https://www.sworldjournal.com/index.php/swj/article/view/swj20-01-031
DOI: 10.30888/2663-5712.2023-20-01-031

УДК: 633.854.78:665.347.8

DETERMINATION OF THE QUALITY OF VEGETABLE OILS
ВИЗНАЧЕННЯ ЯКОСТІ РОСЛИННИХ ОЛІЙ

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Abstract. *The article examines the organoleptic, physico-chemical quality indicators of five samples of sunflower and olive oil, qualitative tests were conducted for the presence of wax, wax-like substances and soap in all samples of the studied oils.*

Key words: *sunflower oil, olive oil, organoleptic indicators, acid number, iodine number.*

Introduction.

Today, there is a trend towards the rapid development of vegetarianism, people are switching to vegetable food, considering it more useful, and the use of oil is also increasing. Oils are important food products: they supply the human body with energy and essential unsaturated fatty acids. Oils belong to the functionally significant components of a balanced diet.

The main oil crop grown in Ukraine is sunflower. Approximately two-thirds of all vegetable oil is produced from sunflower seeds. It is consumed as a valuable food product in its natural form, widely used in the food, textile, paint, perfumery and other industries for the production of margarine, oil, soap, stearin, linoleum [1].

Year after year, the cultivated areas and, accordingly, the production volumes of oils are increasing and their assortment is expanding. At the same time, our country constantly replenishes the internal resources of oil and fat raw materials at the expense of imports, regardless of the level of the harvest of oil crops. Since Ukraine does not produce some types of vegetable oils, for example, olive oil, the need for them is met at the expense of imports. For humans, olive oil is considered the most useful, as it is better absorbed by the body, extremely nutritious and contains a number of valuable components.

The modern food market is characterized by the widespread distribution of falsification and low-quality products, and oils are no exception. Detection of oil falsification remains an urgent scientific task in connection with the appearance on the market of Ukraine of oil and fat enterprises of various forms of ownership, expansion of the range of products. Most often, expensive types of vegetable oils, and primarily olive oil, are falsified. The relevance of the problem is also determined by: the weakening of state control over the quality of products, the emergence of small private sunflower oil producers who do not pay due attention to quality issues [2-4].

The purpose of the work is the study of organoleptic, physico-chemical indicators of the quality of sunflower and olive oil samples, conducting an examination on the compliance of the quality of the oils with the requirements of regulatory documentation.

Main text

1. Materials and methods.

Research objects:

1. Sunflower refined oil *Zhar Ptitsya,* manufacturer: TDV HELIOS.
2. Unrefined sunflower oil *GÁRNA,* manufacturer: TDV UKROLIAPRODUKT.
3. Olive oil *Carli,* manufacturer: FRATELLI CARLI S.P.A – IMPERIA.
4. Olive oil *Carapelli,* manufacturer: CARAPELLI FIRENZE S.p.A.
5. Olive oil *u!,* manufacturer: Cavanna Olii S.n.c.

Research methods: Visual and organoleptic methods were used to assess the quality of the oil. Oil density was determined by the oreometric method method. The refractive index of the oil was determined using the refractometric method. The iodine value was calculated from the refractive index of the oil. Acid and iodine numbers were determined using the titrimetric method. The actual material received was subjected to statistical processing.

Organoleptic evaluation of the quality of vegetable oil consists in evaluating the appearance, taste, smell, transparency and color. Organoleptic quality indicators of vegetable oils are determined by temperature 20 °C [5]. For sunflower oil, the indicators must fully meet the requirements of DSTU 4492:2005 "Sunflower oil. Technical conditions" [6], for olive oil - DSTU 5065:2008 "Olive oil. Technical conditions of supply" [7].

Determination of the density of oils.

Density is a typical indicator for certain types of oil that characterizes their purity. It is determined using a hydrometer. The density increases when the product is oxidized. If the oil temperature is different from 20 °C, the readings of the hydrometer are corrected.

The refractive index was determined according to DSTU 4492:2005 by the refractometric method. The index of refraction of oil is the ability of vegetable oil to refract light relative to air and characterizes the purity, unsaturation, and degree of oxidation of fats. The refractive index increases with the presence of hydroxy groups, an increase in molecular weight and the number of unsaturated fatty acids included in the composition of fat. A change in temperature leads to a change in the density of a substance. With an increase in temperature by 1°C, the density decreases by an average of 0.000387, so the refractive index decreases. For oils, the refractive index is determined at a temperature of 20 °C ($n^{20°C}$) or brought to 20°C by calculation [8].

Refractometric method of determining the iodine number.

The value of the iodine number (in g per 100 g of fat) is calculated using the formula, into which the average value of the refractive index ($n^{20°C}$) obtained for three parallel samples is substituted:

$$\text{I.N.} = \frac{(n_D^{20} - 1{,}4595) \times 100}{0{,}0118}$$

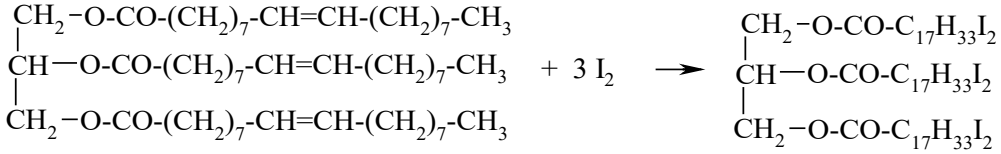
Determination of acid number.

Acid number is an indicator of oil and fat products. It is one of the most important indicators of oil quality and shows the level of fatty acids, the accumulation of which leads to the deterioration of product quality. Research of agricultural products on the acid number in oil is necessary for importers and exporters all over the world, because if the acid number exceeds the norm, then the oil can cause serious poisoning of various forms of severity [9]. It is expressed in mg of KOH/g of oil [10].

Determination of iodine number.

The method is based on the reaction of the unsaturated acid radical of vegetable oil with iodine [11].

For example, for vegetable oil containing a residue of oleic acid, the reaction with iodine occurs according to the following scheme:



The excess of unattached iodine is titrated with sodium thiosulfate in the presence of a starch indicator:

$$2Na_2S_2O_3 + I_2 \rightarrow 2NaI + Na_2S_4O_6$$

In order to find out about the amount of iodine that has joined the radicals of unsaturated fatty acids of the oil under study, a control experiment should be conducted under similar conditions (without the addition of fat). The difference between the amount of 0.1 N sodium thiosulfate solution used to titrate the control and test samples is an indicator of the amount of iodine bound by the amount of vegetable oil.

The iodine number (in g per 100 g of fat) is calculated by the formula:

$$\text{I.N.} = \frac{(V - V_1) \times K \times 0{,}01269}{m} \times 100$$

where V – volume of 0.1 N $Na_2S_2O_3$ solution used for titration in the control experiment, ml;

V_1 – volume of 0.1 N sodium thiosulfate solution used for the titration of the main experiment, ml;

0.01269 – the amount of iodine corresponding to 1 ml of 0.1 N sodium thiosulfate, g;

K – correction factor for 0.1 N sodium thiosulfate solution;

m – weight of fat, g.

Determination of the content of waxes and wax-like substances in oil.

A cold test was conducted to determine the content of waxes and wax-like substances in sunflower oil [9].

Two samples of sunflower oil are stored in a closed or open bottle or flask made of transparent glass with a volume of 200-250 ml: one - for 24 hours at a temperature of 4°C, the second - for 72 hours at a room temperature of 18-20°C. Waxes and wax-like substances are considered absent if, after the specified time, suspended wax crystals are not visually observed. In the presence of suspended crystals, quantitative determination is carried out.

Definition of soap in oil.

The method is based on the fact that soap hydrolyzes in hot water and the sodium hydroxide that is formed changes its color to pink in the presence of an indicator:

$$RCOONa + H_2O \leftrightarrow RCOOH + NaOH$$

Pour 5 ml of distilled water and 2-3 drops of phenolphthalein into a 25 ml test tube (the water should remain colorless). The test tube is heated in a water bath until boiling, then about 1-2 ml of the test sample of oil is added and boiled for 5-10 minutes with constant stirring (careful, because liquid may escape). For uniformity of boiling, pieces of pumice stone or glass capillaries are placed in the test tube. If there is no soap in the oil, the lower water layer in the test tube should remain colorless after cooling. The sensitivity of the method is 0.005% [9].

Statistical processing of the obtained results was carried out using the Student's t-test and the Microsoft Office Excel computer program package [12].

2. Results and their discussion.

Examination of oils was carried out using classical methods: organoleptic, aerometric, refractometric and titrimetric. The obtained data were compared with the known values of the specified parameters according to the regulatory documentation. Determination of organoleptic, physico-chemical indicators of oils was carried out according to the relevant current DSTU [6-8, 10-11]. Five samples of vegetable oils were investigated, including two samples of sunflower oil and three samples of olive oil.

The organoleptic parameters of the samples (odor, color, presence of sediment, transparency) were determined by generally accepted methods [5] (table 1).

Table 1. - Organoleptic properties of oils

Sample	Oil	Color	Taste	Transparency	Aroma
1	Sunflower refined Zhar Ptitsya	Light yellow	Missing	Transparent	Light smell of sunflower seeds
2	Sunflower unrefined GÁRNA	Golden yellow	Slightly salty with a hint of sunflower seeds	Transparent	Intense smell of sunflower seeds
3	Olive Carli	Yellow-green	Slightly bitter with a taste of olives	Transparent	The smell of olives
4	Olive Carapeli	Yellow with a green tint	Slightly bitter with a taste of olives	Translucent	The smell of olives
5	Olivkova u!	Yellow	Slightly bitter with a taste of olives	Translucent	Light smell of sunflower seeds

The tasters noted that refined sunflower oil has a light yellow color, a light smell of sunflower seeds, no taste and sediment, and it is transparent. During the study of unrefined sunflower oil, a golden-yellow color, the aroma and taste of fried seeds, no bitterness, and transparency were noted. A slight precipitate was observed in sample 2, which is not a deviation from the requirements of DSTU ISO 4492:2005. Olive oils are

yellow-green, transparent or semi-transparent, have the smell and taste of olives.

We determined physical constants for all oils: refractive index and density (table 2). These indicators do not exceed the requirements of the relevant DSTU. However, it is impossible to determine the quality of oil based on physical constants. Based on the refractive index of the oils, we calculated the iodine value of the oils (table 2).

Table 2. - Physico-chemical constants of oils

(according to DSTU 4492:2005) (n = 3, P < 0,95)

Sample	Oil	Refractive index n_D^{20}	Iodine number, g I_2 / 100 g	Density g/ml
1	Sunflower refined Zhar Ptitsya	1,476±10^{-3}	139,8	0,918±10^{-3}
2	Sunflower unrefined GÁRNA	1,475±10^{-3}	131,4	0,917±10^{-3}
3	Olive Carli	1,470±10^{-3}	89,0	0,913±10^{-3}
4	Olive Carapeli	1,471±10^{-3}	97,5	0,914±10^{-3}
5	Olivkova u!	1,468±10^{-3}	72,0	0,910±10^{-3}

To determine the iodine value, we also used the titrimetric method - iodometry. The titrimetric method is also used to determine the acid number of oils. The indicated physicochemical indicators of sunflower oil are shown in Table 3.

The acid number reflects the suitability of the oil for food purposes and shows the content of free fatty acids, the accumulation of which indicates a worse quality of the oil [13]. According to DSTU 4492:2005 "Sunflower oil. Technical conditions" [6] the acid number for unrefined oil should correspond to the following values from 1.5 to 6.0 mg KOH / g of fat depending on the grade, and for refined oil from 0.25 to 0.60 mg KOH / g of fat, respectively. As can be seen from Table 3, Zhar Ptitsya refined oil has a high acid value, while GÁRNA unrefined sunflower oil meets the requirements of the first grade oil. According to DSTU, the acid number for olive oil should not exceed 4 mg of KOH/g of fat. All samples of olive oil meet current standards.

The iodine number indicates the content of unsaturated fatty acids in the fat. The iodine number for sunflower oil should correspond to the following values: 118 - 144 g I_2 / 100 g of fat, and for olive oil - 78.5 - 89.9 g I_2 / 100 g of fat. Oil samples № 4 and 5 do not meet the requirements of current legislation (table 3).

Table 3. - The results of the study of the determination of the acid and iodine number of oils

(according to DSTU 4492:2005) (n = 3, P < 0,95)

Sample	Oil	Acid number, mg KOH / g	Iodine number, g I_2 / 100 g
1	Sunflower refined Zhar Ptitsya	1,81±0,40	138,1 ± 0,4
2	Sunflower unrefined GÁRNA	3,63±0,40	127,1 ± 0,4
3	Olive Carli	1,27±0,37	86,9 ± 0,52
4	Olive Carapeli	3,44±0,40	95,6 ± 1,04
5	Olivkova u!	3,81±0,15	74,0 ± 0,99

Therefore, according to the results of laboratory studies of the physico-chemical parameters of the oil samples, Carli olive oil is of the highest quality.

It is known that oil after its production contains 94-95% of oil and 5-6% of related substances. The quality tests we conducted showed the absence of wax, wax-like substances and soap in all samples of the studied oils.

Conclusion

1. Examination of the quality of two samples of sunflower oil and three samples of olive oil was carried out according to organoleptic properties. According to organoleptic indicators, all samples meet the established standards.

2. When determining the acid number, the following results were obtained: unrefined GÁRNA sunflower oil meets the requirements of the first grade oil, all samples of olive oil meet current standards, and refined Zhar Ptitsya oil has an increased acid number. Zhar Ptitsya refined sunflower oil, GÁRNA unrefined sunflower oil and Carli olive oil meet the requirements of current legislation in terms of the iodine value.

3. Quality tests conducted by us showed the absence of wax, wax-like substances and soap in all samples of the studied oils.

4. According to the results of laboratory studies of physico-chemical indicators of oil samples, Carli olive oil is of the highest quality.

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This work was supported by a grant from the Simons Foundation (Award Number: 1030286).