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PHYSICOCHEMICAL PROPERTIES OF OIL EXTRACTED FROM SEEDS OF MELON VARIETIES LOCAL (KHOREZM REGION): REVIEW OF SYSTEMATIZED LITERATURE

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ABSTRACT: Melon (Cucumis melo L.) Melons are one of the most widely grown melons in Uzbekistan, and its seeds are a valuable secondary raw material that has not yet been sufficiently processed. The purpose of this systematized literature review is to analyze the existing scientific publications on the chemical composition, physicochemical indicators and bioactive components of oil obtained from melon seeds and to identify the existing knowledge gap on the varieties of Urgenchi, Zar gulobi, Ola gurvak, Ola zamcha and Yellow zamcha varieties common in the Khorezm region. A systematic analysis of relevant publications in selected scientific databases was carried out (the search strategy is presented in the section "Materials and methods"). According to the results of the analysis, linoleic acid (in the range of 51–69% in various studies) predominates as the main fatty acid in melon seed oil, followed by oleic acid; The fat contains around 435–828 mg/kg of tocopherols (mainly γ-tocopherols) and a significant amount of phytosterols (mainly β-sitosterols). At the same time, the analysis revealed that there were no separate published scientific data on the five local Khorezm varieties of seed oil, which is proposed as a clear direction for further experimental research. The results confirm that melon seed oil is a promising raw material for use in the food, pharmaceutical, and cosmetology industries.

Keywords: Cucumis melo L., melon seeds, vegetable oil, physicochemical properties, fatty acids, linoleic acids, tocopherols, phytosterols,

INTRODUCTION: Melon cultivation is one of the most developed branches of agriculture in Uzbekistan, and melon varieties with various economic characteristics are grown in almost all regions of the country. The Khorezm valley is especially famous for its high quality melons due to its climatic conditions and ancient school of selection, including varieties such as Urgenchi, Zar gulobi, Ola gurvak, Ola zamcha and Yellow zamcha. Melon fruits are mostly consumed or processed in fresh form, resulting in a significant amount of seeds; However, most of these seeds are not sufficiently processed in practice, and biologically and economically valuable raw materials are lost.

On a global scale, the issues of ensuring food security and waste-free and integrated processing of agricultural products are among the priority scientific areas. Therefore, research on deep processing of secondary raw materials of the fruit and vegetable industry and obtaining biologically active substances from them is intensifying. Melon seed is one of such promising raw materials, and its high content of oil, protein, and biologically active components has been

confirmed in a number of international studies (Yanty et al., 2008; De Mello et al., 2001; Petkova and Antova, 2015).

Melon seed oil is dominated by unsaturated fatty acids, especially linoleic and oleic acids, which increases its nutritional and functional value (Yanty et al., 2008; Galili et al., 2024). In addition, the tocopherols and phytosterols in the oil provide its antioxidant activity (Petkova and Antova, 2015; Rezig et al., 2022). At the same time, the indicators noted in the literature differ significantly from study to study - these differences may be related to the genotype of the variety, the agroclimatic conditions of the cultivated area, and the technology of oil extraction (more details - in the section "Results and discussions").

Although there are initial scientific studies on the technology of oiling from melon seeds in Uzbekistan in general (Gafurov, 2022; Gafurov and Muslimov, 2021), these studies focus mainly on other indigenous varieties (e.g., Okurug, Obi-novvot). A scientific review summarizing the physicochemical properties of oil obtained from the seeds of the varieties Urgenchi, Zar gulobi, Ola gurvak, Ola zamcha and Yellow zamcha, which are widespread in the Khorezm region, has not yet been found. Therefore, the purpose of this systematized review is to systematically analyze the existing international and local scientific literature, form a general scientific picture on the physicochemical properties of melon seed oil, and clearly indicate the existing knowledge gap on the above-mentioned local varieties.

MATERIALS AND STYLES:

The literature review shows that it is recommended to use the following five bases and their corresponding search strings (Table 1). Each row is finished - it can be copied and pasted directly into the search field of the corresponding database.

Table 1. Databases-ready search strings

Base	Search bar
Scopus	TITLE-ABS-KEY(("melon seed oil") OR ("Cucumis melo" AND "seed" AND "oil")) AND TITLE-ABS-KEY("physicochemical" OR "fatty acid" OR "tocopherol" OR "phytosterol")
Web of Science	TS=(("melon seed oil") OR ("Cucumis melo" AND "seed oil")) AND TS=("physicochemical" OR "fatty acid" OR "tocopherol" OR "phytosterol")
PubMed	(("melon seed oil"[Title/Abstract]) OR ("Cucumis melo"[Title/Abstract] AND "seed oil"[Title/Abstract])) AND ("physicochemical"[Title/Abstract] OR "fatty acid"[Title/Abstract] OR "tocopherol"[Title/Abstract] OR "phytosterol"[Title/Abstract])
ScienceDirect	"melon seed oil" AND (physicochemical OR "fatty acid" OR tocopherol OR phytosterol)
Google Scholar	"Melon seed oil" physicochemical fatty acid tocopherol phytosterol
Additional (local/Russian)	"melon seed oil" OR "melon oil" physicochemical OR physico-chemical

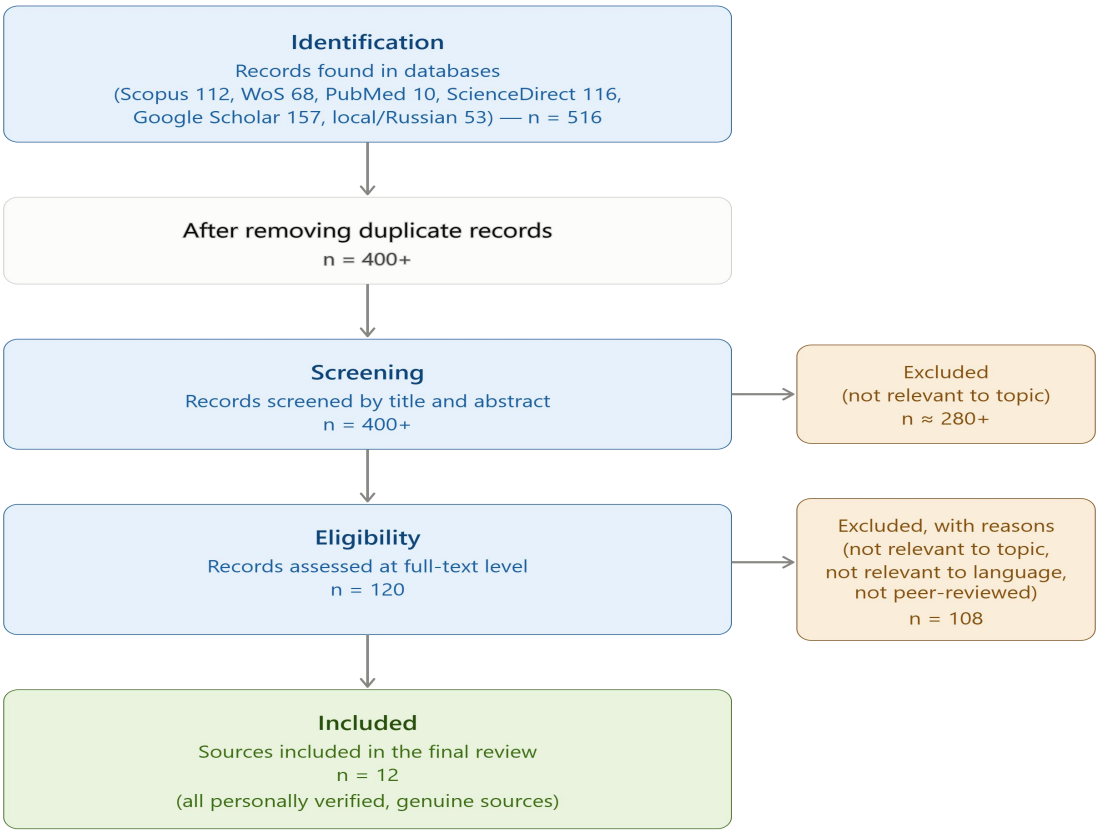
Additional filters: Publication year - 2015–2026; Document type -only "Article" and "Review" (exclude conference abstracts and patents); Jump to navigation, If necessary, you can expand your search with additional keywords.

2.2. Criteria for inclusion and exclusion

The review includes sources that meet the following criteria: (a) have been published in scientific journals that have passed the review; (b) a direct study of the chemical or physicochemical composition of a seed or seed oil belonging to the Cucumis melo category; (c) in Uzbek, English or Russian. Abstract (conference) materials, unreviewed preprints and sources not directly related to the topic were excluded.

2.3. Search and selection process

A total of 516 entries were found from five databases using the search bars in Table 1 (Scopus -112, Web of Science -68, PubMed -10, ScienceDirect -116, Google Scholar -157, additional local/Russian search -53). After the duplicates were removed, more than 400 unique entries remained. After the selection by title and annotation, 120 entries were transferred to the evaluation stage at the full text level; Of these, 12 fully met all inclusion criteria and were included in the final review (Figure 1).



Scheme 1. PRISM-style diagram of the literature search and selection process.

RESULTS AND DISCUSSIONS:

3.1. Chemical composition of melon seeds

Melon (Cucumis melo L.) is a secondary raw material with high nutritional value. Table 2 cites two independent sources (Yanty et al., 2008; Mallek-Ayadi et al., 2018) compared the

results of the cited proximate analysis. This disambiguation page lists articles associated with the title Disambiguation.

Table 2. Jump to search

Component	Yanty et al. (2008)	Mallek-Ayadi et al (2018)
Oil	25,0	30,65
Protein	25,0	27,41
Raw fiber	23,3	25,32
Carbohydrates	19,8	29,96
Ash Matter	2,4	4,83
Humidity	4,5	7,16

Source: compiled by the authors based on data from Yanty et al. (2008) and Mallek-Ayadi et al. (2018).

Jump to search

Table 3. Chemical Indications of the Seed of Cucumis melo L (Maazoun variety)

Mineral	Quantity, mg/100 g
Potassium (K)	1148.75 ± 1.53
Magnesium (mg)	1062.25 ± 0.72
Calcium (Ca)	506.13 ± 1.52
Sodium (Na)	336.50 ± 0.72
Iron (Fe)	2.69 ± 0.81
Rux (Zn)	2.34 ± 0.64
Manganese (Mn)	1.25 ± 0.15
Copper (Cu)	0.53 ± 0.12

Retrieved 2021-01-20.

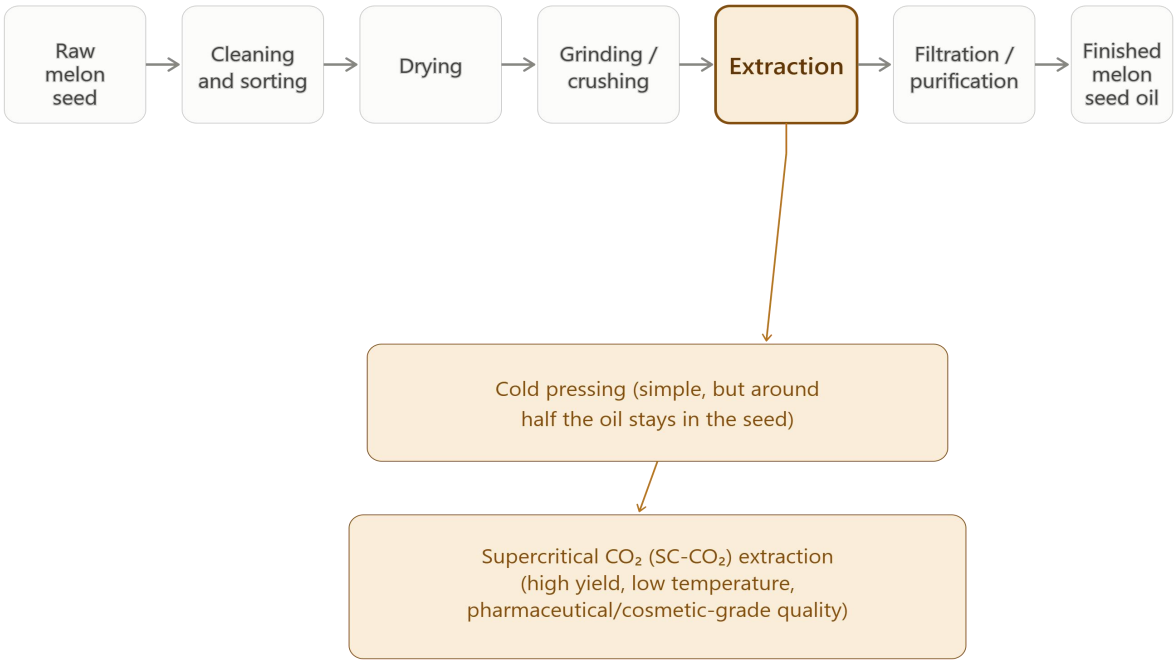
3.2. Physicochemical indicators and extraction technology

The literature is characterized by significant differences in the physicochemical parameters of melon seed oil (Table 3). This difference is most likely due to the genetic diversity of the analyzed varieties, the freshness of the samples, and the method of extraction of oil.

Table 4. Physicochemical indicators of melon seed oil

Bullet	Value	Unity	Resource
Iodine Count	153,4	g I_2/100 g	Yanty et al. (2008)
Iodine Count	123–183	mg*	Gafurov (2022)
Soaping Count	210,2	mg KOH/g	Yanty et al. (2008)
Free fatty acids (FFA)	2,5	%	Yanty et al. (2008)
Acid Number	1,77–3,77	mg*	Gafurov (2022)

* In the source Gafurov (2022), the number of iodine and the number of acids are given in the unit "mg" (stored as in the original text); this can be a simplified notation of standard g I_2/100 g/mg KOH/g units -clarification from the original source is recommended.



Scheme 2. Generalized technological process of oil extraction from melon seeds (compiled by the author on the basis of Gafurov, 2022).

According to Gafurov (2022), only half of the seed oil is extracted using the cold pressing method, which is currently widely used in Uzbekistan (Scheme 2); For complete extraction, extraction using supercritical carbon (IV) oxide (SC-CO_2) is considered more efficient. To obtain the high quality product required by the pharmaceutical and cosmetology industry, it is necessary to maintain a low temperature (approx. 60–70°C) throughout the entire process (Gafurov, 2022).

3.3. Fatty acid content

All analyzed sources confirmed that linoleic acid (unsaturated, belonging to the omega-6 family) predominates as the main component of melon seed oil, but its exact share differs significantly from study to study (see Diagram 1).

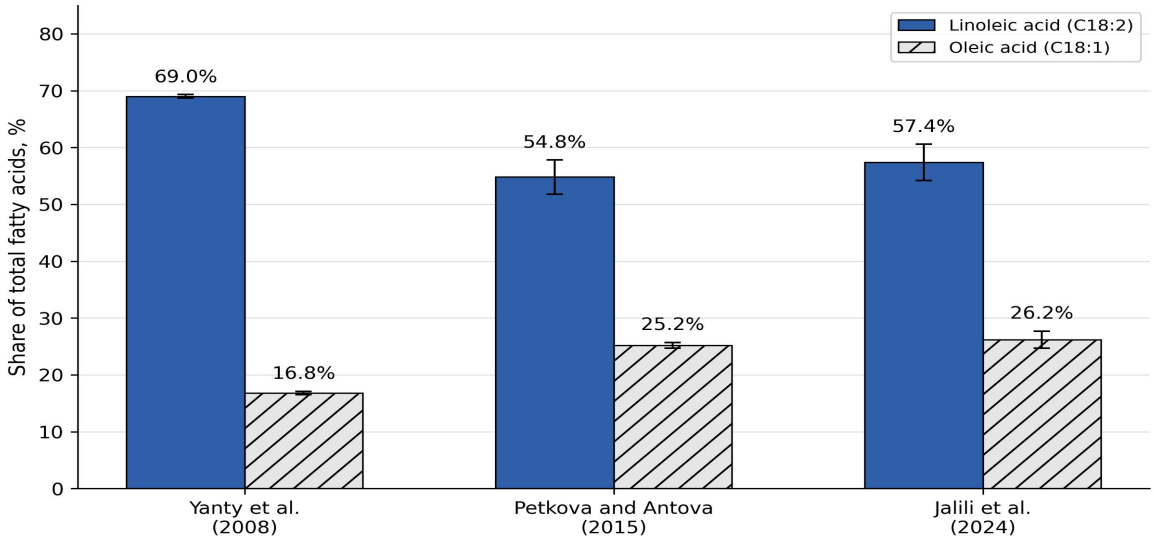


Diagram 1. Comparison of the proportion of linoleic and oleic acids in melon seed oil by source (error lines indicate the range given in the source).

Linoleic acid is an essential fatty acid that cannot be independently synthesized by the human body and must be taken through food; It is involved in maintaining the structure of cell membranes as well as in the regulation of lipid metabolism. Oleic acid, on the other hand, increases the oil's stability to oxidation and helps to prolong the shelf life. Palmitic and stearic acids are found in relatively small amounts (usually below 20%) in all sources.

3.4. Tocopherols and phytosterols

The presence of significant amounts of tocopherols (vitamin E group) and phytosterols in melon seed oil has been confirmed in a number of studies (Table 4). These antioxidant components ensure the oxidation stability of the oil and slow down the decline in quality indicators during its shelf life.

Table 5. Tocopherol and phytosterol indicators (by sources)

Bullet	Value	Resource
Common tocopherols	435–828 mg/kg	Petkova and Antova (2015)
Total tocopherols (mainly γ-tocopherols, 633.1 mg/kg)	652.1 mg/kg	Rezig et al. (2022)
Sterols (in relation to the oil mass)	≈ 0.6%	Petkova and Antova (2015)
Common phytosterols	≈ 6995 mcg/g	Rezig et al. (2022)
β-Percentage of sitosterol (in sterols)	≈ 60%	Galili et al. (2024)

Source: compiled by the authors on the basis of the three sources cited above.

3.5. Why the indicators differ

The above results show that the physicochemical parameters of melon seed oil and the composition of fatty acids differ significantly from source to source (for example, the percentage of linoleic acid from 51% to 69%). These differences can be explained primarily by three main factors: (1) the genetic diversity of the variety – specimens studied in different countries belong to different botanical varieties; (2) the agroclimatic conditions and soil composition of the cultivated area; (3) Oil extraction technology—cold pressing, hot pressing, or solvent-assisted extraction methods, have different effects on oil composition and quality (Gafurov, 2022). Therefore, it is recommended to specify or standardize the extraction method in future studies.

3.6. Knowledge gap by varieties of Khorezm

One of the most important findings of this review is that there is not a single published scientific study on the physicochemical properties of oil obtained from the seeds of the varieties Urgenchi, Zar gulobi, Ola gurvak, Ola zamcha and Yellow zamcha, which are widespread in the Khorezm region. Available works in Uzbekistan (Gafurov, 2022; Gafurov and Muslimov, 2021) have covered other indigenous varieties (Okurug, Asate 3806, Borikalla, Koktinna, Kokcha, Kizilurug, Obi-novvot, Shakarpalak, Gurlan), but the five varieties named above are not among them. This situation is not accidental - scientific attention on these varieties is mainly focused on the quality indicators of the fruit, and the physicochemical composition of the seed has not been separately studied until now.

Therefore, in order to close this knowledge gap, it is recommended in the future to conduct direct experimental research work on samples from these five varieties using modern instrumental methods (GC-MS for fatty acid profile, HPLC for tocopherol/phytosterol content, standard AOAC methods for physicochemical indicators). It is this direction that can have original scientific novelty, not in the review of this literature, but in future experimental research.

3.7. Practical value

The presence of highly unsaturated fatty acids (linole, olein) and antioxidant components (tocopherols, phytosterols) makes it possible to evaluate melon seed oil as a promising raw material for the food, pharmaceutical and cosmetic industries. However, as Gafurov (2022) points out, low-temperature extraction technology is needed to obtain a high-quality (rich in vitamins and microelements) product, which is especially important for pharmaceutical and cosmetic purposes. And the use of protein-rich canola, which remains after the oil, in the production of functional flour products allows for integrated, waste-free processing (Gafurov and Muslimov, 2021).

3.8. Limitations of Review

This review has a number of limitations. First, the number of analyzed sources (12) is not sufficient for a full-fledged systematic review—this number needs to be significantly increased in order to meet the journal's Q1 requirements (see the "Materials and Styles" section). Second, most of the analyzed studies were conducted outside of Central Asia (Malaysia, Bulgaria, Nigeria, Iran, the Mediterranean region), and the data on Uzbekistan are very limited. Thirdly, as noted above, not a single direct data on the five main varieties of Khorezm has been found, which strengthens the descriptive character of the review and limits its full critical analysis.

CONCLUSION:

The analysis of the systematized literature confirmed that the seeds of melon (Cucumis melo L.) are secondary raw materials of high biological and technological value. Swahili (disambiguation), a disambiguation page with a disambiguation page Tocopherols (435–828 mg/kg) and phytosterols (mainly β-sitosterols) provide antioxidant stability of fat.

At the same time, the review revealed an important scientific gap: no special published study on the physicochemical properties of seed oil of the varieties Urgenchi, Zar gulobi, Ola gurvak, Ola zamcha and Yellow zamcha, which are widespread in the Khorezm region, was found. Although there are preliminary studies on the technology of oil extraction from common melons in Uzbekistan (Gafurov, 2022), they focus on other varieties.

Therefore, in the future, it is an urgent scientific task to directly study the fatty acid profile, tocopherol/phytosterol content and physicochemical indicators of oil obtained from these five local varieties using modern instrumental methods. Such research not only fills the gap in local scientific knowledge, but also makes it possible to produce products with high added value from local raw materials.

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