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LUMINESCENT SPECTROSCOPY AND CHROMATOGRAPHY OF MILK THISTLE OIL OF DIFFERENT STORAGE PERIODS

S. Myagkota[1], Doctor of Science in Physics, professor
R. Shevchuk[2], Doctor of Science in Agriculture, associate professor
O. Sukach[2], PhD in Technical Sciences, associate professor
O. Mazurak[3], PhD in Technical Sciences, associate professor
I. Solovodzinska[3], PhD in Biology, associate professor
O. Kushnir[1], PhD of Physics, associate professor
T. Kokhana[1], PhD in Economics, associate professor
A. Pushak[4], PhD in Physics, associate professor
N. Gloskovska[4], PhD in Physics, research fellow
J. Len[5], PhD in Chemistry
O. Golubets[6], PhD in Agriculture

[1]Department of Engineering Mechanics
[2]Department of Cars and Tractors
[3]Department of Ecology
Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies
50, Pekarska, 79040, Lviv, Ukraine
[4]Department of Experimental Physics
Ivan Franko National University of Lviv
Kyryla i Mefodiya Str. 8a, Lviv, 79005, Ukraine
[5]Department of Materials, Substances and Products Research
Lviv Research Expert Forensic Center of the Ministry of Internal Affairs of Ukraine
24, Konyushynna St., 79040, Lviv, Ukraine
[6]Scientific and research center for products testing
State Enterprise «UKRMETRTESTSTANDARD»
4, Metrologichna Str., 03143, Kyiv, Ukraine

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Correspondence:

A. Pushak
E-mail: apushak@gmail.com

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Abstract The luminescence spectral properties of milk thistle oil obtained by cold pressing were studied over a storage period of up to two years. A high sensitivity of luminescence-active components of the oil (tocopherols, polyunsaturated fatty acids, vitamins, pigments, and oxidation products) to storage time under household conditions (in a refrigerator at +4 °C) was observed. It was established that storage for more than six months leads to oxidation and degradation of phenols, tocopherols, polyunsaturated (linoleic and linolenic) and monounsaturated (oleic) fatty acids, vitamins (B_2, E), the precursor of vitamin A (carotene), and the chlorophyll pigments. These processes are accompanied by a decrease in the intensity of luminescence bands of tocopherol-phenol group, polyunsaturated (linoleic, linolenic) and monounsaturated (oleic) fatty acids, vitamins (B_2, E), and chlorophyll pigment with characteristic peaks at λ_{max} = 332, 390, 415, 515, 525, and 678 nm, along with changes in intensity and structure of the excitation spectra of these fluorophores. The decomposition and oxidation of phenols, tocopherols, polyunsaturated fatty acids, vitamins (B_2, E), carotene, and chlorophyll pigments are reflected by the appearance of luminescence bands with peaks at λ_{max} = 370, 440, and 470 nm. The fatty acid composition of milk thistle oil of different storage durations was determined using gas chromatography. The results are consistent with those reported by other authors. Chromatographic analysis revealed a significant decrease in polyunsaturated linolenic acid (ω-3) and monounsaturated oleic acid (ω-9), indicating their effective oxidation during storage.

Keywords: milk thistle, vitamin A, vitamins (B_2, E), polyunsaturated fatty acids, phenol, tocopherol, carotene, chlorophyll.

Introduction. Formulation of the problem

Vegetable oils are an important component of human dietary fats. Despite the widespread consumption of conventional vegetable oils (olive, sunflower, flaxseed, and rapeseed), produced by cold pressing of respective plant seeds, the oil industry faces the continuous challenge of expanding the range of

medicinal oils extracted from unconventional sources. One such valuable oil-bearing plant is milk thistle (*Silybum marianum* (L.) Gaerth) of the *Asteraceae* family.

Analysis of recent research and publications

Milk thistle seeds are rich in biologically active substances, including oils with high polyunsaturated fatty acid content [1]. Extracted milk thistle oil is widely used for medicinal purposes due to its beneficial effects on lipid metabolism, particularly its ability to reduce blood cholesterol levels. [2, 3]. A number of medicinal preparations have been developed on the basis of milk thistle (Silybum marianum) oil, in particular containing the flavonolignan complex silymarin. According to [4], vitamin E present in milk thistle oil strengthens blood vessel walls, promotes skin healing from burns, and regulates endocrine functions, while vitamin K supports calcium absorption. Based on the above, milk thistle oil is a medicinal product recommended for use as a product with a beneficial ratio of fatty acids [4, 5]. Research confirms that for a healthy human body, the optimal ratio of ω-3:ω-6 polyunsaturated fatty acids should be 1:10, while in cases of cardiovascular disease treatment, the recommended ratio is 1:3-1:5 [6].

The aim of our study was to analyze the luminescence spectral characteristics of milk thistle oil over two years of storage, as occurring changes provide insights into the oil's evolving chemical composition. To identify these changes, the luminescence spectral properties of stored oil samples were compared to those of freshly pressed oil.

Materials and methods.

Milk thistle oil samples were obtained in a laboratory environment using the cold pressing method (pressing temperature t≤46°C) with the use of a specially designed grinder and press [7, 8]. The samples were stored in 200 mL transparent glass bottles, kept upright in a household refrigerator at t = +4°C. The bottles were sealed with appropriate caps to prevent contamination, and no light exposure was allowed in the storage conditions.

A schematic diagram of the experimental setup for measuring the luminescence spectral properties of the oils is presented in Figure 1. Excitation wavelengths from the deuterium lamp emission continuum were selected using an MDR-12 monochromator. The oil samples were placed in quartz cuvettes (10×10×45 mm).

Luminescence spectra were measured using the single-photon counting method, employing an MDR-2 monochromator and a photomultiplier tube (PMT-100). The signal from the photomultiplier was amplified and processed by a programmed microcontroller, which recorded pulse frequencies and transmitted the results to a personal computer. The results of measurements were visualized on a monitor as graphical plots, with options for data storage. Excitation and luminescence spectra were measured at 1 nm increments.

Fatty acid composition analysis was conducted using gas chromatography, utilizing an Agilent Technologies 7890 B gas chromatograph equipped with a zb-FAME capillary column (Phenomenex, USA), 20 m in length, with an internal diameter of 0.18 mm and a phase thickness of 0.15 μm. The carrier gas was helium at a flow rate of 1.0 mL/min. Injection mode: split (100:1). Injector temperature: 250°C. Detector temperature (PID): 260°C. The chromatograph thermostat program:

- 80°C - 1.5 min;
- 40°C/min to 160°C - 0 min;
- 5°C/min to 185°C - 0 min;
- 30°C/min to 260°C - 2 min.

The injection volume was 0.5 μL. Fatty acid identification was performed by comparing retention times of sample components with reference fatty acids. Quantitative determination was carried out using the Unichrome R software, with results expressed in g/100 g of oil sample.

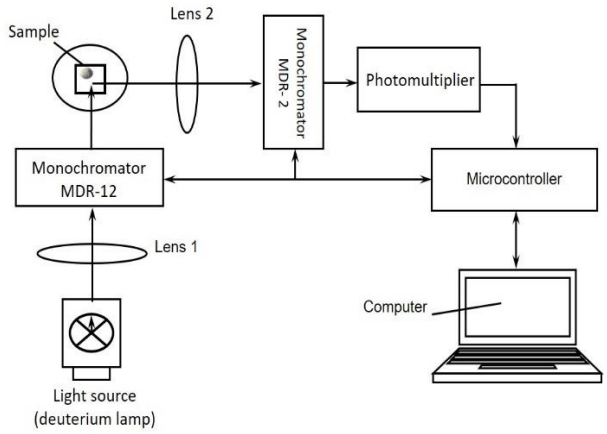

Fig. 1. Block diagram of the set-up for determining the luminescence spectral characteristics of milk thistle oi

Results of the research and their discussion

Vegetable oils mainly consist of triglycerides of higher carboxylic acids (~95%). Additional constituents include vitamins, pigments, free polyunsaturated fatty acids (linolenic (ω-3), linoleic (ω-6), and arachidonic acids), monounsaturated oleic acid (ω-9), and oxidation derivatives. Several of these compounds exhibit luminescence activity, such as α-, β-, γ-, and δ-tocopherols (variants of vitamin E), polyunsaturated fatty acids (ω-3, ω-6, and arachidonic acids), monounsaturated oleic acid (ω-9), vitamins B_2 and E, carotene, chlorophyll, and pheophytin [9, 10]. These fluorophores can serve as indicators of potential destructive changes in the chemical composition of the oil and, consequently, its quality over the storage period.

Let us analyze these oil fluorophore components in more detail.

Figure 2 presents the photoluminescence spectra of freshly pressed oil obtained by cold pressing (curve 1) and oil obtained by cold pressing but aged over storage for 6 months, one year, and two years (curves 2, 3, and 4, respectively) under excitation at λ_{exc} = 280 nm.

The luminescence emission spectrum of freshly pressed oil exhibits a broad band with λ_{max} = 332 nm and continuous long-wavelength emission in the spectral range λ < 550 nm (curve 1). The excitation spectrum of the luminescence band of freshly pressed oil with λ_{max} = 332 nm consists of a band with λ_{exc} = 300 nm and a short-wavelength shoulder at around 270 nm (curve 1'). These luminescence spectral characteristics of the luminescence band with λ_{max} = 332 nm closely match the luminescence spectral characteristics of different forms of α-tocopherol. The spectral position of the short-wavelength shoulder at 270 nm in the excitation spectrum of the luminescence band with λ_{max} = 332 nm coincides with the spectral position of the excitation spectrum of phenolic compounds, whose luminescence spectrum overlaps with the luminescence band of tocopherol [11-14]. Such characteristics of the luminescence band with λ_{max} = 332 nm indicate that its spectral position is determined by the superposition of electronic states of different forms of tocopherol and phenol.

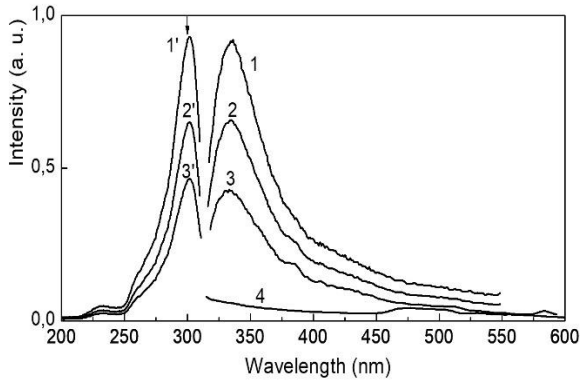

Fig. 2. Photoluminescence emission (curves 1-4) and excitation spectra (curves 1'-3') of milk thistle oil with different storage periods under excitation at 280 nm.

1, 1'- freshly pressed oil;
2, 2' - oil aged by oxidation with air access in a non-hermetically sealed container for 0.5 year;
3, 3' - oil aged by oxidation with air access in a non-hermetically sealed container for 1 year;
4 - oil aged by oxidation with air access in a non-hermetically sealed container for 2 years.

For oil stored in a household refrigerator for 6 months and 1 year, the luminescence intensity of the band with λ_{max} = 332 nm significantly decreases (curves 2, 3), as does the intensity of the excitation spectrum of this luminescence band (curves 2', 3'). Extending the storage period to two years leads to substantial degradation of the oil and a decrease in the luminescence intensity of the band with λ_{max} = 332 nm (curve 4). The registration of excitation spectra of luminescence bands in oil aged for two years was complicated due to light scattering caused by the turbidity into which the oil had transformed. These changes in the structure of emission spectra and excitation spectra of the luminescence band with λ_{max} = 332 nm indicate significant denaturation and degradation of phenol and α-tocopherol in aged milk thistle oil. That is, in the oil stored in a closed but non-hermetically sealed container for 2 years, auto-oxidation processes occurred due to the residual air. Similar effects of auto-oxidation on excitation and emission luminescence spectra have been recorded for olive and linseed oils [15-18].

The emission in the 350–550 nm region of freshly pressed milk thistle oil or oil stored for six months in a refrigerator is more structured when the oil samples are excited with light with a wavelength of 315 nm (Fig. 3, curves 1, 2, 3). For such milk thistle oil samples obtained under the aforementioned conditions, the luminescence spectra are dominated by a band with a maximum at 370 nm, a shoulder at 430 nm, and continuous emission in the 430–575 nm region.

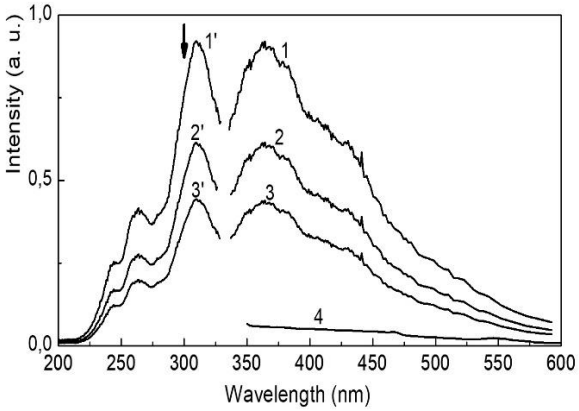

Fig. 3. Photoluminescence emission (curves 1-4) and excitation spectra (curves 1'-3') of milk thistle oil with different storage periods under excitation at 315 nm

1, 1'- freshly pressed oil;
2, 2' - oil aged by oxidation with air access in a non-hermetically sealed container for 0.5 year;
3, 3' - oil aged by oxidation with air access in a non-hermetically sealed container for 1 year;
4 - oil aged by oxidation with air access in a non-hermetically sealed container for 2 years.

The luminescence in 350–550 nm region of freshly pressed milk thistle oil, as well as oil samples stored in a refrigerator for 0.5, 1, and 2 years, shows a more detailed structure upon excitation at 315 nm (Fig. 3, curves 1, 2, and 3). Under these conditions, the emission spectra of milk thistle oil samples exhibit a dominant band with a maximum at 370 nm, accompanied by a

shoulder at 430 nm and continuous luminescence in the range of 430–575 nm. The excitation spectrum of the luminescence band at λ_{max} = 370 nm for freshly pressed milk thistle oil (Fig. 3, curves 1', 2', 3') covers both short-wavelength (225–310 nm) and long-wavelength regions (310–360 nm) relative to the excitation band λ_{exc} = 300 nm, which is formed by different types of tocopherol and phenol (the spectral position of the excitation band λ_{exc} = 300 nm is marked with an arrow; see Fig. 2, curve 1).

As the oil ages, the short-wavelength part of the excitation spectrum of the luminescence band with λ_{max} = 370 nm in the 230–290 nm region decreases more slowly than the long-wavelength part of the excitation spectrum of this luminescence band in the 275–350 nm region.

Such structure of the excitation spectrum of the luminescence band with λ_{max} = 370 nm and its behavior during oil aging confirm its defective, oxidative nature. Specifically, the excitation of the luminescence band with λ_{max} = 370 nm in the 240 and 262 nm regions indicates significant denaturation and degradation of phenol and α-tocopherol in aged milk thistle oil, leading to the formation of hydroperoxides (band at 240 nm) and their breakdown into secondary oxidation products (aldehydes, ketones, esters, alcohols, and short-chain hydrocarbons) (band at 262 nm).

For the oil stored in a non-hermetically sealed container for 2 years in a household refrigerator, the luminescence spectrum exhibits continuous emission in the 350–600 nm region (Fig. 3, curve 4). As mentioned earlier, the registration of excitation spectra of the luminescence bands in the oil aged for two years was complicated due to the scattering of light caused by turbidity developed in the aged oil.

The emission spectra of freshly pressed milk thistle oil and that stored in a household refrigerator for 0.5 years, when excited with light at wavelengths of 325 and 350 nm, were identical in structure and intensity and are presented in Fig. 4a, curves 1, 2. Note that the luminescence spectrum of milk thistle oil when excited by light with a wavelength of 350 nm is more structured than when excited by light with a wavelength of 325 nm (Fig. 4a, curves 1 and 2).

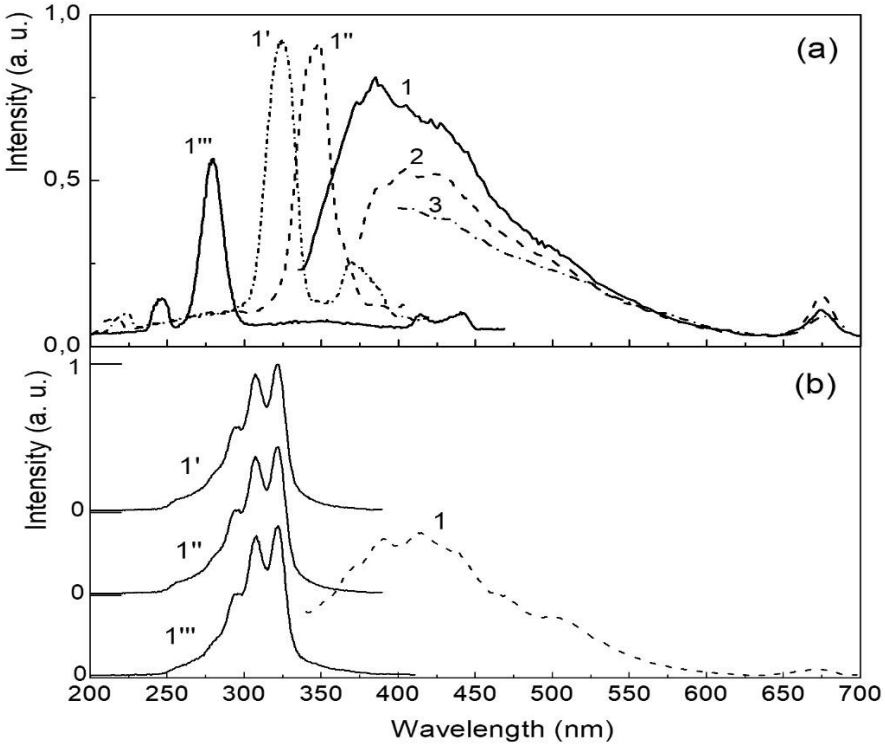

Fig. 4. a) Photoluminescence emission (curves 1, 2, 3) and excitation spectra with λ_{max} = 390, 415, 440 and 490 nm (curves 1', 1'', 1''', respectively) of milk thistle oil aged by oxidation with air access in a non-hermetically sealed container for 0.5 year.

1 - Photoluminescence emission spectrum of milk thistle oil aged by oxidation with air access in a non-hermetically sealed container for 0.5 year under excitation at 325 nm;

2, 3 - Photoluminescence emission spectra of milk thistle oil aged by oxidation with air access in a non-hermetically sealed container for 0.5 and 2 years, respectively, under excitation at 350 nm;

1', 1", 1'" - Photoluminescence excitation spectra of milk thistle oil aged by oxidation with air access in a non-hermetically sealed container with λ_{max} = 420, 440 and 490 nm, respectively.

b) . Photoluminescence emission (curve 1) and excitation spectra (curves 1'-1'") of freshly pressed linseed oil under excitation at 325 nm

1', 1", 1'" - Photoluminescence excitation spectra of freshly pressed linseed oil with λ_{max} = 390, 415, 430 nm, respectively.

Under these excitation conditions, the emission spectrum exhibits three closely spaced bands with λ_{max} = 390, 415, and 430 nm, shoulders in the 445, 475, and 525 nm regions, and a band with λ_{max} = 678 nm. The excitation spectrum structure of the luminescence bands with λ_{max} = 390 and 415 nm is similar and consists of a band in the 325 nm region (curve 1'). The excitation spectrum structure of the luminescence bands with λ_{max} = 390 and 415 nm is similar to that of the excitation spectra of luminescence bands with λ_{max} = 390, 415, and 430 nm in linseed oil obtained by cold pressing (Fig. 4b, curves 1 and 1', 1", 1"', respectively) [19]. Such luminescence spectral characteristics are typical for polyunsaturated fatty acids: linolenic (ω-3), linoleic (ω-6), and monounsaturated oleic acid (ω-9) in their isolated form [20, 21].

The different structure of the luminescence excitation spectra in the 415, 440, and 490 nm regions for freshly pressed milk thistle oil or oil stored in a household refrigerator for 0.5 years (Fig. 4a, curves 1 and 1', 1", 1"', respectively) confirms the assumption of the different nature of luminescence centers responsible for luminescence in this spectral range. It should be noted that luminescence in the 445–475 nm region, recorded for other vegetable oils, particularly olive and linseed oils aged over time, is attributed to the products of primary and secondary oxidation [20–26]. Specifically, according to the data presented in [22], emission in the 410–480 nm region is attributed to primary oxidation products, while in the 480–540 nm region, it corresponds to secondary oxidation products of vegetable oils. The appearance of primary oxidation products – hydroperoxides - explains the presence of a band in the excitation spectrum at 270 nm (curve 1'"). The primary oxidation products of vegetable oils – hydroperoxides - are unstable compounds. At temperatures above room temperature, they decompose, forming aldehydes, ketones, esters, alcohols, and short-chain hydrocarbons, resulting in an unpleasant odor in oxidized oils and deterioration of their taste quality [16, 22, 23].

The emission spectrum of aged oil stored in a household refrigerator for 2 years exhibits continuous emission in the 400–650 nm region, with maximum intensity at 480 nm (curve 3). Thus, the products of primary and secondary oxidation are reflected in the structure of the luminescence spectra and excitation spectra of luminescence in milk thistle oil stored in a household refrigerator for six months or 2 years (Fig. 4a, curves 1, 2, 3 and 1', 1", 1'").

According to the results of chromatographic analysis of milk thistle oil of different storage durations (Table 1), the fatty acid profile is mainly represented by linoleic, oleic, palmitic, stearic, and linolenic acids, confirming the assumption that linoleic and oleic acid predominantly contributes to the luminescence spectrum in the 390–430 nm region.

The obtained data on the fatty acid composition of freshly pressed milk thistle oil correlate well with literature data [27]. The analysis of the fatty acid composition of milk thistle oil stored under household conditions for 2 years revealed a significant decrease in the content of polyunsaturated linolenic (ω-3) and monounsaturated oleic (ω-9) fatty acids (see Table 1, and Fig 5), indicating their effective oxidation during storage. This is also reflected in the luminescence spectra of the oils by the presence of bands in the 440–490 nm region, which are attributed to oxidation products [22, 26]. A slight increase (within a few percent) in linoleic (ω-6) polyunsaturated fatty acid may be explained by the agronomic characteristics of the raw material cultivation, the oil production technology, and storage conditions, which result in an increasing amount of free linoleic acid due to oxidative reactions. A similar phenomenon has been observed in the case of linseed and Palestinian olive oils obtained by cold pressing [19, 28, 29].

Table 1. – The content of fatty acids in milk thistle oil with different storage periods

№	Fatty acids	Acid code	Values, %			
			2 month	2 years	[27]	[28]
1	Myristic	14:0	0,09	0,09	0,09	-
2	Palmitic	16:0	8,01	8,39	8,00	9,60
3	Palmitoleic	16:1	0,08	0,09	-	-
4	Stearic	18:0	5,29	5,29	4,80	2,86
5	Oleic	c 9 18:1	26,98	23,21	20,70	31,00
6	Linoleic	18:2	50,26	57,22	56,60	46,00
7	Linolenic	18:3	3,30	0,33	-	5,20
8	Arachinic	20:0	2,82	2,57	2,70	-
9	Eicosenoic	c 11 20:1	0,9	0,78	-	-
10	Behenic	22:0	1,67	1,66	2,10	-
11	Lignoceric	24:0	0,58	0,54	0,70	-
12	∑ **saturated**		18,47	18,34		
13	∑ **monounsaturated**		27,96	24,09		
14	∑ **polyunsaturated**		53,56	57,56		

The presented considerations support the hypothesis of a predominant contribution of linoleic (ω-6) and oleic (ω-9) acid (in view of its content in the oil) to the formation of the luminescence spectrum structure of aged milk thistle oil in the 390–430 nm region.

The obtained data on the fatty acid composition of freshly pressed milk thistle oil correlate well with literature data [27]. The analysis of the fatty acid composition of milk thistle oil stored under household conditions for 2 years revealed a significant decrease in the content of polyunsaturated linolenic (ω-3) and monounsaturated oleic (ω-9) fatty acids (see Table 1, and Fig 5), indicating their effective oxidation during storage. This is also reflected in the luminescence spectra of the oils by the presence of bands in the 440–490 nm region, which are attributed to oxidation products [22, 26]. A slight increase (within a few percent) in linoleic (ω-6) polyunsaturated fatty acid may be explained by the agronomic characteristics of the raw material cultivation, the oil production technology, and storage conditions, which result in an increasing amount of free linoleic acid due to oxidative reactions. A similar phenomenon has been observed in the case of linseed and Palestinian olive oils obtained by cold pressing [19, 28, 29]. The presented considerations support the hypothesis of a predominant contribution of linoleic (ω-6) and oleic (ω-9) acid (in view of its content in the oil) to the formation of the luminescence spectrum structure of aged milk thistle oil in the 390–430 nm region.

Based on the above considerations, it can be suggested that the luminescence bands with λ_{max}=390, 415, and 430 nm in the emission spectrum within the 390–490 nm region (see Fig. 4, curves 1, 2) originate from overlapping emissions characteristic of linoleic (ω-6) polyunsaturated and monounsaturated oleic (ω-9) fatty acid. In the 440–490 nm region, the bands are attributed to the products of auto-oxidation and, to a lesser extent, photo-oxidation of the milk thistle oil components, considering the storage of the oil in a closed container in a household refrigerator.

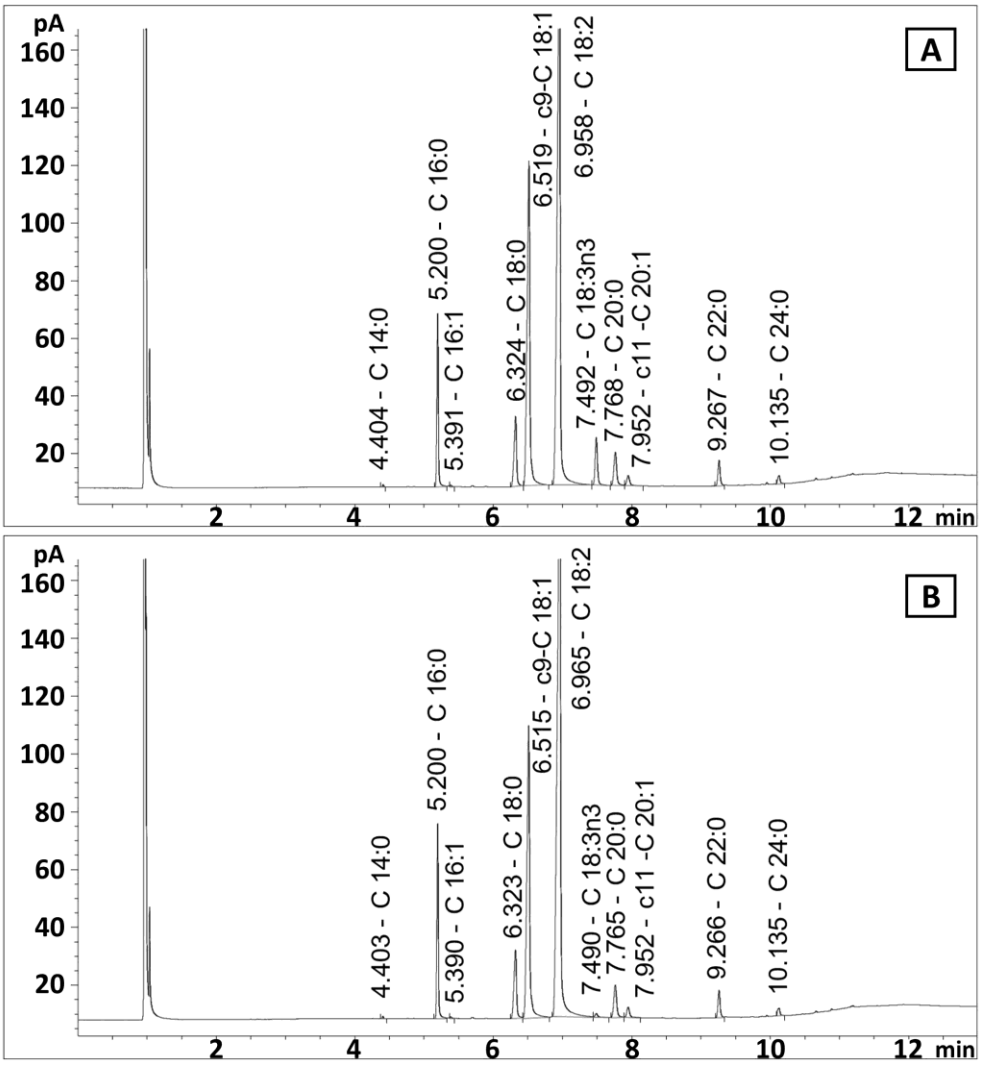

Fig. 5. Chromatogram of the fatty acid composition of milk thistle oil with different storage periods: 1- oil stored in household conditions for 2 months, 2- oil stored in household conditions for 2 years and fatty acid composition of milk thistle oil according to [23, 24, 25]

It should be noted, however, that the nature of the luminescence bands in the 470–490 nm region is complex, as the luminescence spectral properties of bands in the 470–520 nm and 525 nm regions are characteristic of the emission of vitamins E, B_2, and carotene, according to [24, 25, 30, 31]. This is also reflected in the structure of the luminescence spectrum of freshly pressed milk thistle oil and oil aged for 0.5, 1, and 1.5 years in a household refrigerator under excitation at 405 nm (Fig. 6, curves 1 and 2, 3, 4, respectively).

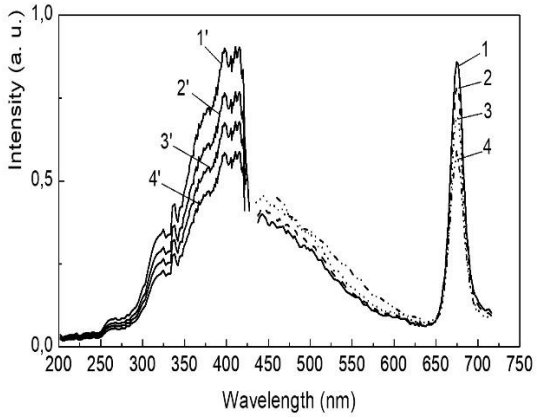

Fig. 6. Photoluminescence emission (curves 1-4) spectra of milk thistle oil of different storage periods under excitation at 405 nm and excitation spectrum of chlorophyll with λ_{max} = 668 nm (curve 1')

1, 1' - freshly pressed oil;
2 - oil aged by oxidation with air access in a non-hermetically sealed container for 0.5 year;
3 - oil aged by oxidation with air access in a non-hermetically sealed container for 1 year;
4. - oil aged by oxidation with air access in a non-hermetically sealed container for 2 years.

The spectrum consists of a broad, non-elementary luminescence band with a maximum at 445 nm, shoulders at 475 and 515 nm, and a band at λ_{max} = 678 nm, which is attributed to the chlorophyll pigment [18, 19, 26, 30-34]. The bands with maxima at 445 and 470 nm are attributed to oxidation products, as mentioned earlier. An additional argument supporting this claim is the slight increase in luminescence intensity in this spectral region, which is characteristic of oil stored for more than 6 months compared to the luminescence intensity of freshly pressed oil

For oils aged by storage for six months or one year in a household refrigerator, the intensity of the chlorophyll luminescence band with λ_{max} = 678 nm decreases (Fig 6, curves 2, 3 respectively), indicating the auto-oxidation of this pigment during storage, with a minor contribution from photo-oxidation, considering the storage conditions. The emission spectrum of the oil aged for two years exhibits a structureless emission in the 460–650 nm region and emission band of chlorofil with λ_{max}= 678 nm (Fig 6, curves 4).

The structure and spectral position of the excitation spectrum of the chlorophyll pigments [35] luminescence band, as a component of milk thistle oil, is similar to that found in rapeseed oil [23]. As oxidation proceeds during oil aging, both the intensity of the chlorophyll luminescence band (curves 1, 2, 3, 4) and its excitation intensity decrease (curves 1', 2', 3', 4'). It should be noted that the registration of excitation spectra of the luminescence bands in oil aged for two years was complicated due to light scattering caused by the turbidity into which the oil had transformed.

Thus, the process of auto-oxidation of the components of milk thistle oil during two years of storage is effectively reflected in the excitation and emission luminescence spectra of aged oils, what makes possible identification of oils that are unsuitable for consumption as medicinal oil products.

Conclusion

Luminescence spectral analysis confirmed the presence of luminescence-active compounds in milk thistle oil, including phenols, tocopherols, polyunsaturated fatty acids, monounsaturated fatty acids, vitamins B_2 and E, carotene, and chlorophyll pigment, with characteristic luminescence bands at λ_{max}=332, 390, 415, 430, 525, and 678 nm.

Two-year storage led to the oxidation and degradation of phenols, tocopherols, polyunsaturated fatty acids (linoleic, linolenic), monounsaturated oleic acid, vitamins (B_2, E), and carotene. This process is accompanied by a decrease in intensity and structural changes in the luminescence bands typical for these components, as well as the appearance of luminescence bands at λ_{max} = 370, 445, and 475 nm, which are characteristic of their oxidation products.

Changes in the structure of luminescence spectral characteristics of milk thistle oil fluorophores including phenols, tocopherols, polyunsaturated fatty acids (linoleic, linolenic), monounsaturated oleic acid, vitamins (B_2, E), carotene, chlorophyll pigment, and oxidation products of the oil components at different storage durations correlate with data on the fatty acid composition of milk thistle oil stored for various periods. These changes can be used to assess the quality of milk thistle oil, particularly its suitability as a medicinal food product.

The results of spectral-luminescent and chromatographic analysis of milk thistle oil can be used to create blended oils with a balanced ratio of polyunsaturated linolenic (ω-3) and linoleic (ω-6) fatty acids.

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ЛЮМІНЕСЦЕНТНА СПЕКТРОСКОПІЯ ТА ХРОМАТОГРАФІЯ ОЛІЇ РОЗТОРОПШІ РІЗНОГО ТЕРМІНУ ЗБЕРІГАННЯ

С.В. Мягкота[1], доктор фізико-математичних наук, професор, *E-mail*: smyagkota@gmail.com
Р.С. Шевчук[2], доктор сільсько-господарських наук, доцент, *E-mail*: rshevchook@i.ua
О.М. Сукач[2], кандидат технічних наук, доцент, *E-mail*: 19oleg85@ukr.net
О.Т. Мазурак[3], кандидат технічних наук, доцент, *E-mail*: mazurak.oksana1969@gmail.com
І.Є. Соловодзінська[3], кандидат біологічних наук, доцент, *E-mail*: ira_solovodzinska@ukr.net
О.П. Кушнір[1], кандидат фізико-математичних наук, доцент, *E-mail*: oleg.p.kushnir@gmail.com
Т.М. Кохана[1], кандидат економічних наук, доцент, *E-mail:* kohanat78@gmail.com
А.С. Пушак[4], кандидат фізико-математичних наук, доцент, *E-mail*: apushak@gmail.com
Н.В. Глосковська[4], кандидат фізико-математичних наук, науковий співробітник, *E-mail*: nglosk@googlemail.com
Ю.Т. Лень[5], кандидат хімічних наук, *E-mail*: ulia77@i.ua
О.В. Голубець[6], кандидат сільсько-господарських наук, *E-mail*: golubetsolga@ukr.net

[1]Кафедра інженерної механіки
[2]Кафедра автомобілів і тракторів
[3]Кафедра екології
Львівський національний університет ветеринарної медицини та біотехнологій імені С.З. Ґжицького
вул. Пекарська, 50, Львів, Україна, 79040
[4]Кафедра експериментальної фізики
Львівський національний університет імені Івана Франка
вул. Кирила і Мефодія, 8, Львів, Україна, 79005
[5]Відділ досліджень матеріалів, речовин і виробів
Львівський науково-дослідний експертно-криміналістичний центр МВС України
вул. Конюшинна, 24, Львів, Україна, 79040
[6]Науково-методична лабораторія хроматографічних досліджень
Науково-дослідний центр випробувань продукції «УКРМЕТРТЕСТСТАНДАРТ»
вул. Метрологічна, 4, Київ, Україна, 03143

Анотація. Досліджено спектрально-люмінесцентні властивості олії розторопші, отриманої методом холодного пресування, з різним терміном зберігання (до 2 років). Зареєстровано високу чутливість люмінесцентно активних компонент олії (токоферолів, поліненасичених жирних кислот, вітамінів, пігментів, продуктів окислення) в залежності від часу зберігання олії в побутовому холодильнику (за температури +4 °С). Встановлено, що зберігання олії більше шести місяців приводить до окислення та розпаду фенолів, токоферолів, поліненасичених (лінолевої, ліноленової) і мононенасиченої – олеїнової жирних кислот, вітамінів (B_2, Е), попередника вітаміну А (каротину), пігментів хлорофілу, що супроводжується зменшенням інтенсивності смуг люмінесценції токоферол-фенольної групи, поліненасичених (лінолевої, ліноленової) і мононенасиченої – олеїнової жирних кислот, вітамінів (B_2, Е), пігмента хлорофілу з λ_{max} = 332, 390 і 415, 515, 525, 678 нм зі зміною інтенсивності та структури спектрів збудження люмінесценції вказаних флуорофорів. Розпад та окислення фенолів, токоферолів, поліненасичених жирних кислот, вітамінів (B_2, Е). попередника вітаміну А (каротину), пігментів хлорофілу супроводжується появою у спектрах люмінесценції смуг з максимумами λ_{max} = 370, 440 і 470 нм. Визначено жирно-кислотний склад олії розторопші різного терміну зберігання з використанням методу газової хроматографії. Дані якого є подібними до таких, отриманих іншими авторами. На основі хроматографічного аналізу олії розторопші різного терміну зберігання виявлено значне зменшення кількості поліненасиченої ліноленової (ω-3) та мононенасиченої олеїнової (ω-9) жирних кислот, що вказує на їх ефективне окислення в процесі зберігання.

Ключові слова: олія розторопші, вітамін А, вітаміни (B_2, Е), поліненасичені жирні кислоти, фенол, токоферол, каротин, хлорофіл.