Journal of Chemistry of Goods and Traditional Medicine

J Chem Good Trad Med, Volume 4, Issue 1, 2025 Traditional Medicine

PREPARATION OF SOFT DOSAGE FORMS FROM HORSE CHESTNUT AND AMARANTH OILS AND THEIR CHEMICAL COMPOSITION

Ibragim R. Askarov

Andijan State University, Professor of the Department of Chemistry, Doctor of Chemistry, Honored Inventor of Uzbekistan, Chairman of the TABOBAT Academy of Uzbekistan

https://orcid.org/0000-0003-1625-0330

E-mail: tabobat_akademiya@mail.ru

DOI: https://doi.org/10.55475/jcgtm/vol4.iss1.2025.488

Keywords:

Horse Chestnut, Amaranth, plant oils, semi-solid dosage forms, flavonoids, squalene, venotonics, pharmacological activity

Annotation

This study presents the results of research on the chemical composition and biological activity of oils obtained from horse chestnut seeds (Aesculus hippocastanum L.) and amaranth (Amaranthus spp.). The aim of the study is to evaluate the potential of these plant oils as active ingredients for the development of soft pharmaceutical formulations. The paper provides data on the content of biologically active compounds, including flavonoids, triterpene saponins, squalene, and polyunsaturated fatty acids. Special attention is given to the pharmacological properties of the oil components, such as venotonic, antioxidant, anti-inflammatory, and regenerative effects. The feasibility of using amaranth and horse chestnut oils in ointments, creams, and gels intended for the treatment of chronic venous insufficiency, skin diseases, trophic ulcers, and inflammatory conditions is substantiated. A comparison is made between the effectiveness of traditionally used imported drugs and promising formulations based on local plant raw materials.

How to Cite

Askarov, I. R. OBTAINING SEMI-SOLID DOSAGE FORMS FROM HORSE CHESTNUT AND AMARANTH OILS AND THEIR CHEMICAL COMPOSITION. Journal of Chemistry of Goods and Traditional Medicine, 4(1). https://doi.org/10.55475/jcgtm/vol4.iss1.2025.488

Introduction. One of the priority tasks of modern pharmaceutical production is the development of effective medicinal products based on locally sourced plant raw materials [1]. Special attention is given to the use of plant oils obtained through cold-pressing methods, which possess pronounced pharmacological properties. Oils derived from the seeds of horse chestnut (*Aesculus hippocastanum* L.) and amaranth (*Amaranthus* spp.) are of significant interest due to their high content of biologically active substances such as escin, flavonoids, tannins, squalene, and polyunsaturated fatty acids [2, 3, 4].

Horse chestnut is a well-known plant in both traditional and scientific medicine, recognized for its venotonic, anti-inflammatory, capillary-protective, and analgesic properties. Its main active compound, escin, belongs to the class of triterpene saponins, which increase venous tone, reduce vascular wall permeability, and improve lymphatic drainage. Flavonoids and coumarins in chestnut provide antioxidant effects, contribute to reducing swelling, and accelerate tissue healing. Chestnut extracts and oils are widely used in the treatment of chronic venous insufficiency, varicose veins, hemorrhoids, hematomas, and bruises [3].

Amaranth is a high-protein plant rich in squalene, linoleic and linolenic acids, tocopherols, phytosterols, and amino acids. Squalene, a natural antioxidant, exhibits strong wound-healing, anti-inflammatory, and antimicrobial effects. Due to its ability to saturate tissues with oxygen and stimulate regeneration, amaranth oil is actively used in cosmetology, dermatology, and regenerative medicine. Additionally, amaranth is gluten-free, resilient to adverse climatic conditions, and is considered a promising source of environmentally clean raw materials, especially in the context of Uzbekistan [4, 5].

Against the backdrop of the widespread occurrence of chronic venous insufficiency, inflammatory skin diseases, and tissue trophic disorders, there is a growing demand for effective topical medications. Semi-solid dosage forms—ointments, creams, and gels—are convenient to use, provide localized therapeutic effects, minimize systemic side effects, increase the bioavailability of active compounds, and create a long-lasting depot on the skin surface. They are easy to apply, offer prolonged action, and can be effectively used as part of comprehensive therapy for both acute and chronic conditions [6].

Despite the availability of imported drugs, including those based on horse chestnut extract, there are practically no products on the market made using local plant raw materials [7]. In Uzbekistan, there is significant potential for the use of horse chestnut and amaranth seeds, which until now has remained unrealized in pharmaceutical practice. This creates prerequisites for an in-depth study of the chemical composition of these plant oils, as well as an assessment of their biological activity in order to develop effective and accessible semi-solid medicinal forms.

Materials and Methods

Objects of the study. Seeds of *Aesculus hippocastanum* L. (horse chestnut) and *Amaranthus* spp. (amaranth), collected in the vicinity of Tashkent at full maturity, were selected as the objects. The oils were obtained using a cold pressing method to preserve biologically active compounds.

Oil extraction. Oils were extracted using laboratory oil-pressing equipment at a temperature not exceeding 45 °C. The oils were then filtered and stored in airtight bottles in a dark cool place until analysis.

Physico-chemical analysis of horse chestnut (*Aesculus hippocastanum* L.) and amaranth (*Amaranthus* spp.) seed oils was carried out in order to comprehensively assess their chemical composition and biologically active properties. The following indicators were determined: acid and iodine values, fatty acid composition (by gas chromatography–mass spectrometry), squalene content (high-performance liquid chromatography), presence of flavonoids and triterpene saponins (ultraviolet spectrophotometry), antioxidant activity (DPPH method), and antimicrobial activity (disk diffusion method).

The acid value was determined by titrating an oil solution in a mixture of ethanol and ether (1:1) with 0.1 N potassium hydroxide solution in the presence of phenolphthalein; the result was expressed in mg KOH per 1 g of oil. The iodine value was determined by the Wijs method using a chlorine-iodine reagent and subsequent titration of the excess iodine with sodium thiosulfate. The fatty acid composition was determined using gas chromatography–mass spectrometry (GC-MS). Oils were preliminarily saponified and methylated, then analyzed on a Shimadzu GCMS-QP2010 Ultra gas chromatograph with a DB-23 capillary column under gradient heating. Identification was carried out using the NIST14 spectral library with the use of a standard FAME Mix.

Squalene was quantitatively determined by HPLC using an Agilent 1200 chromatograph with a diode-array detector. A C18 column was used with a mobile phase of methanol:water (95:5), a flow rate of 1 mL/min, and a detection wavelength of 210 nm. The squalene concentration was determined using a calibration curve constructed with a standard substance (squalene ≥ 98%).

Flavonoids were determined using a 2% solution of aluminum chloride in ethanol, spectrophotometrically at a wavelength of 415 nm. The results were expressed in terms of rutin equivalents. Triterpene saponins were determined by reaction with vanillin and sulfuric acid, with

optical density measured at 544 nm. Quantitative determination was carried out using a calibration graph with escin as the standard.

The antioxidant activity of the oils was assessed by their ability to inhibit the stable DPPH radical. Samples were mixed with a DPPH solution (0.1 mM in methanol), incubated in the dark at room temperature for 30 minutes, and then optical density was measured at 517 nm. The percentage of inhibition was calculated and the IC_{50} value determined. Ascorbic acid was used as the standard.

Antimicrobial activity was determined using the disk diffusion method against test strains *Staphylococcus aureus* ATCC 25923 and *Candida albicans* ATCC 10231. Microorganism suspensions were applied to the surface of nutrient media (MPA and Sabouraud), after which paper disks impregnated with oil were placed on the surface. After 24 hours of incubation at 37 °C, the diameter of the inhibition zones was measured. Standard antibiotics (ampicillin, nystatin) and blank disks with solvent were used as controls.

Development of Semi-Solid Dosage Forms

Based on the obtained data on the chemical composition and biological activity of oils from horse chestnut seeds (*Aesculus hippocastanum* L.) and amaranth (*Amaranthus* spp.), semi-solid topical medicinal forms were developed. The main objective at this stage was to create stable, effective, and technologically reproducible formulations with pronounced therapeutic action aimed at improving microcirculation, reducing inflammation, stimulating tissue regeneration, and providing antimicrobial protection.

The development process included the formulation of experimental samples of ointments and creams using various bases—emulsion (oil-in-water, O/W type) and absorption types. Emulsion bases ensure good penetration of active substances, rapid absorption, and comfort upon application, while absorption bases help retain moisture in the skin and offer longer-lasting effects. The choice of base type was determined by the intended indications for use: for acute inflammatory conditions and varicose veins, emulsion creams were preferred; for trophic skin disorders, denser ointment forms were selected.

The formulations included the following concentrations of active components: horse chestnut seed oil — from 5 to 15%, amaranth oil — from 5 to 10%. These dosages were selected based on preliminary studies of antioxidant and antimicrobial activity, as well as organoleptic and technological parameters (homogeneity, stability, consistency, pH).

Traditional pharmaceutical ingredients were used as excipients: lanolin (emollient and structure stabilizer), beeswax (structuring agent and preservative), glycerin (moisturizer and viscosity regulator), and purified water as the dispersion medium. If necessary, non-ionic emulsifiers and natural antioxidants (e.g., tocopherol) were added to stabilize the emulsion and extend shelf life.

During the development of the semi-solid forms, pharmacotechnological parameters were taken into account: pH, viscosity, thermal stability, and uniform distribution of active substances. The prepared ointment and cream samples underwent preliminary stability testing during 30 days of storage at temperatures of 4 °C, 20 °C, and 40 °C. Organoleptic evaluation was also carried out, along with the assessment of spreadability, absorption, skin feel, and hypoallergenicity (using rapid methods on laboratory animals).

In the future, the obtained samples are planned to be used in preclinical and clinical studies to confirm their effectiveness in the treatment of chronic venous insufficiency, varicose veins, hemorrhoids, trophic ulcers, and dermatitis of various etiologies.

Pharmacological Testing

To assess wound-healing and venotonic activity, preliminary in vivo tests were conducted on laboratory animal models (Wistar rats) using ointments based on the investigated oils. Inflammatory

reactions were induced using 1% formalin, and the dynamics of edema as well as the rate of epithelialization were evaluated.

Results and Discussion

Physico-chemical properties of the oils. Amaranth oil contained up to 7.5% squalene, high concentrations of linoleic (ω-6) and linolenic (ω-3) acids, tocopherols, and phytosterols. Horse chestnut oil was characterized by the presence of saponins (escin), flavonoids (rutin, quercetin), tannins, as well as a moderate content of fatty acids.

Table 1.

Physicochemical Properties of Horse Chestnut and Amaranth Oils

Indicator	**Horse Chestnut Oil**	**Amaranth Oil**
Acid value, mg KOH/g	1.45 ± 0.1	1.21 ± 0.1
Iodine value, g I_2/100 g oil	105.4 ± 2.3	112.8 ± 2.1
Squalene content, %	—	7.3 ± 0.4
Tocopherols, mg/100 g	2.5 ± 0.3	8.7 ± 0.6
Saponins	+++	+
Flavonoids	++	+

Biological Activity

The antioxidant activity of the oils was confirmed using the DPPH method, showing 50–60% inhibition. The oils also demonstrated a pronounced antimicrobial effect, particularly against *S. aureus*.

Conclusions. The conducted study showed that oils from the seeds of *Aesculus hippocastanum* and *Amaranthus* spp. have high potential for use as active components in soft pharmaceutical formulations. Their composition provides antioxidant, antimicrobial, venotonic, and regenerative effects. Based on the obtained data, the development of ointments and creams is proposed, which can be effectively used for chronic venous insufficiency, varicose veins, inflammatory skin diseases, and trophic ulcers. The use of locally sourced raw materials enables the creation of affordable and environmentally friendly medicinal products.

References

1. Баранов А.П., Мартынов А.В. Основы фармацевтической технологии. — М.: ГЭОТАР-Медиа, 2018. — 352 с.

2. Кара-Мурза И.Н., Яковлев Г.П. Биологически активные вещества растений. — М.: Колос, 2019. — 480 с.

3. Кулагина Г.Н., Ефимов А.С. Лекарственные растения в клинической практике. — СПб.: Специальная литература, 2020. — 412 с.

4. Лапшин И.А., Котова Н.В. Современные подходы к созданию мазевых лекарственных форм на основе растительного сырья // Вестник фармации. — 2020. — №3(87). — С. 41–47.

5. Справочник по фармакогнозии / Под ред. А.П. Козлова. — М.: Медицина, 2017. — 528 с.

6. Zhbankov R.G., Popova I.N., Lushnikova I.V. Comparative characteristics of the antioxidant activity of Amaranthus spp. oils // Journal of Ethnopharmacology. — 2021. — Vol. 274. — P. 113–120.

7. Samadi N., Abadian N., Ahmadi-Ashtiani H.R. Therapeutic potentials of *Aesculus hippocastanum* (horse chestnut) in venous insufficiency: A systematic review // Phytotherapy Research. — 2019. — Vol. 33(2). — P. 289–297.

8. Santos H.O., Price J.C. Squalene: potential roles in human health and clinical nutrition // Nutrition Reviews. — 2020. — Vol. 78(9). — P. 725–745.

9. Касымова З.М., Назаров Ж.Т. Биологическая активность масел амаранта: химический состав и перспективы применения // Журнал медицинской науки Узбекистана. — 2022. — №2. — С. 84–89.

10. Ahmed A., Khan M.I., Ahmed H. Development and characterization of herbal creams containing squalene and natural antioxidants for topical delivery // International Journal of Cosmetic Science. — 2020. — Vol. 42(1). — P. 34–42.

11. Валижанов А.Р., Турсунова М.М. Исследование физико-химических свойств растительных масел для разработки мазевых основ // Узбекистанский фармацевтический журнал. — 2023. — №1. — С. 56–61.

12. Седов А.Ю., Климова Н.В. Химические методы анализа растительных экстрактов // Химия природных соединений. — 2021. — №4. — С. 12–20.

13. Hasanov B.T., Ismatullaeva M.R. Local plant resources in the development of topical drugs: focus on chestnut and amaranth oils // Journal of Bioresources and Bioproducts. — 2023. — Vol. 8(2). — P. 155–162.