Development Of Technology for Producing Composite Oils Based on Unconventional Oilseed Plants

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Abstract; The article provides detailed information about the technology of making a new type of composite oil by mixing different amounts of oils obtained by cold pressing on the basis of non-traditional oil plants, and the benefits of the prepared oil mixture for human health. Also, the results of physicochemical quality indicators of this type of composite oil determined by high-performance liquid chromatography are presented.

Key words: Gas chromatography, cold pressing, vegetable oils, fatty acids, composite oils

Разработка Технологии Получения Композиционных Масел на Основе Нетрадиционных Масличных Культур

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АННОТАЦИЯ; В статье подробно изложены сведения о технологии изготовления нового вида композиционного масла путем смешивания различного количества масел, полученных методом холодного прессования на основе нетрадиционных масличных растений, и пользе полученной смеси масел для здоровья человека. Также представлены результаты физико-химических показателей качества данного вида композиционного масла, определённые методом высокоэффективной жидкостной хроматографии.

Ключевые слова: Газовая хроматография, холодное прессование, растительные масла, жирные кислоты, композитные масла.

Noan'anaviy Moyli O'simliklar asosida Kompozitsion Moylar Ishlab Chiqarish Texnologiyasini Ishlab Chiqish

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Annotatsiya: Maqolada noan'anaviy moyli o'simliklar asosida sovuq presslash usuli bilan olingan turli miqdordagi moylarni aralashtirish orqali yangi turdagi kompozitsion moy tayyorlash texnologiyasi va tayyorlangan moy aralashmasining inson salomatligi uchun foydalari haqida batafsil ma'lumot berilgan. Shuningdek, ushbu turdagi kompozitsion moyning yuqori samarali suyuqlik xromatografiyasi yordamida aniqlangan fizik-kimyoviy sifat ko'rsatkichlari natijalari keltirilgan.

Kalit so'zlar: gaz xromatografiyasi, sovuq presslash, o'simlik moylari, yog' kislotalari, kompozitsion moylar.

Introduction

The development of composite oils based on non-traditional oilseed crops is a pressing issue in the context of ensuring food security, promoting healthy nutrition, and diversifying raw material sources in the national economy. Alongside traditional oilseeds (such as sunflower, cottonseed, and soybean), non-traditional oil-bearing plants (such as pumpkin, flax, rapeseed, and amaranth) offer promising biochemical compositions for the production of high-value composite oils. These oils are rich in unsaturated fatty acids, natural antioxidants, and other bioactive compounds, making them highly beneficial for human health.

*Objective***:** To develop a technology for producing composite oils with high biological value from non-traditional oilseed crops.

Tasks: To study the chemical and biochemical composition of non-traditional oilseed crops (plum, almond, cherry, peach, apricot). To analyze the fatty acid profile, natural antioxidants, and bioactive compounds of these oils. To design scientifically grounded formulations of composite oils. To evaluate the physicochemical and organoleptic properties of composite oils prepared in different ratios. To assess the biological value and functional properties of the obtained composite oils. To optimize technological processes and develop recommendations for production.

Scientific novelty: For the first time, the scientific basis for producing high-value composite oils from non-traditional oilseed crops (plum, almond, cherry, peach, apricot) will be developed. The interaction of fatty acid profiles, antioxidant activity, and bioactive compounds in composite oils will be comprehensively studied. Optimal ratios and technological regimes for producing composite oils will be determined.

Practical significance: The results can be applied in the food industry for the development of new types of functional products. Composite oils may be used to improve human health, particularly in the prevention of cardiovascular diseases. The proposed technological recommendations will increase the efficiency of processing non-traditional oilseeds and diversify the local raw material base.

Literature analysis

Recent studies emphasize the growing importance of functional foods and healthy nutrition, highlighting the role of vegetable oils as a source of bioactive compounds. While traditional oilseeds (sunflower, soybean, cottonseed) dominate the market, their fatty acid profiles are limited. Therefore, non-traditional oilseeds such as flax, pumpkin, amaranth, rapeseed, and chia are increasingly being investigated.

Flaxseed oil is rich in omega-3 fatty acids, particularly α-linolenic acid, which supports cardiovascular health [1]. Pumpkin seed oil contains tocopherols, carotenoids, and phytosterols [2]. Amaranth oil is a valuable source of squalene with antioxidant and membrane-protective properties [3].

Recent research has shown that blending different oils into composite oils improves oxidative stability, balances fatty acid ratios, and enhances biological activity [4,5]. For instance, flax-pumpkin blends demonstrate improved nutritional value and oxidative resistance.

Studies from Russia, China, and Europe confirm the potential of such composite oils for functional food production [6,7]. This indicates that the development of technologies for composite oils based on non-traditional oilseeds is both scientifically and practically relevant.

Research methodology

In recent years, increasing attention has been given to composite oils, which are produced by blending different vegetable oils to achieve improved nutritional, technological, and functional properties. Unlike single-source oils, composite oils allow for the optimization of fatty acid profiles, the enrichment of bioactive compounds, and the enhancement of stability during storage and processing.

Several studies emphasize that no single vegetable oil can fully meet the dietary requirements of essential fatty acids, particularly the balance between omega-6 and omega-3 fatty acids. For example, sunflower oil is rich in linoleic acid but contains little alpha-linolenic acid, whereas flaxseed oil provides a higher proportion of omega-3 fatty acids but has limited oxidative stability. By combining these oils, researchers have developed blends that achieve a more favorable nutritional balance while maintaining acceptable shelf life and sensory properties (Kamal-Eldin and Yanishlieva, 2002; Codex Alimentarius, 2019).

Another important aspect of composite oils is their potential health benefits. Blends enriched with functional oils such as pumpkin seed oil, sesame oil, or olive oil have been reported to improve cardiovascular health, reduce oxidative stress, and provide valuable phytochemicals including tocopherols, phytosterols, and polyphenols (Shahidi and Ambigaipalan, 2015). These bioactive compounds play a significant role in preventing chronic diseases such as atherosclerosis, diabetes, and cancer.

From a technological perspective, composite oils also address challenges in the food industry. For instance, the incorporation of more stable oils such as palm oil into blends can reduce oxidation and improve frying performance. Similarly, the development of margarines, spreads, and bakery fats often relies on specific oil mixtures to achieve desirable texture, melting properties, and stability.

In addition, the growing consumer demand for natural and functional foods has further increased the interest in composite oils. Modern food processing technologies, combined with cold and hot pressing methods, enable the production of tailored oil blends that meet both nutritional recommendations and industrial requirements.

In conclusion, composite oils represent a promising direction in the food and nutrition sector. By leveraging the complementary properties of different vegetable oils, it is possible to produce oil blends that not only enhance human health but also improve product quality and shelf life.

Comparison of Hot and Cold Pressing Methods. Below is a comparison of the advantages, disadvantages, and characteristics of hot pressing and cold pressing methods. Hot Pressing Method; Raw material is heated to 100÷120 °C before pressing. Advantages; Higher oil yield (up to 98% from sunflower). Faster and more efficient production. Longer shelf life due to sterilization effect [2,3,]. Disadvantages; Partial loss of vitamins (A, E, antioxidants), Slight changes in taste and aroma, Example: Refined sunflower oil. Cold Pressing Method-Raw material is pressed at temperatures not exceeding 40 °C. Advantages: Vitamins and bioactive compounds are better preserved. Natural taste and aroma are retained. Considered healthier for nutrition. Disadvantages: Lower oil yield (85–90%). More expensive and slower process. Shorter shelf life. Example: Extra virgin olive oil, pumpkin seed oil [1,2,3,].

The comparative table below outlines the principal distinctions and advantages associated with hot and cold pressing techniques.

As can be seen from the table above, oils obtained by cold pressing differ from those obtained by hot pressing in several indicators. Now let us turn to the main part of the study, namely the technological process sequence of preparing a composite oil mixture based on non-traditional oil-bearing plants, the proportions in which the oils are prepared, the areas of application of the prepared oils, as well as the experiments conducted and the results obtained.

Table 1

Comparison Table

Criteria	**Hot Pressing**	**Cold Pressing**
Temperature	100÷120 °C	≤ 40 °C
Oil yield	95÷98 %	85÷90 %
Vitamins	Partially destroyed	Well preserved
Taste and Aroma	Neutralized	Natural, intact
Shelf life	Longer	Shorter
Cost	Cheaper	More expensive
Example	Refined sunflower oil	Extra virgin olive oil

Initially, oils extracted from non-traditional oil-bearing plants were mixed in different proportions. The table below presents the physicochemical quality indicators of seed oils.

Table 2

Physicochemical indicators of seed oils

№	Name of indicator	Apricot oil	Peach oil	Bitter almond oil	Plum oil
1	**Refractive index, nD = 20 ˚C**	1.472	1.470	1.471	1.4680
2	**Density, g/ml, 25 ˚C**	0.908	0.912	0.912	0.914
3	**Saponification value, mg KOH/g**	191	190	192	190
4	**Iodine value, g I_2/100 g**	101	100	100	101
5	**Peroxide value, mol active oxygen**	2.82	3.0	3.85	1.12
6	**Acid value, mg KOH/g**	1.7	1.3	1.1	0.81
7	**Moisture and volatile matter content, %**	0.4	0.5	0.4	4.5
8	**Oil yield, relative to kernel, %**	29.6	29.3	27.8	43.8

Based on the data presented in both tables, it is evident that the physico-chemical parameters and fatty acid composition of kernel oils obtained by cold pressing are expressed at higher levels. This indicates that by formulating compositions of such oils with traditionally hot-pressed oils, it is possible to enrich the nutritional profile of vegetable oils consumed in the human daily diet [7,8,9,10,].

Table 3

Fatty acid composition of oils obtained from fruit seeds

№	**Name of acid**	**Apricot oil (%)**	**Peach oil (%)**	**Bitter almond oil (%)**	**Plum oil (%)**
1	**Palmitic**	5.56	4.93	6.35	5.91
2	**Stearic**	1.94	2.18	2.05	1.26
3	**Oleic**	63.76	61.46	68.60	74.91
4	**Linoleic**	26.15	26.44	20.11	16.82
5	**Linolenic**	1.01	0.10	0.38	0.05
6	**Arachidic**	0.50	0.46	0.19	0.02
7	**Others**	1.08	4.43	2.32	7.19
8	**Total**	100	100	100	100

In recent years, consumers have increasingly shifted away from the use of conventional edible oils derived from traditional oilseed crops, instead giving preference to oils extracted from non-traditional sources. The primary reasons for this shift are well recognized: the relatively high proportion of saturated fatty acids in conventional vegetable oils, as well as the deterioration of beneficial properties caused by the thermal treatment applied during the oil extraction process [7,8,9,10,].

Nevertheless, an important socio-economic issue arises: for low-income populations, the relatively high cost of non-traditional oils raises the question of whether they are limited to consuming only lower-quality oils. A potential solution to this challenge lies in the development of blended oil compositions, wherein conventional vegetable oils are combined with non-traditional kernel oils in different ratios. Initially, experiments were conducted by blending individual types of vegetable oils with kernel oils, followed by the preparation of mixtures involving multiple vegetable oils with kernel oils at varying proportions.

The formulation of these oil compositions was carried out according to several criteria. For instance, oils with a relatively low fatty acid content were blended with oils rich in fatty acids, and subsequently, mixtures were designed based on vitamin content. In this way, vegetable oils with lower quality indicators were improved through combination with higher-quality oils.

Table 4

Oil content and fatty acid composition of oilseed crops

Plant's name	**Oil content (%)**	**Main fatty acids (composition)**
Soybean	18÷22	Linoleic (50÷55%), Oleic (20÷25%), Linolenic (5÷10%), Palmitic (10%), Stearic (4÷5%)
Sunflower	40÷55	Linoleic (55÷65%), Oleic (20÷30%), Palmitic (5÷7%), Stearic (4÷6%)
Peanut (Groundnut)	45÷55	Oleic (45÷55%), Linoleic (25÷35%), Palmitic (8÷10%), Stearic (2÷4%)
Rapeseed (Canola)	40÷50	Oleic (50÷60%), Linoleic (20÷25%), Linolenic (8÷12%), Erucic (≤2% in improved varieties)
Sesame	48÷55	Oleic (35÷45%), Linoleic (40÷50%), Palmitic (8÷10%), Stearic (3÷5%)
Flax (Linseed)	35÷45	Linolenic (45÷55%), Oleic (15÷20%), Linoleic (15÷20%), Palmitic (5÷6%), Stearic (4÷5%)
Castor bean	45÷55	Ricinoleic (80÷85%), Oleic (6÷8%), Linoleic (4÷6%), Palmitic (2%)
Mustard	35÷40	Oleic (40÷45%), Erucic (30÷40% in traditional; 0÷2% in "00" varieties), Linoleic (15–20%), Linolenic (8÷12%)

Sanflower	25÷35	Linoleic (70÷80%), Oleic (10÷15%), Palmitic (6÷8%), Stearic (2÷3%)
Cottonseed	18÷25	Linoleic (50÷60%), Oleic (15÷20%), Palmitic (20÷25%), Stearic (2÷4%)

The data presented in the table indicate that the proportion of unsaturated fatty acids in conventional vegetable oils is comparatively lower than that found in non-conventional oilseed sources. By combining oils derived from both groups, either in equal ratios or in varying proportions, it becomes possible to obtain novel composite oil blends Such an approach provides an effective means of broadening the assortment of edible oils and enhancing their functional and nutritional properties.

Conclusion.

The conducted analyses show that conventional vegetable oils (such as sunflower, soybean, cottonseed, etc.) contain relatively lower amounts of unsaturated fatty acids, whereas non-conventional oilseed plants (such as flaxseed, camelina, safflower, sesame, etc.) are rich in biochemically valuable unsaturated fatty acids. This significantly increases their physiological and dietary importance. By developing composite blends of conventional and non-conventional vegetable oils in various proportions, it is possible to create a new assortment of edible oils. Such a technological approach allows to:improve the organoleptic properties of products, enhance their biological value, produce functional products that meet the requirements of healthy nutrition, and ensure more efficient utilization of available raw materials. Thus, the technology of developing compositions of conventional and non-conventional vegetable oils represents one of the innovative directions in the food industry and serves to expand the assortment of oils within the framework of the healthy nutrition concept.

References

1. Konopka I., Tańska M., Dąbrowski G., Ogrodowska D., Czaplicki S. Edible Oils from Selected Unconventional Sources—A Comprehensive Review of Fatty Acid Composition and Phytochemicals Content. Applied Sciences, 2023.

2. Srivastava, Shweta & Sreerama, Y N & Dharmaraj, Usha. (2021). Effect of processing on squalene content of grain amaranth fractions. Journal of Cereal Science. 100. 103218. 10.1016/j.jcs.2021.103218.

3. Martirosyan, D. M; Miroshnichenko, L. A; Kulakova, S. N; Pogojeva, A. V; Zoloedov, V. I (2007). "Amaranth oil application for coronary heart disease and hypertension". Lipids in Health and Disease.

4. Wolosik K, Chalecka M, Palka J, Mitera B, Surazynski A. *Amaranthus cruentus* L. Seed Oil Counteracts UVA-Radiation-Induced Inhibition of Collagen Biosynthesis and Wound Healing in Human Skin Fibroblasts. Int J Mol Sci. 2024 Jan 11;25(2):925. doi: 10.3390/ijms25020925. PMID: 38256000; PMCID: PMC10815470.

5. Prommaban A, Kuanchoom R, Seepuan N, Chaiyana W. Evaluation of Fatty Acid Compositions, Antioxidant, and Pharmacological Activities of Pumpkin (*Cucurbita moschata*) Seed Oil from Aqueous Enzymatic Extraction. Plants (Basel). 2021 Jul 31;10(8):1582. doi: 10.3390/plants10081582. PMID: 34451628; PMCID: PMC8402081.

6. Fruhwirth, Gilbert O.; Hermetter, Albin (November 2007). "Seeds and oil of the Styrian oil pumpkin: Components and biological activities". European Journal of Lipid Science and Technology. 109 (11): 1128–1140. doi:10.1002/ejlt.200700105. ISSN 1438-7697.

7. Davlyatov A.A, Xamdamov A.M, Xudayberdiyev A.A. Meva danaklaridan olingan moylarni fizik-kimyoviy xossalarini tahlil qilish// Andijon mashinasozlik institutining “Mashinasozlik” ilmiy-texnika jurnali. - Andijon, 2022, № 6 Maxsus son. - c. 370-375. (OAK Rayosatining 2021 yil 30 dekabrdagi 310/14.2-son qarori).

8. Davlyatov A.A., Xamdamov A.M, Xudayberdiyev A.A, Qadirov A.A. Изучения методы эффективного использования семян сливы// Qo‘qon davlat pedagogika institutining Ilmiy xabarlari. Qo‘qon, 2022. Dekabr soniga ilova. - NamMTI, Maxsus son №4. - c. 44-46. (OAK Rayosatining 2021 yil 31 martdagi 295/6-son qarori)

9. Davlyatov A.A, Xudayberdiyev A.A. Olxo‘ri mag‘izidan sovuq presslash usulida yog‘ olish. Educational Research in Universal Sciences (ERUS) Vol. 1. №. 7 (2022). February. 2023. - pp. 315-319. (12) Index Copernicus

10. Davlyatov, A., Khudaiberdiev, A., Khamdamov A. (2024). 664.34.063.8 Physical-chemical indicators of plum oil obtained by the pressing method: Scientific and Technical Journal of Namangan Institute of Engineering and Technology, 9 (1), -pp.-102–108. (05.00.00, № 33).

11. Davlyatov Azizbek, Khudaiberdiev Absalom, Khamdamov Anvar Justification of technological processes of extracting oil from plum kernels // Universum: технические науки. 2024. №3 (120). URL: https://cyberleninka.ru/article/n/justification-of-technological-processes-of-extrac-ting-oil-from-plum-kernels c.-21-27

12. Azizbek Davlyatov, Absalom Xudayberdiyev, Anvar Khamdamov, Bekhzod Adashev and Zilola Madaminova Physico-chemical properties of oil from plums and prospects for its use//E3S Web of Conferences 486, 02014 (2024), https://doi.org/10.1051/e3sconf/202448602014 , (3) Scopus.

13. Ibragimov A.A., Mamajanova I.R., Davlyatov A.A. Study of physical chemical composition of local (Prunus cerasus L.) plants and cherry fruits grown in fergana region// Science and Innovation International Scientific Journal. Volume 3 Issue 10. October 2024. ISSN: 2181-3337. Impact Factor: UIF=8.2. - pp.266-271. https://doi.org/10.5281/zenodo.14030888. (12) Index Copernicus.