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GROUNDING OF PARAMETERS OF FILTERING ELEMENT FOR VEGETATIVE OIL REFINEMENT

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Abstract. The research aims to improve oil quality by grounding parameters of the filtering element used in their refinement from various admixtures. The research included cold pressing of rape and flax oils on the screw press with activated supply of seeds. The quality of technological process of vegetative oil refinements may be improved by appropriate choice of filtering elements of adequate size parameters. Grounding of the cellule size of filters for admixture extraction from vegetative oils after their cold pressing depends much on the admixture load. For the research rape and flax oils, the main portion of admixtures should be 2–5 μm. To extract the admixtures efficiently, the filtering element with the cellule sized less than 2 μm should be applied and only then the qualitative parameters set by standards for food oils can be obtained.

Key words: filtration, vegetative oil, admixture, variation curve of distribution.

INTRODUCTION

Recently, there has been observed the increased demand for vegetative oil used both, for technical and food purposes. However, vegetative oils constitute the basic raw materials for biodiesel and various types of lubricants and additions for them [Kovalyshyn and Opanashchuk 2004]. Importantly, vegetative oils are also vital culinary ingredients in public catering as well as diet enrichment. Nevertheless, oils should always be free of mechanic admixtures, water, wax agents, etc. [Tristyatsky et al 1991]. These materials influence the value of vegetative oils. The improvement of oil value is one of the basic and the most crucial tasks which need solutions to support competitiveness under rather problematic conditions of market environment.

There exist two ways of obtaining vegetative oils, i.e. extraction and pressing. Extraction process is facilitated by the use of highly productive screw extractors of uninterrupted action. It also provides the better extraction of oil from seeds of oil-containing crops. Oils losses with screw drop to 1%. The use of organic solvents (petrol or ben-

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zene) increases the demand for diligent oil refinements [Shymsky 1974], in particular, extraction of these solvents. The mechanical way of oil obtaining consists in using presses of various constructions of rather low efficiency. Yet, under such conditions oil keeps its eating quality. The oil contents in squeezing is 7–8%.

Nevertheless, the extraction of oil contributes to dissolution of phosphatides, wax-type materials and water in oils. The aforementioned substances, in turn, cause the complex physical and chemical processes of self-hydration and coagulation of phosphatides, crystallization of highly molecular wax-type materials, etc., when the oil pressing period is prolonged and the temperature reduced. The lower temperature and damper oil promote faster and complete swelling and expansion of phosphatides, formation of wax crystals and wax-type materials. Their expansion occurs when the oil temperature falls and it depends on the contents and features of materials [Sergyeyev 1975].

As for industrially produced oils, they undergo pressing in the pre-presses in the hot state to vibration sieve equipped with specially knitted sieves having 25 threads per 1 cm. The size of solid particles in oils vary from several centimeters up to 2–4 μm [Beloborodov 1966]. The number of solid particles hung up in the pressed oil may vary from 2 up to 10% with density of 1.10–1.14 $h \cdot cm^{-1}$ [Beloborodov 1966].

Mechanic admixtures in vegetative oils which are not taken away during the period of the prime refinement may spoil the oil quality. This causes intensive oxidation as well as fermentative and hydrolytic processes as all these processes procede much quicker on the surface of mechanic admixture particles than in the volume. A comparative high temperature and rather long period of prime refinement of vegetative oils with mechanic particles of protein origin facilitate sugar amino reactions, denaturation of protein materials, formation of lipoprotein complexes, etc. All these factors hazard the next stages of oils procession [Zhuzhikov 1971].

The research is aimed at improvement of the quality of oils by grounding parameters of the filtering element used in the refinement from various admixtures.

MATERIAL AND METHODS

The principal parameter of filtering element is the admixture size which indicates the levels of oil refinement. To ground the size of those admixtures which would allow their high number and focus the experimental materials on the valid standards [GOST 1129 – 93 1993], there should be established the size of additions and their percent contents.

The research results were obtained using cold pressing of rape and flax oils on the screw press with activated supply of seeds. The oils were put aside for 1 day and then all admixtures were taken away to determine their particles size and their contents.

The admixture material under study was put into the electronic microscope JEOL T220A (fig. 1) and then magnified 100 times.

Fig. 1. Scanning electronic microscope JEOL T220A
Rys. 1. Mikroskop elektronowy skaningowy JEOL T220A

The magnified admixtures were photographed by a digital camera. The resulting photos (fig. 2) were examined to detect solid particles and determine their size.

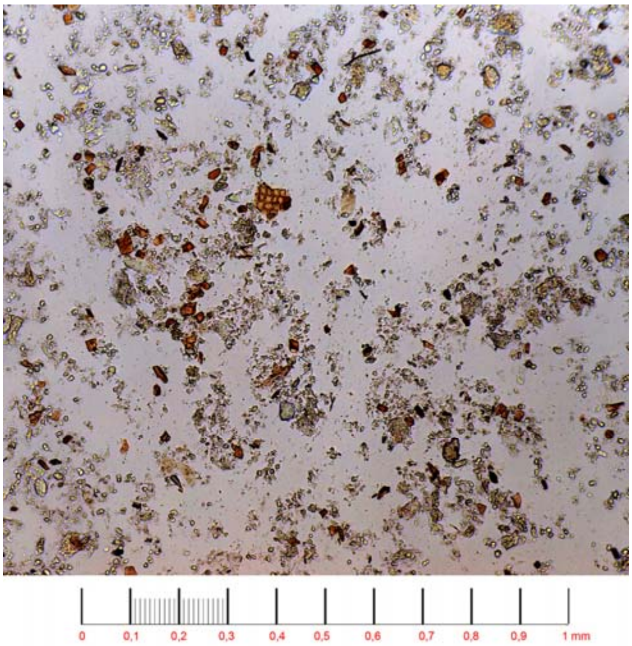

Fig. 2. Magnified image of admixtures present in oil
Rys. 2. Powiększone zdjęcie zanieczyszczeń obecnych w oleju

All the data obtained the scanned admixtures was processed according to the methods of statistic qualities determination and the law of distribution of the size under research [Sydorchuk et al 1998]. Then, after some replications, the empirical data was provided (corpus). The data of empiric series of the researched parameters assisted to calculate the basic statistic qualities. The resulting data were illustrated by the variation curves of admixture distribution in oils.

All empirical data series were placed in the increasing order and, thus, variational series of 100 parameters was formulated (the lowest parameter is 1.8 μm and the highest – 8.8 μm).

Variance series was divided into k intervals and their number determined by the following formula:

$$k = 1 + 3.32 \log N. \tag{1}$$

$$k = 1 + 3.32 \log 100 = 7.64.$$

where N – the number of experiments (the volume of corpus).

Let us take 7 intervals.

Each step of interval is calculated using the following formula:

$$\Delta Y = \frac{Y_N - Y_1}{k} \tag{2}$$

where Y_N, Y – the highest and the lowest parameters of variance series.

$$\Delta Y = \frac{8.8 - 1.8}{7} = 1$$

RESULTS AND DISCUSSION

The concluding results of the investigation on rape and flax oils admixtures are illustrated in table 1.

Having compiled the calculating in table 1 for two types of oils, frequency m_1 is obtained. The summarized parameters allowed to draw the variance curves of distribution (fig. 3).

The discussion of the presented above variance curves of distribution according to admixtures rates in vegetative oils comprised the following points. In the case of rape oil, the highest number of admixtures are those of 2.8–5.8 μm size. Majority of them are of 3.8–4.8 μm, they constitute 27%. As for flax oil, 57% of all admixtures have the size of 2.8–4.8 μm. In comparison with rape oil, the flax one has much over number of larger admixtures (of over 6.8 μm size). Their content in the flax oil accounts for 6%, while in the rape oil – 15%.

Table 1. Statistic quality of rape and flax oil admixture rate
Tabela 1. Jakość statystyczna wielkości zanieczyszczeń w olejach rzepakowym i lnianym

Parameter Parametr		Number of test – Numer testu 1	2	3	4	5	6	7
Rape oil – olej rzepakowy	Interval Przedział $Y_i^н$ $Y_i^в$	1.8–2.8	2.8–3.8	3.8–4.8	4.8–5.8	5.8–6.8	6.8–7.8	7.8–8.8
	Middle of an interval Połowa zakresu przedziału Y_i	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Frequency Częstotliwość m_i	3	19	27	23	10	13	5
Flax oil – olej lniany	Frequency Częstotliwość m_i	5	28	39	14	8	4	2

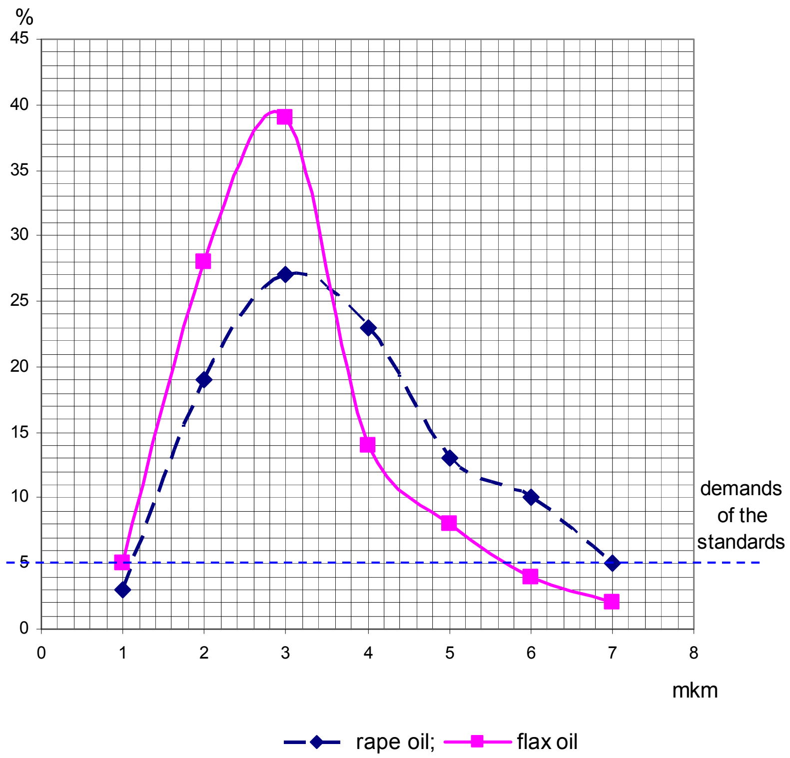

Fig. 3. Variance curves of distribution based on admixture rates in vegetative oils
Rys. 3. Krzywe wariancji rozdzielania podstawowych wielkości zanieczyszczeń w olejach roślinnych

Therefore, the extraction of admixtures from the vegetative oils and examination of their parameters allow to determine the size of cellules of a filtering element. When choosing such elements, one must take into consideration the following requirement. The filtering element must extract at least 95% of oil admixtures. That seems to be the only way to reach the parameters of the valid standards [GOST 8988 – 77].

The presented case of the experimental refinement of the oil necessitates the use of filters with cellules of 2 μm. Application of such filters in the technological line of vegetative oils procession will ensure the extraction of almost all admixtures. Their content in oils after refinement may be less than 5% which is quite permissible [DSTU 46: 20060]. For such purposes, non-corrosive nets with square cellules 12x18H10T, TU 14-4-507-99 (the size of a cellule must be of 0.15 mm) can be employed.

CONCLUSIONS

1. The quality of technological process of vegetative oil refinement may be improved by appropriate choice of filtering elements with the proper size parameters.
2. Grounding of the size of cellules of filters for admixture extraction from vegetative oils after their cold pressing depends largely on the admixture rate.
3. For the experimental rape and flax oils, the main share of admixtures should be of 2–5 μm size. To extract the admixtures efficiently, filtering element with the cellules sized less than 2 μm should be applied. Only under such conditions, the qualitative parameters set by standards for food oils may be obtained.

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PODSTAWOWE PARAMETRY ELEMENTÓW FILTRUJĄCYCH PODCZAS RAFINOWANIA OLEJÓW ROŚLINNYCH

Streszczenie. Badania mają na celu poprawę jakości olejów za pomocą prawidłowo dobranych podstawowych parametrów elementu filtrującego użytego do oczyszczania oleju z różnych zanieczyszczeń. Badaniom poddano olej z rzepaku i lnu tłoczony na zimno prasą śrubową z aktywnym dozowaniem nasion. Jakość olejów roślinnych może być ulepszona poprzez odpowiedni dobór elementów filtrujących w procesie rafinowania. Podstawowa wielkość oczek filtrów podczas usuwania zanieczyszczeń z olejów roślinnych tłoczonych na zimno zależy głównie od wielkości tych zanieczyszczeń. W doświadczeniu z olejem rzepakowym i lnianym przeważały zanieczyszczenia wielkości 2–5 μm. Aby skutecznie usunąć zanieczyszczenia, należy użyć filtrującego elementu z oczkami o wielkości poniżej 2 μm. Tylko takie warunki pozwalają na osiągnięcie dla olejów jadalnych parametrów jakościowych wymaganych przez normy.

Słowa kluczowe: filtrowanie, oleje roślinne, krzywa wariancji

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