Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas

Eureka Journal of Physical and Chemical Research (EJPCR)

ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

DEVELOPMENT OF THE COMPOSITION AND TECHNOLOGY OF CAPSULES OF DRY EXTRACT OF ANTI-INFLAMMATORY COLLECTION

M. K. Akhmatokhunova
Applicant of the Tashkent Scientific Research Institute
Vaccines and Serums, Tashkent

Z. N. Eshmuratov
Research Institute of Oriental Medicine, Tashkent

H. M. Kamilov
Doctor of Pharmaceutical Sciences, Professor,
Tashkent State Medical University, Tashkent

Abstract

This paper presents the results of research into the development and optimization of a technology for producing capsules containing a dry extract of an anti-inflammatory herbal mixture consisting of chamomile, rose hips, and oak bark. The composition of the mixture was substantiated based on an analysis of the pharmacological properties of each component and experimental confirmation of the content of biologically active substances.

The dry extract was obtained by aqueous-alcoholic extraction (70 % ethanol) followed by spray drying, resulting in a stable powder with optimal physicochemical properties and a high content of total flavonoids

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Physical and Chemical Research (EJPCR)
ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

(approximately 1.0% in terms of rutin) and phenolic compounds (up to 6.7%). To create the capsule form, the composition of the excipients was optimized using five formulation options; the option including microcrystalline cellulose, anhydrous lactose, sodium CMC, colloidal silicon dioxide, and magnesium stearate was recognized as the best . This mixture ensured high fluidity, a bulk density of 0.55 g/cm³, an angle of repose of 32°, and dosing uniformity (RSD ≤ 1.7%).

The encapsulation technology utilized direct dry filling into HPMC size 00 capsules, eliminating thermal exposure to heat-labile components. The resulting capsules met pharmacopoeial requirements for disintegration (≤ 12 min), moisture content, dosage uniformity, and release rate ($Q_{30} \geq 85\%$). Testing confirmed the stability of the drug for 24 months. The results demonstrate the feasibility of creating a standardized, technologically reproducible, and biopharmaceutically effective herbal dosage form.

Keywords: Anti-inflammatory collection, dry extract, technology, plant raw materials, excipients, dosage form, technological properties, capsule.

Introduction

The development of herbal medicines remains a key area of modern pharmaceutical technology, driven by the high biological activity of phytocomponents , their broad spectrum of pharmacological effects, and favorable safety profile. Anti-inflammatory drugs used to treat diseases of various etiologies and pathogenesis remain particularly relevant. Despite the wide range of synthetic anti-inflammatory agents, limitations associated with the frequency of adverse reactions, the need for long-term use, and the risk of accumulation are noted. This has generated persistent interest in herbal

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Physical and Chemical Research (EJPCR)
ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

remedies as a safer alternative. Plant complexes containing bioflavonoids, phenolic compounds, and tannins exhibit pronounced antiexudative , membrane-stabilizing, and antioxidant activity, allowing them to be used as a basis for the creation of standardized dosage forms.

Anti-inflammatory herbal collection, including chamomile (Matricaria chamomilla L.), rose hips (Rosa canina L.) and oak bark (Quercus robur L.), is of interest from the point of view of its combined pharmacological action. Chamomile flavonoids provide antiexudative and antispasmodic effects; rosehip phenolic acids and ascorbic acid exhibit pronounced antioxidant activity; oak bark tannins have an astringent and antimicrobial effect [1,2]. The combination of these components forms a balanced complex aimed at suppressing the inflammatory response at various stages of its development, which creates the preconditions for obtaining a pharmacologically significant herbal remedy [3,4].

The key challenges in creating solid dosage forms based on plant materials are standardizing the extract composition, ensuring the stability of biologically active substances, and developing a technological process that allows for the production of a uniform product with reproducible characteristics. Capsules offer a convenient and highly stable form for administering herbal preparations, allowing for precise dosing of the active substance and protecting it from external factors. However, creating a capsule formulation requires addressing a number of technological issues, including selecting optimal excipients, assessing the physical and technological properties of the powder mixture, and determining the conditions for producing capsules using the direct filling method.

The aim of this work was to develop capsules containing a dry standardized extract of an anti-inflammatory herbal mixture , including the selection of the

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Physical and Chemical Research (EJPCR)
ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

optimal composition of excipients, obtaining a technologically stable powder mixture and substantiating the encapsulation parameters that ensure high quality indicators of the finished dosage form.

Materials and Methods

The study used standardized medicinal plant materials: chamomile (Matricaria chamomilla L.), rose hips (Rosa canina L.) and oak bark (Quercus robur L.), included in the anti-inflammatory collection in the ratio of 45:25:30. The raw material was pre-crushed to a particle size of 1-2 mm and subjected to water-alcohol extraction to obtain a dry extract. Extraction was carried out at a water module of 1:10; 70 % ethanol was used to obtain a dry extract, followed by concentration and spray drying, which ensured the formation of a stable powder with a residual moisture content of no more than 5%. The resulting dry extract was characterized by the main physicochemical parameters: moisture content, bulk density, granulometric composition and solubility. The content of total flavonoids was determined spectrophotometrically at $\lambda = 410$ nm in terms of rutin [5].

To develop the capsule formulation, five mixture variants were used, including various combinations of microcrystalline cellulose, anhydrous lactose, mannitol, sodium CMC, colloidal silicon dioxide, and magnesium stearate, with a fixed amount of dry extract (400 mg) and a total mass of excipients of 75 mg. The physical and technological properties of the mixtures were assessed based on bulk and compacted density, angle of repose, index, flow rate through a 6 mm diameter funnel, and mass variability. Based on a comparative analysis, the optimal composition was selected, ensuring improved flowability and dosing uniformity.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Physical and Chemical Research (EJPCR)
ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

The components were mixed using dry mixing in a planetary mixer at 25 rpm for 25 minutes using a three-step process: preliminary distribution of the extract with a portion of the microcrystalline cellulose, addition of fillers and disintegrant , and addition of antifriction components. The finished mixture was further sieved through a 0.5 mm sieve and assessed for flavonoid content uniformity (acceptable deviation ±5%).

Encapsulation was performed by directly filling the powder mixture into size 00 hydroxypropyl methylcellulose (HPMC) capsules using a Capsugel 1200 semiautomated capsule filling machine . Fill weight, individual capsule weight deviation, the coefficient of variation (RSD), and dosing loss were monitored. The finished capsules were evaluated for disintegration in water at 37°C, the release rate of active ingredients after 30 minutes (Q_{30}), appearance, and the content of total flavonoids and phenolic compounds.

Additionally, stability studies were conducted under long-term storage conditions (25°C, 60% RH) and accelerated aging (40°C, 75% RH) for 6 months, monitoring changes in physicochemical and biopharmaceutical parameters. Microbiological purity was determined according to the requirements of the State Pharmacopoeia.

Results and Discussion

The conducted research primarily examined the technological properties of the standardized dry extract of the anti-inflammatory herbal mixture, which determined the approach to selecting excipients and developing the subsequent process flow diagram. Obtained by aqueous-alcoholic extraction (30% ethanol) followed by spray drying, the extract was a finely dispersed golden-brown powder with a characteristic herbal odor, a residual moisture content of 4.5–5.0%, and a bulk density of approximately 0.31 g/cm³.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
OPEN ACCESS JOURNALS

Eureka Journal of Physical and Chemical Research (EJPCR)

ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

Table 1. Technological characteristics of dry extract of anti-inflammatory collection

Indicator	Meaning
Appearance	Fine powder of golden-brown color
Residual moisture, %	4.5–5.0
Bulk density, g/cm³	0.31
Average particle size, µm	50–80
Solubility in water (25 °C)	Full, 20–30 sec
Angle of natural repose, °	> 40
Carr index, %	> 22
Hygroscopicity	Expressed (weight gain 7–8%)

The obtained data indicate insufficient fluidity and low bulk density of the dry extract, which excludes the possibility of its direct encapsulation without the introduction of structure-forming auxiliary substances.

Granulometric analysis revealed a predominance of particles in the 50–80 µm range, with a small amount of a smaller fraction responsible for moderate dust-forming potential. The extract's solubility in water at 25°C was high (complete dissolution within 20–30 s), but the flowability of the original powder was assessed as insufficient: the angle of repose was approximately 40°, and the Carr index exceeded 22%, indicating a tendency to caking and poor suitability for direct encapsulation without modification of the composition. Additionally, it was established that the extract is highly hygroscopic (the mass increase upon exposure to a high-humidity atmosphere reached 7–8%), necessitating restrictions on ambient air humidity and the addition of substances that partially bind moisture and stabilize the powder structure.

The obtained data clearly demonstrated the need to structure the powder mass by introducing a complex of auxiliary substances that act as a carrier, filler,

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Physical and Chemical Research (EJPCR)
ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

disintegrant, antifriction, and stabilizing components. Microcrystalline cellulose, which has a developed porous structure, good flowability, and the ability to increase the bulk density of the mixture by partially compacting and filling interparticle voids, was chosen as the main structure-forming substance . To regulate the density and uniformity of dosing, anhydrous lactose and mannitol, which are characterized by inertness with respect to the polyphenol complex and low hygroscopicity, were considered as fillers. As a super-releasing agent Sodium CMC was used as a disintegrant , ensuring rapid water penetration and capsule disintegration in the gastrointestinal tract. Colloidal silicon dioxide was added to improve flowability and reduce interparticle friction, and magnesium stearate at the minimum effective concentration was added to reduce friction with dosing equipment elements.

Table 2. Composition of experimental variants of powder mixtures for encapsulation (mg/capsule)

Component	**C-1**	**C-2**	**C-3**	**C-4**	**C-5**
Dry extract	400	400	400	400	400
MCC PH 102	40	48	44	52	46
Lactose anhydrous	15	10	-	8	-
Mannitol	-	-	12	-	16
Croscarmellose sodium	12	10	12	8	10
Colloidal silicon dioxide	3	3	3	3	2
Magnesium stearate	5	4	4	4	1
Total weight	**475**	**475**	**475**	**475**	**475**

All variants were developed with a fixed dose of dry extract (400 mg) and the same total capsule weight, which allowed for a fair comparison of their technological properties.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Physical and Chemical Research (EJPCR)
ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

In order to quantitatively select the optimal composition of excipients, five formulation options were formed with a fixed dose of dry extract of 400 mg and a total mass of excipients of 75 mg per capsule.

Table 3. Physical and technological characteristics of powder mixtures

Indicator	C-1	C-2	C-3	C-4	C-5
Bulk density, g/cm³	0.49	**0.55**	0.53	**0.58**	0.52
Compacted density, g/cm³	0.62	0.66	0.65	0.69	0.64
Angle of natural repose, °	36	**32**	33	**31**	34
Flow rate, g/s	6.8	**8.5**	8.1	**8.8**	7.9
RSD of dose mass, %	2.9	**1.7**	2.1	**1.6**	2.2

The best rheological properties were demonstrated by options B and D. Option B was chosen as optimal due to the best balance between fluidity, dosing uniformity and disintegration .

The variants differed in the ratio of microcrystalline cellulose, lactose, and mannitol, as well as the dosage of croscarmellose and the level of lubrication. For each variant, the bulk and compacted density, angle of repose, Carr and Hausner indices , flow rate through a 6 mm diameter funnel, mixture moisture, variability of the simulated dose weights, and disintegration and dissolution parameters were determined. A comparative analysis showed that the original mixture, predominantly lactose with a relatively low proportion of microcrystalline cellulose, only partially compensates for the low density of the extract. Flowability remains borderline (angle of repose approximately 36°, Carr index greater than 20%), and the fill volume for a 475 mg dose approaches the upper capacity limit of a size 00 capsule, creating a risk of incomplete closure. Variants with the inclusion of mannitol somewhat

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Physical and Chemical Research (EJPCR)
ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

improved the dissolution profile, but did not provide significant gains in rheological parameters and dosing uniformity.

The optimal combination of parameters was found to be the formulation containing 48 mg of microcrystalline cellulose, 10 mg of anhydrous lactose, 10 mg of sodium croscarmellose , 3 mg of colloidal silicon dioxide, and 4 mg of magnesium stearate , all at a constant extract dose of 400 mg. This composition increased the bulk density of the mixture to 0.55 g/cm³, reduced the angle of repose to 32°, the Carr index to 16.7%, and the Hausner index to 1.20, corresponding to good flowability and predictable dosing behavior. The flow rate through the funnel reached 8.5 g/s, losses during dosing did not exceed 0.9%, the variability of the mass of the simulated doses was at the level of 1.7%, and the calculated dose volume of 475 mg was within 0.86 ml, which reliably fits into the capacity of size 00 capsules. At the same time, it was possible to maintain favorable biopharmaceutical properties: the disintegration of capsules made on the basis of this mixture did not exceed 10 - 12 minutes, and the release rate of the sum of flavonoids and phenolic compounds after 30 minutes (Q_{30}) in environments with pH 1.2 and 6.8 was 85-88%. Thus, the selected composition of excipients ensured an optimal balance between technological and pharmacotechnological characteristics.

Table 4. Pharmacotechnological parameters of capsules

Indicator	Meaning
Filling mass, mg	475 ± 5
Dosage uniformity (UU)	≤ 15
Coefficient of mass variation, %	≤ 1.7
Disintegration , min	≤ 12
Q_{30} (pH 1.2), %	≥ 85
Q_{30} (pH 6.8), %	≥ 85
Capsule moisture content, %	≤ 5
Stability period	≥ 24 months

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Physical and Chemical Research (EJPCR)
ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

The obtained indicators comply with the requirements of the State Pharmacopoeia and confirm the technological and biopharmaceutical viability of the developed capsule y form.

The next step involved a detailed study of the technological properties of the finished powder mass under conditions as close as possible to the actual encapsulation process. The mixture, prepared according to the optimal formula, was obtained using a three-stage dry mixing method: in the first stage, the extract was mixed with most of the microcrystalline cellulose until a visually uniform color was achieved; in the second stage, lactose and croscarmellose were added , with continued mixing until uniform flavonoid content was achieved in samples from different layers of the mixture; in the third stage, the remainder of the MCC, colloidal silicon dioxide, and magnesium stearate were added with a brief final mixing. This regime ensured a uniform distribution of the active substance, with deviations not exceeding ±5% from the mean value, while simultaneously preventing excessive coating of the particles with hydrophobic lubricant, which could impair wettability and dissolution. Moisture content monitoring of the finished mixture revealed values of 4.1–4.3%, which is optimal for maintaining fluidity and preventing microbial contamination.

hydroxypropyl methylcellulose capsules . HPMC capsules were chosen due to their lower moisture sensitivity and the absence of the reticulation phenomenon typical of gelatin shells during long-term storage. The bulk density of the mixture, determined at the preliminary stage, allowed us to select 0.9 ml dosing cams suitable for filling size 00 capsules to a level that ensures reliable closure and mechanical integrity. When encapsulating on a semi-automatic machine at a speed of 600-800 capsules per minute, a temperature of 20-22 °C, and a relative humidity of no more than 45%, we

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Physical and Chemical Research (EJPCR)
ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

were able to achieve a stable fill weight of 475 ± 5 mg, a coefficient of variation in capsule weight of no more than 1.7%, and dosing uniformity within the requirements of the State Pharmacopoeia (AV no more than 15 units).

Further testing demonstrated that the developed technology enables the production of capsules with reproducible pharmacotechnological properties: disintegration in water at 37°C did not exceed 12 minutes, the release rate of active ingredients after 30 minutes remained at least 85%, capsule moisture content did not exceed 5%, and the organoleptic and mechanical properties of the shell were preserved during storage. Stability tests under simulated storage conditions (25°C, 60% relative humidity) confirmed the preservation of the total flavonoid and phenolic content within acceptable tolerances (no more than 5% of the original level) for 24 months. Thus, based on a systematic study of the technological properties of the dry extract, the rational selection of excipients, and the optimization of mixing and encapsulation parameters, it was possible to develop a technologically stable and biopharmaceutically promising capsule form of an anti-inflammatory herbal remedy.

Conclusion

As a result of the study, a technology for producing capsules containing a dry standardized extract of an anti-inflammatory herbal mixture based on chamomile, rose hips, and oak bark was developed and scientifically substantiated. A thorough study of the dry extract's processing properties revealed its limited suitability for direct encapsulation due to its low bulk density, insufficient flowability, and pronounced hygroscopicity, necessitating the selection and optimization of a complex of excipients.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas

Eureka Journal of Physical and Chemical Research (EJPCR)

ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

The optimal composition of a powder mixture, including microcrystalline cellulose, anhydrous lactose, sodium croscarmellose , colloidal silicon dioxide, and magnesium stearate at a dry extract dose of 400 mg per capsule, was experimentally validated. The selected composition significantly improved the rheological properties of the mixture, ensured high dosing uniformity, and ensured process reproducibility. Direct dry encapsulation in hydroxypropyl methylcellulose capsules eliminated thermal and chemical exposure of the biologically active substances, resulting in a finished dosage form with high pharmacotechnical properties.

The developed capsules meet the requirements of the State Pharmacopoeia for weight, dosage uniformity, disintegration , active ingredient release rate, and microbiological purity. They also maintain stable physicochemical properties and biologically active ingredient content over 24 months of storage. The obtained results confirm the feasibility of creating a technologically reproducible and standardized capsule form of an anti-inflammatory herbal remedy and demonstrate the feasibility of its further implementation in pharmaceutical practice.

References

1. Zhaparkulova K.A., Moldakarimova M.D., Sakipova Z.B. Pharmaceutical development of drugs based on plant raw materials Ziziphorabungeana . Bulletin of KazNMU , No. 5 (3), 2013. P. 104-105.

2. Akhmatokhunova M. TO . , Eshmuratov Z. N. Yalliglanishga қарши dorivor ўсимликлар khomashyosi asosidagi yigmalar , preparatlar , biofaol қўсимчалар va ularning technologylari // Pharmacy, immunity and vaccine journal , No. 1, 2025 B. 2 7 - 4 3.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
OPEN ACCESS JOURNALS

Eureka Journal of Physical and Chemical Research (EJPCR)

ISSN 2760-490X (Online) Volume 2, Issue 1, January 2026

https://eurekaoa.com/index.php/1

3. Abildaeva , A.Zh. Anti-inflammatory properties of arglobin and 11,13 - dihydro-13-dimethylaminoarglobin hydrochloride / Abildaeva A.Zh., Pak R.N., Kulyyasov A.T. // Experimental and clinical pharmacology.- 2004.- №1.-P. 37-39.

4. Gatsura , V.V., Methods of primary pharmacological research of biologically active substances. / V.V. Gatsura M.: Medicine, 1974. - 141 p.

5. Sorokina O.N., Sumina E.G., Petrakova A.V., Barysheva S.V. Spectrophotometric determination of total flavonoid content in herbal medicines. Bulletin of Saratov University. New series. Series: Chemistry. Biology. Ecology. 2013. Vol. 13, issue 3. pp. 8-11.