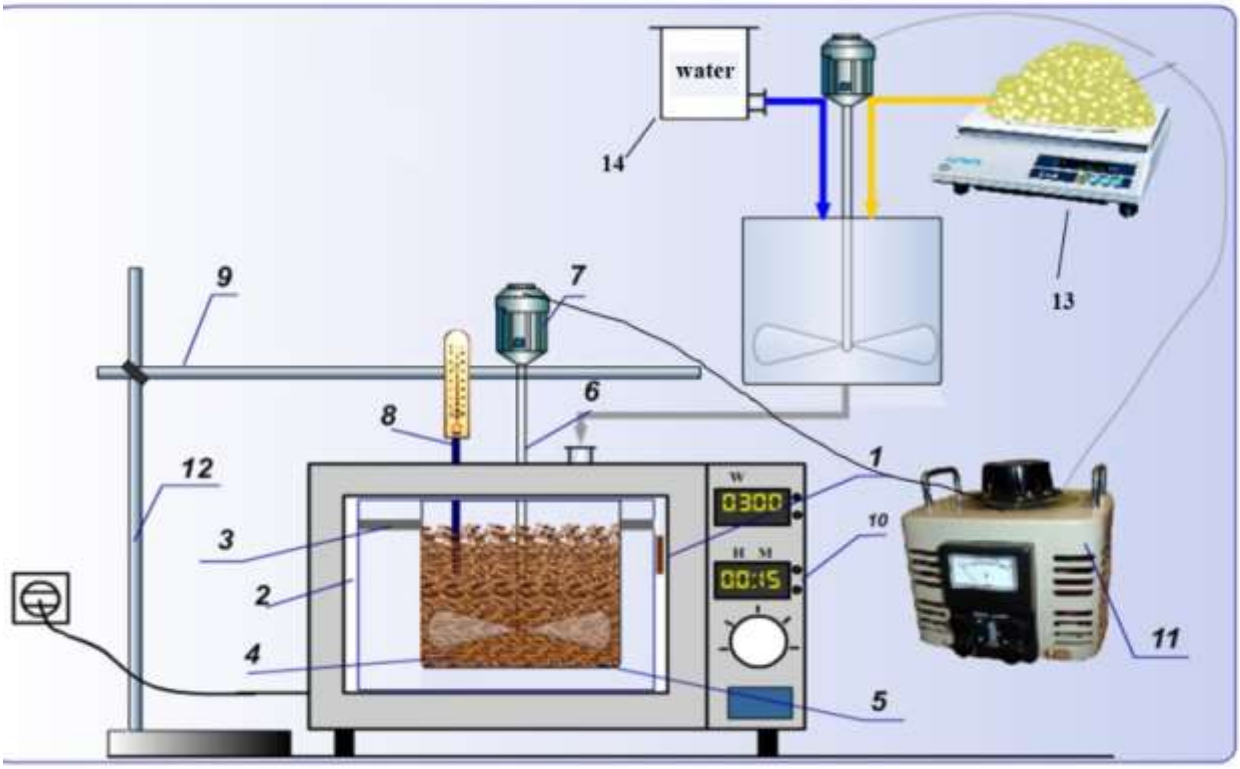


Figure 1. Laboratory device of hydrothermal processing with ultra - high-frequency rays on the grain mower

1-magnetron; 2-resonator; 3-magnetorator; 4-container for milling; 5-seed grinder; 6-bottle mixer; 7-engine; 8-thermometer; 9-magnetor for Engine; 10-Ultra-High-Frequency Control block; 11-LATR; 12-tripod; 13-electronic scales; 14-container for water
With the help of ultra-high-frequency beams, a separate water tank is additionally installed to transfer water in order to determine how the moisture content of the flue during a certain time unit is affected by changes in the level of the flue, as well as the optimal humidity indicator of the flue during processing. By calculating the amount of water supplied to the mower based on the initial moisture indicator of the mower obtained for the sample, the amount of water was calculated and the humidity was changed.
Hydrothermal treatment of milled cotton seeds in a laboratory device the procedure for hydrothermal treatment was defined as follows: the sample amount of cotton seed mowing (e.g. 500 g) was moistened with water to the level specified in the experimental conditions.
The milled cotton seeds obtained for the sample were pulled out on scales (13), mixed in a blender using water from the water tank (14) to the required moisture indicator for the laboratory in relation to the initial moisture indicator. The moisture indicator reached the required amount for laboratory analysis, the flue (5) was transmitted to the inner part of the resonator (2) Chamber of the hydrothermal processing device using ultra-high-frequency rays to a flat-bottomed porcelain container (4), which was fastened using dielectric holders (3). The working chamber was mixed using a glass mixer (6), which was passed through the middle of the laboratory device and lowered to the center of the porcelain container, in order to ensure uniform distribution of heat along the entire charge of the product under the influence of rays emanating from a magnetron (1) with a frequency of 2450 MGs when processing using ultra-high The glass mixer is fastened to the engine (7), which is fastened to the tripod (12) handle (9). The number of rotations of the mixer was controlled using LATR (11). The processing time of the milled cotton seed was controlled by means of an

alcohol thermometer (8), which was maximized to the handle (9), depending on the power and humidity indicator of the milled during the unit. The cap part of the laboratory device is covered with a coating on the alloy, ensuring that heat as well as radiation do not go out. After the cover part of the device was closed, the power and time indicators of ultra-high frequency radiation were controlled using the Control Unit (10). The laboratory device has a capacity of 100÷600 W and a maximum of 120 minutes, such power and time has been enough for hydrothermal processing using ultra-high frequency rays on milled cotton seeds.

The analysis of high-gossipolli forpress oil, processed in a super-high-frequency electric magnetic field on milled cotton seeds, was carried out based on the following methods:

The acid number of Fats was determined according to UzDST 1203 [16] and a 1% alcohol solution of phenolphthalein was obtained as an indicator. This methodology is based on titration of the oil with a standard alkali solution in the presence of a phenolphthalein indicator.

A solution neutralized alcohol and diethyl ether was applied as a lubricant. 3-5 grams of oil, weighed on an analytical scale, is poured into a colba, a solution of 50 ml of ethyl alcohol and diethyl ether is added to it, mixed well and made sure that the oil is completely dissolved in the solvent. 3-5 drops of 1% phenolphthalein solution were added to the same mixture and mixed.

The resulting solution, constantly stirring, was rubbed from the Burette with a solution of 0.1 n corrosive potassium Alkali in alcohol in 30 seconds until a light pink color appeared, which did not disappear.

A.N (mg, KOH/g) was calculated by the following formula:

A.N. = 5,611, a*k / m ;

here: 5,611-0,1 n titre to a solution of corrosive potassium, gr / ml;

A is the amount of 0.1 n corrosive alkali solution spent on titration, ml; k is the titre correction; m is the sample weight of the oil being analyzed, g;

The oxidation state of the oil was measured iodometrically according to perexis number at UzDSt 1200:2009 [24];

The number of Perekis was calculated as follows: the fat content may be 5 g less. It is necessary to choose a smaller amount of the sample. If the weight of the sample affects the result, it is imperative to indicate this along with the result.

The sample Portage was dissolved in a 50 cm3 solution of acetic acid/isooctane, through careful circular motions, followed by the addition of 30 cm3 of anhydrous acetic acid. The sample was slightly heated.

A magnetic mixer was used for mixing and a 0.5 cm potassium iodide saturated solution was added, the sample was mixed in a magnetic mixer within 60 seconds (using a timer with an accuracy of±1 s), medium speed to prevent scattering, and immediately 30 to 100 cm of water was added. The amount of water depends on the equipment being used.

Note: depending on the phase inversion and the device being used, a large amount of water can be spent. The vibrating phase is the bottom. In the case of a higher amount of water, the Potentiometric difference between the initial and end points of titration will be greater (~100 mV). This causes the titration curve to appear with the exact point of bending.

Titrated at medium speed with a simple solution of sodium thiosulfate in a platinum electrode combined into the sample being tested.

The Parallel salt test used a solution of thiosulfate no more than 0.1 cm3.

Titration automatically determines the equivalent point of most of the equipment. The final point was graphically determined using the bending point style.

Processing results:

In the oxygen milliequivalent per 1 kilogram, the peroxide number was calculated according to the following formula:

$$P.N = (V-V_0)*C(Na_2S_2O_3)*f*1000/m$$

here V is the volume of the standard solution of sodium thiosulfate required for detection, sm^3;

V_0-salt is the volume of the standard solution of sodium thiosulfate being used for testing, sm^3;

$C_{(Na2S2O3)}$ - molar concentration of a standard solution of sodium thiosulfate (5.8), mol/dm^3;

F is the factor of the standard solution of sodium thiosulfate;

The general and internal porosity of materials was determined by the standard method in a Mercury porozimeter of 200 units of the Italian firm "Sarlo Erbo strumentarion" [17].

The method of mercury porometry was used to evaluate porosity and quantitative classifications of porous structure. Its greatest advantage is the absolute inertness of mercury to oilseed components. In addition, this method makes it possible to identify the largest pores. There is no way to detect a pore size smaller than 37.

The mercury-porometric equipment consists of the following nodes: a system for creating pressure for introducing mercury, and a system for measuring the volume of mercury pressed into the pore.
The weighed sample was placed in a special cell - a dilatometer with a glass capillary tube. In order to fill the cell with mercury, it was placed in a special autoclave, air was removed from the dilatometer and sample pores by preliminary vacuuming, and then mercury was introduced into the vacuumed system. The change in mercury level with increasing pressure is quantitatively determined using an electronic system. The increase in pressure was recorded on a mercury manometer.
The entire analysis was performed in automatic mode.
A pressure porosimeter measures the movement of a column of mercury under pressure.
- the amount of dispersal materials was calculated according to the following formula:

$$\rho = \frac{G}{V};$$

here: G- is the weight of the material in this volume, kg; V- is the volume occupied by the material, m3.
The formula for calculating the porosity of the particle layer:

$$E = 1 - \frac{\rho_H}{\rho_T};$$

here: pH is the spill weight of the scattering material, kg/m^3; pH is the density of its solid fraction, kg/m^3.

Results and Discussion.

The internal structure of the seed pulp is greatly influenced by the processes of grinding it in the VS-5 equipment and mixing it with the return product before roasting. Therefore, it is appropriate to analyze the cotton seed pulp after it has been mixed with the returned product, and we have taken this into account in our research. At the same time, high-frequency processing of ground cotton seeds is performed for 15 min under a frequency of 2450 MHz and a power of 300 W. Was carried out during The results of the experiment are presented in Table 1.

Table 1. Porosity index of seed pulp before and after ultra-high frequency treatment

Mercury vapor pressure, kPa	The radius of the measured pores, $\overset{o}{A}$	Crushed cotton seed, ($\sum V_n$), sм^3/g	
		efore ultra-high frequency processing	After ultra high frequency processing
100	75000	0	0,008
200	37600	0	0,012
300	25000	0	0,017
400	18750	0	0,019
500	15000	0,006	0,021
1000	7500	0,009	0,023
1500	5000	0,011	0,024
2000	3750	0,012	0,025
2500	3000	0,012	0,026
3000	2500	0,013	0,028
3500	2142	0,013	0,029
4000	1875	0,015	0,031
5000	1500	0,017	0,033

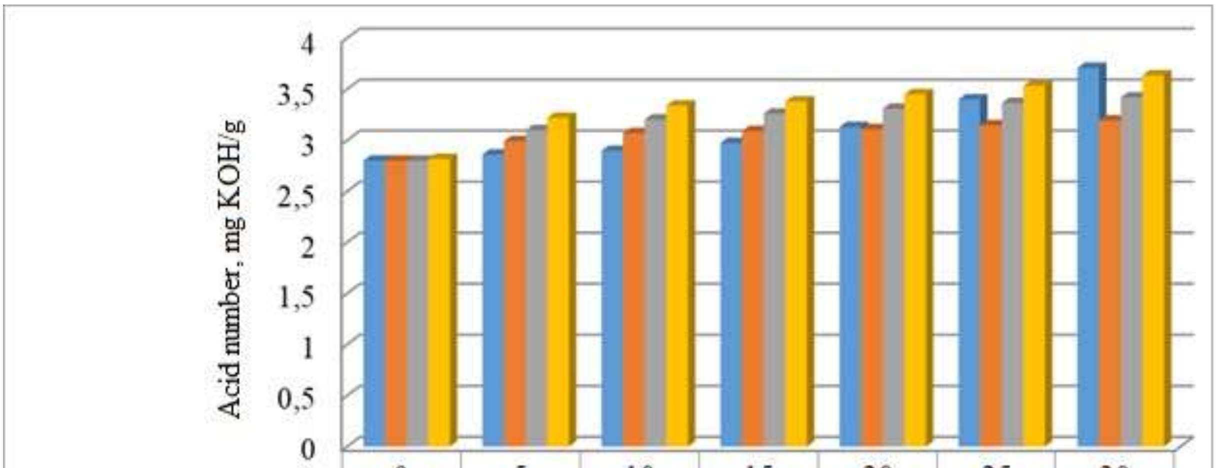
The analysis of the data presented in the table shows that supermacropores (from 75,000 to 7,500) are almost absent in the cotton seed pulp before ultra-high frequency treatment, and it is explained that this is due to the process of crushing it. After ultra-high frequency treatment, 75,000 to 7,500 macropores (0.008 to 0.019 cm3/g) appear in the cotton seed pulp. This situation makes it easier for the oil to separate from the roast during the pressing process. At the same time, the size of macropores (from 1875 to 7500) increased by an average of 2.0-2.2 times after ultra-high frequency treatment, which also shows a positive effect on the rate of oil release from the pulp in the press. Also, the volume size of mesopores (from 20 to 200) and the volume size of micropores (up to 20) also increase, indicating that the volume of pores up to 1500 increased from

0.017 to 0.033 cm3/g effectively affected the ultra-high frequency electromagnetic field. It can be seen that ultra-high frequency treatment of cottonseed meal provides an opportunity to obtain an oily material (grind) with high porosity, which facilitates diffusion mass transfer during pressing processes.

High-frequency treatment of the solution causes an immediate increase in the internal hydraulic pressure of the fluids, particularly the water inside the cells, resulting in maximum damage to the cell walls. As a result, the reactive ability of the components present in the material increases [18-21].

Increasing the ultra-high frequency processing power (W) from 300 to 600 W and time (t) from 5 to 30 min. Increased the acid number of press oil by 1.2-1.4 times. The results of the experiment are presented in Figure 2.

As it can be seen, despite the fact that the color indicator of the oil in the fry is worsened during the high-frequency treatment, the change in the color indicator of the oil is not significant compared to the industrial method.



	0	5	10	15	20	25	30
№ Industrial style	2,8	2,86	2,896	2,974	3,13	3,4	3,71
№ 2 100 W	2,8	2,992	3,069	3,091	3,108	3,146	3,194
№ 3 300 W	2,8	3,1	3,203	3,261	3,309	3,365	3,42
№ 4 600 W	2,817	3,22	3,34	3,38	3,45	3,535	3,636

Figure 2. Changes in oil acid number depending on the power and duration of ultra-high frequency treatment of seed crushing

As a result of the oxidation of triacylglycerides in the technological processes of oil production, unsaturated fatty acids increase. At the same time, the largest changes in the peroxide value of oil occur during crushing, frying, and high-temperature processing of crude oil (or mistella) [22, 23].

Processing of vegetable oils to reduce their peroxide value is a complex process that has a negative impact on the cost of the product. Therefore, methods are currently being sought to reduce this indicator in the oil extraction process itself, including crushing and frying.

5-30 min from us with 2450 MHz frequency, 300-600 W super high frequency. The change of the peroxide value of the oil obtained from the processed seed extract was studied.

The analysis of the peroxide number of the oil was performed according to UzDSt 1200:2009 "Calculation of the peroxide number of vegetable oils" [24]. It was found that when cotton seed pulp is treated with high frequency in the above regimes, the peroxide value of press oil changes from 10 to 17 mmol/kg. At the same time, the increase in the number of peroxides of the oil changes depending on the increase of the ultra-high frequency processing power (from 300 to 600 W) and time (from 5 to 30 min.).

As a result of ultra-high frequency treatment of seed extract with different powers, the peroxide number of oil compared to the indicator of oil obtained by conventional technology, as well as the degree of oxidation depending on the duration of treatment are presented in Figure 3.

According to the comparison of the results of the analysis of the oils obtained by the conventional method and the ultra-high frequency processing of the seed, microwave radiation causes less oxidation of fatty acids in triacylglycerides.

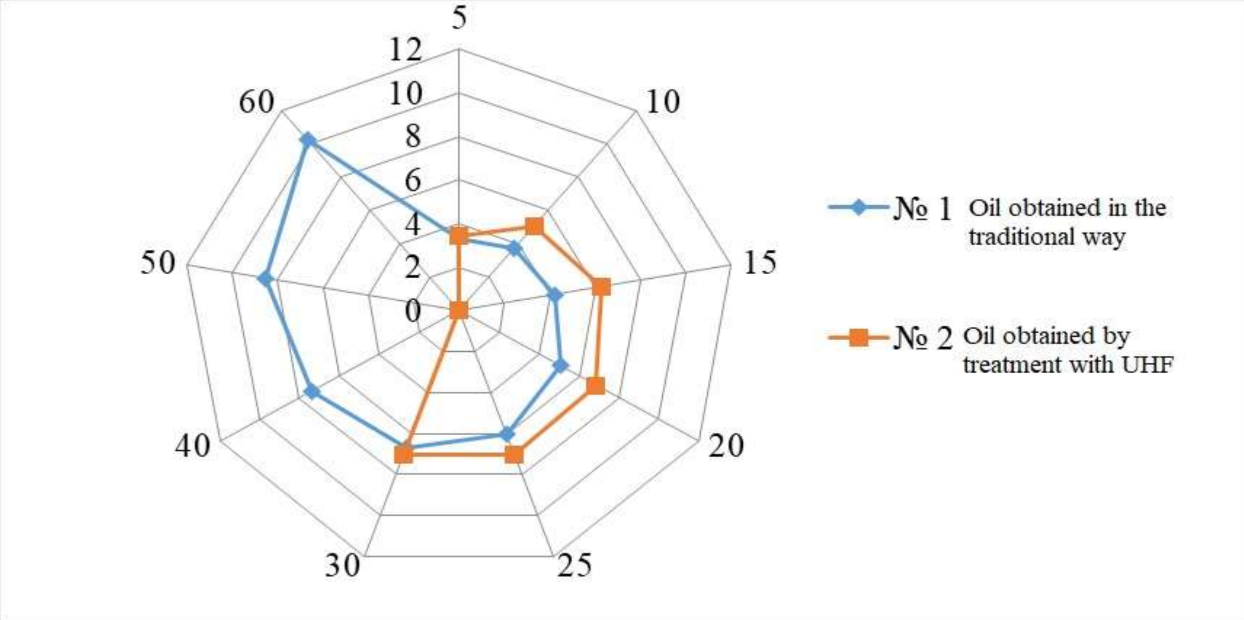


Figure 3. Changes in the percentage of oil depending on the method and duration of processing the seed extract

According to the data presented in the figure, instead of traditional convective roasting of cottonseed oil, the use of ultra-high frequency processing reduces the peroxide value of the oil, which leads to an increase in the output of purified edible oil, and a decrease in the cost of its processing.
When the soaked oily material is fried in the traditional technology in the dusty pots, all the cells of the pulp that have not been damaged during the crushing of the kernel and have not yet reached it are destroyed.
Disruption of the intact parts of the cell walls in the frying pans is explained by mechanical processing, i.e. Mixing, due to the deterioration of the gel part of the cell under the influence of moisture, and a decrease in the strength of the bonds holding the oil in the cell. But increasing the humidity affects not only the surface, but also the inside of the solution, and as the temperature rises, the liquid turns into steam and tends to the upper layers. An increase in temperature leads to intense evaporation and, accordingly, the escaping vapor particles cause maximum damage to the cell walls. As a result, the size of the fry decreases and the viscosity of the oil decreases. In turn, this causes the oil to flow to the top of the cell. Some parts of the material are over-roasted due to the different temperature distribution in the furnaces.
Conclusion. In ultra-high-frequency processing, the process is more efficient, because the increase in temperature ensures uniform distribution of the material throughout the volume. Therefore, despite the acceleration of changes with the increase of radiation power, with the same residual moisture in the treated material, the final negative changes are much less than in the traditional method.
Comparison of these indicators with the physico-chemical indicators of oil obtained by the traditional method of hydrothermal treatment of cotton seed pulp shows that ultra-high frequency treatment has a "soft" effect on oily material. For example, as mentioned above, when the parameters of ultra-high frequency processing are changed, the acid number of the obtained oils increases. This process is associated with an increase in the moisture content of the processed material. On the other hand, with humidity up to 15% and ultra-high frequency radiation power up to 300 W, the processing time is halved.
Based on the results of the research, it can be concluded that despite the increase of acid and peroxide values of the oil, treatment of cotton seed pulp with the help of ultra high frequency rays is more effective than the traditional method.

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