UDC 615.453.42:615.322
DOI https://doi.org/10.32782/health-2024.1.18

DEVELOPMENT OF CAPSULE COMPOSITION BASED ON DRY EXTRACT OF *SALVIA SCLAREA L.* AND SPECIFICATION OF QUALITY CONTROL

Kholov Safarali Begijonovich,
Postgraduate Student at the Department of Pharmaceutical Technology and Pharmacology
Tajik National University
ORCID: 0009-0009-6021-2391

Musozoda Safol Mirahmad,
Doctor of Pharmaceutical Sciences,
Professor at the Department of Pharmaceutical Technology and Pharmacology
Tajik National University
ORCID: 0009-0006-3933-0498

Makhsudov Kobildzhon Saidmahdievich,
Candidate of Pharmaceutical Sciences,
Assistant at the Department of Pharmaceutical Technology and Pharmacology
Tajik National University
ORCID: 0000-0002-0857-6181

Kukhtenko Halyna Pavlivna,
Candidate of Pharmaceutical Sciences,
Associate Professor at the Department of Cosmetology and Aromatology
National University of Pharmacy
ORCID: 0000-0002-7914-8053

Quality assurance of medicinal products is a critical aspect of pharmaceutical development since the efficacy and safety of medicinal products for patients depend on it. Ensuring the proper quality of phytopreparations includes many aspects, the crucial among which are the use of a standardized substance of plant origin, the use of high-quality auxiliary materials, and quality control at all stages of production. This article presents part of the experimental results on developing the composition and technology of capsules based on the substance of dry extract of clary sage (DECS) grown in Tajikistan. Clary sage (Salvia sclarea) has a wide range of therapeutic effects, is traditionally used by the indigenous population of Tajikistan, and has a high level of study and scientific substantiation of biological activity. DECS was before standardized for the content of the amount of flavonoids and hydroxycinnamic acids. The quantitative content of the amount of flavonoids was not less than 13.0% in terms of apigenin and the quantitative content of the amount of hydroxycinnamic acids was not less than 1.2% in terms of rosmarinic acid. The results of pharmacological activity screening by the staff of the Department of Pharmaceutical Technology and Pharmacology of the Tajik National University showed anti-inflammatory, diuretic activity and a moderate anxiolytic effect of DECS. The obtained results formed the basis for the development of capsules based on the DECS substance and quality control criteria at the stage of the technological process of "obtaining a mass for encapsulation." To ensure the quality of the developed capsules, more stringent acceptance criteria were introduced for a number of pharmaco-technological indicators. These indicators include loss on drying, flowability, bulk density, compatibility, tapped density (at V1250), and uniformity of the content of DECS in the weighed mass of the capsule content. These criteria are specified for products obtained during the "obtaining a mass for encapsulation" stage of the technological process. Implementing these stricter criteria serves as a measure to guarantee the drug product's quality.

Key words: *Salvia sclarea L., clary sage, capsules, dry extract, solid dosage form, technology.*

Сафаралі Холов, Сафол Мусозода, Кобілджон Махсудов, Галина Кухтенко. Розроблення складу капсул на основі сухого екстракту шавлії мускатної та специфікації контролю якості

Забезпечення якості лікарських засобів є критично важливим аспектом фармацевтичного розроблення, оскільки від цього залежать ефективність та безпека лікарських засобів для пацієнтів. Забезпечення належної якості фітопрепаратів включає багато аспектів, ключовими серед яких є використання стандартизованої субстанції рослинного походження, використання високоякісної допоміжної сировини, контроль якості на всіх етапах виробництва. У цій статті представлено частину експериментальних результатів щодо розроблення складу та технології капсул на основі субстанції сухого екстракту шавлії мускатної (СЕШМ), вирощуваній

у Таджикистані. Шавлія мускатна має широкий спектр терапевтичної дії, традиційно використовувана корінним населенням Таджикистану, має високий рівень вивченості та наукового обґрунтування біологічної активності. СЕШМ попередньо був стандартизований за вмістом суми флавоноїдів та гідроксикоричних кислот. Кількісний уміст суми флавоноїдів становить не менше 13,0% у перерахунку на апігенін та кількісний уміст суми гідроксикоричних кислот не менше 1,2% у перерахунку на розмаринову кислоту. Результати скринінгу фармакологічної активності співробітниками кафедри фармацевтичної технології та фармакології Таджицького національного університету показали протизапальну, діуретичну активність та помірний анксіолітичний ефект СЕШМ. Отримані результати лягли в основу розроблення капсул на основі субстанції СЕШМ та критеріїв контролю якості на етапі технологічного процесу «отримання маси для капсулювання». Із метою забезпечення якості капсул для низки фармакотехнологічних показників, таких як утрата в масі під час висушування, плинність, насипна густина, здатність до ущільнення, насипна густина після ущільнення (на V_{1250}), однорідність вмісту СЕШМ у наважці маси капсули у перерахунку на біологічно активні речовини, введених у специфікацію на проміжну продукцію на стадії технологічного процесу «отримання маси для капсулювання», були введені більш жорсткі межі критеріїв прийнятності, що є елементом гарантії забезпечення якості готового лікарського засобу.

Ключові слова: *Salvia sclarea L., clary sage, шавлія мускатна, капсули, сухий екстракт, тверді лікарські форми, технологія.*

Introduction. *Salvia sclarea L.*is a traditional medicinal plant widely used in various cultures as a therapeutic agent [1–5]. *Salvia* L. is one of the largest genera of the *Lamiaceae* family, the most studied medicinal plant of this genus is *Salvia officinalis* L. [6–11]. Due to the content of biologically active components such as flavonoids, phenolic compounds and diterpenoids, clary sage possesses antioxidant, anti-inflammatory, and antimicrobial activity, and its application can be useful in the treatment of various diseases [12, 13]. At the Department of Pharmaceutical Technology and Pharmacology of the Tajik National University, work is underway to develop hard gelatin capsules containing dry extract of Tajik clary sage (DECS). The results of pharmacological activity screening showed that when administered intragastrically to rats for 5 days at doses of 200 and 300 mg/kg, DECS exhibits anti-inflammatory and diuretic activity, and the dose of 300 mg/kg also shows a moderate anxiolytic effect [14, 15]. Considering the range of pharmacological activities of DECS presented above, it is rational to consider DECS as a potential combination agent for use in urology and as a combination cardiac drug. Due to differences in the dosage of DECS, to achieve a certain pharmacological effect, it was decided to develop capsules based on the DECS substance in a dose of 200 mg for use in urology as an anti-inflammatory agent and in a dose of 300 mg as an auxiliary drug in the complex treatment of cardiovascular diseases. Thus, the development of the composition and technology of capsules containing dry extract of clary sage is a promising area of scientific research.

The purpose of the study is to perform pharmaco-technological and physico-chemical experiments aimed at developing the composition of capsules with DECS and the specification of quality control of intermediate products at the stage of obtaining a mass for encapsulation.

Materials and methods. For the studies, we used DECS, standardized in terms of the content of the sum of flavonoids and hydroxycinnamic acids. The quantitative content of the amount of flavonoids of not less than 13.0% in terms of apigenin and the quantitative content of the amount of hydroxycinnamic acids of not less than 1.2% in terms of rosmarinic acid have been determined. DECS was obtained by extraction with 70% ethanol [16]. The pharmaco-technological properties of the capsule mass were studied following the methods of SPU 2.0: 2.2.32 Loss on drying, 2.9.34 Bulk density and tapped density of powders, 2.9.36 Powder fluidity. Capsule quality control was performed according to the methods of SPU 2.0 2.9.1 Disintegration of tablets and capsules, 2.9.3 Dissolution test for solid dosage forms, 2.9.6 Uniformity of content of the active substance per unit of dosed medicinal product [17]. Assay of the amount of flavonoids was carried out following the requirements of SPU 2.0 monograph "Absorption spectrophotometry in the ultraviolet and visible region" (2.2.25), according to the SPU 2.1 method of quantification of *"Sophorae japonicae* flos immaturus" in terms of apigenin. Quantitative determination of the amount of hydroxycinnamic acids was carried out according to the SPU 2.1 "*Orthosiphonis folium*" method in terms of rosmarinic acid [18].

The article presents some of the results of experimental studies on the development of capsule composition and includes the use of excipients such as lactose monohydrate (Tabletose® 80), sodium croscarmellose (Solutab®, type: A), colloidal anhydrous silicon dioxide (Aerosil A-380), talc, magnesium stearate, hard gelatin capsules No. 0 (capsule composition: titanium dioxide 2%, gelatin up to 100%).

Results and discussion. Hard gelatin capsules represent a versatile and convenient form for various types of medicinal products, and the direct encapsulation technology is one of the most economical technological methods of medicinal products obtaining due to the small number of technological operations. The direct encapsulation technology can be applied in the case when the capsule mass has the necessary pharmaco-technological properties. It should be considered that capsule machines operate on the principle of complete filling of the capsule volume, and at the stage of development of the capsule composition, it is necessary to perform a set of studies to ensure the accuracy of dosing of the active substance. Pharmacological studies have found that the therapeutic dose of DECS can vary from 200 mg/kg to 300 mg/kg, proceeding from which, taking into account the bulk density of DECS 0.755±0.03 g/mL (compressibility index 31.79±0.2%), the optimal capsule size was selected (Table 1).

Preliminary analysis of data on the physicochemical and technological properties of the active substance showed the need to use excipients to improve its flowability in the production of capsules [19, 20]. Considering that the introduction of diluents, disintegrants and glidants is necessary to increase the flowability of DECS, capsules No.0 or No.00 can be selected for filling. The choice of larger capsules No.000 will lead to an unjustified increase in the amount of excipients. Analysis of the dependence of the compaction index (Carr index, %) on the ratio of the tested mixtures of excipients showed minimal deviations in the values for the mixture of lactose monohydrate : NaCMC in the range of ratios 5:1, 1:1 and 1:5 (data are not given). The plan provided that the results of studies with intermediate values of indicators in some subjects are associated with the results of samples with boundary values that can be used in the formulation. This approach is preferable in the case of the development of a product line with different dosages of the active substance, i.e. a change in dosage does not lead to a change in the composition of the excipients. A powdering mixture consisting of aerosil, talc and magnesium stearate was added to the test composition, in a ratio of 1:1:0.3 not exceeding their permissible content standards per unit of the dosed drug. To determine the composition of the capsules, the technological characteristics of the mixture of excipients with DECS capsule masses calculated for capsules of sizes No.00 and No.0 were studied (Table 2). Tests were carried out on the device for bulk density determination SVM, ERWEKA, and flowability at GTB, ERWEKA.

The results of the studies in Table 2 indicate the absence of statistically significant deviations in the technological properties of capsule masses, and the use of capsules No.0 is more rational from an economic point of view.

The study of the effect of the disintegrating agent (NaCMC) concentration was carried out within the established ratios of the disintegrant filler from 5:1 – 1:1 – 1:5, so changes within this limit will not affect

Table 1

Capsule size selection

Capsule No.	Average capsule capacity, mL	Volume, which is occupied by DECS, %		Free volume of the capsule, %	
		Dosage 200 mg	Dosage 300 mg	200 mg	300 mg
000	1.37	19.34	28.97	80.66	71.03
00	0.95	27.89	41.79	72.11	58.21
0	0.68	38.97	58.38	61.03	41.62
1	0.5	53.0	79.4	47.0	20.6
2	0.37	71.62	-	28.38	-
3	0.30	88.33	-	11.67	-

Table 2

Technological characteristics of DECS compositions with excipients

Test samples of capsule masses		Flowability (g/s)	Densities (g/mL)		Compaction index (Carr), %
			Bulk density	Tapped density	
		DECS 200 mg / 300 mg			
Capsules composition	No.00	7.45±0.02 / 7.18±0.03	0.709±0.05/ 0.650±0.03	0.854±0.05/ 0.785±0.04	16.97±0.05 / 17.19±0.05
	No. 0	7.15±0.02 / 7.08±0.02	0.693±0.05/ 0.678±0.04	0.848±0.05/ 0.839±0.04	18.27±0.05 / 19.18±0.05

Note. n=6.

the bulk density of the capsular mass, which may be critical for the quality of the developed product. The composition of the capsules is given in Table 3.

The disintegration time of capsules with DECS was studied according to the procedure of SPU 2.0 2.9.1, on the ZT 220 device, "ERWEKA". The results are provided in Table 4.

From the presented data of capsule disintegration (Table 4), it was found that the disintegration time of the capsules does not significantly depend on the change in the concentration of NaCMC in the studied limits. The disintegration of the capsules meets the requirements of the SPU and does not exceed 30 minutes [19].

Dissolution is one of the most important qualitative characteristics of solid dosage forms, in particular capsules, the study of which allows not only to study the technology of manufacturing the dosage form but also to study its bioavailability. The test method was developed under the requirements of SPU 2.0 2.9.3 "Dissolution for solid dosage forms". The test met the following conditions: the number of capsules was 2 pieces; the volume of the dissolution medium was 500 mL; the composition of the dissolution medium was water; the temperature of the dissolution medium was 37± 0.5 °C; the paddle rotation speed was 100 rpm; the sampling time was 15, 30, 45, 60 min; the sampling method was a pipette; the volume of the test sample was 10 mL; the test samples were filtered immediately after their sampling. Tests were carried out on the device DT128, "ERWEKA". Assay of flavonoids and hydroxycinnamic acids for capsules with DECS was carried out by spectrophotometric method (Hitachi U-3900/3900H spectrophotometer).

For the capsule dissolution test (for the assay of flavonoids), the differential spectrum of the drug substance complex from $AlCl_3$ in the region from 325 nm to 450 nm was studied. In the absorption spectra of an aqueous solution of capsules based on the DECS substance, there were absorption maxima characteristic of extracts from the clary sage herb and for the DECS substance, therefore, to calculate the quantitative content of flavonoids, the specific absorption index of the apigenin standard sample at a wavelength of 390 nm was used [16].

The assay of hydroxycinnamic acids was carried out by adding a freshly prepared solution of sodium nitrite and sodium molybdate to the test solution. The absorbance of the test solution was measured on a spectrophotometer at a wavelength of 505 nm. The content of the sum of hydroxycinnamic acids was calculated in terms of rosmarinic acid.

To determine the dissolution time, the release kinetics of DECS from the capsules was studied. The results of the studies (average values) are shown in Table 5.

Experimental data indicate that the solubility of capsules with DECS is quite "high". Thus, the optimal dissolution time is an interval of 30–45 minutes.

As a result of the studies carried out in the development of the composition of capsules based on the substance of DECS, characteristics have been identified that can change under the influence of the parameters of the technological process and the properties of active or auxiliary substances. Such characteristics are identified as critical quality characteristics of the medicinal product. In order to ensure encapsulation conditions, the encapsulation mass must comply with the specified technological properties. At the same time, it is necessary to maintain the accuracy of the dosage for each capsule. To control the quality of the intermediate products at the stage of obtaining the mass for encapsulation, a specification was developed, into which the parameter of control of the active substance content

Table 3

Composition of the test capsules

Name of substance	Content, g /sample No.					
	0.2–1	**0.2–2**	**0.2–3**	**0.3–1**	**0.3–2**	**0.3–3**
DECS	0.2			0.3		
Lactose monohydrate	0.3096	0.2408	0.172	0.2196	0.1708	0.122
NaCMC	0.0344	0.1032	0.172	0.0244	0.0732	0.122
Powdering mixture	0.037					

Table 4

Capsule disintegration study results

	Decomposition time, min /sample No.					
	0.2–1	**0.2–2**	**0.2–3**	**0.3–1**	**0.3–2**	**0.3–3**
Capsules with DECS	11.5±0.5	11.0±0.3	11.5±0.3	12.1±0.4	10.8±0.3	11.8±0.4

Note. n=6.

Table 5

The results of the "Dissolution" test for capsules based on the DECS substance

200mg DECS capsule				
BAS.	**Sampling time, min**			
	15	**30**	**45**	**60**
% of flavonoids in terms of apigenin that passed into solution	92.3±0.1	95.8±0.1	96.1±0.2	96.5±0.3
% of hydroxycinnamic acids in terms of rosmarinic acid that passed into solution	90.1±0.2	92.3±0.2	92.8±0.1	93.4±0.2
Capsules, 300 mg DECS				
	15	30	45	60
% of flavonoids in terms of apigenin that passed into solution	92.8±0.3	94.6±0.1	95.6±0.2	96.2±0.3
% of hydroxycinnamic acids in terms of rosmarinic acid that passed into solution	91.1±0.3	92.3±0.2	93.5±0.1	93.8±0.2

Note. n=6.

uniformity in the weighed amount of the mass for encapsulation was introduced. Acceptance criteria have been established following the SPU. The results of the studies are presented in Table 6.

The results of the scientific work demonstrate that for a number of pharmaco-technological indicators introduced into the specification for intermediate products, the acceptance criteria

Table 6

Indicators of the quality of the capsule mass based on the DECS substance

Control parameter	**Acceptance criteria**		**Control method**
	200mg DECS capsule	**300 mg DECS capsules**	
Description	Green-brown powder		Visual control
Loss on Drying	Not more than 5%.		SPU 2.0 2.2.32 Loss on drying
Flowability	Within 11-13 sec/100g 100 g capsule mass using a funnel with an outlet diameter of 25 mm.		SPU 2.0 2.9.36 Powder flowability
Bulk density	Within 0.60-0.70 g/mL		SPU 2.0 2.9.34 Bulk density and tapped density of powders
Compactability	Not less than 18%		Calculation method
Tapped density (at V_{1250})	In the range of 0.80-0.90 g/mL.		SPU 2.0 2.9.34 Bulk density and tapped density of powders
Uniformity of the content of DECS in the weighed mass of the capsule content	From 85.0% to 115.0% of DECS in the weighted mass for encapsulation in terms of the sum of flavonoids and hydroxycinnamic acids		SPU 2.0 2.2.25 Ultraviolet and visible absorption spectrophotometry 2.9.6 Uniformity of the content of the active substance per unit of the dosed medicinal product
Assay:	The content of biologically active substances in the weighed amount of the mass in terms of the amount of flavonoids should be from 2.56% to 2.83% in terms of apigenin and from 0.27% to 0.30% of the amount of hydroxycinnamic acids in terms of rosmarinic acid in terms of the average mass of the capsule content	The content of biologically active substances in the weighed amount of the mass in terms of the amount of flavonoids should be from 3.84% to 4.24% in terms of apigenin and from 0.41% to 0.45% of the amount of hydroxycinnamic acids in terms of rosmarinic acid in terms of the average mass of the capsule content	SPU 2.0 2.2.25 Ultraviolet and visible absorption spectrophotometry
Labeling	The presence of an identification label on the container with intermediate products.		Visual inspection according to specification

have stricter limits, which serves as an element of confidence that the technological process is carried out in accordance with the requirements of regulatory documentation, and the obtained intermediate products meet the regulated quality indicators, which ensures the quality of the finished products.

Conclusions. Studies on the development of the composition of capsules based on DECS substance in conjunction with the criteria for quality control of intermediate products at the stage of the technological process "obtaining a mass for encapsulation" is a guarantee of the production of a finished product of stable quality from batch to batch.

BIBLIOGRAPHY

1. The phytochemical and chemotaxonomic study of Salvia spp. growing in Ukraine / O. M. Koshovyi et al. *Journal of Applied Biology & Biotechnology*. 2020. Vol. 8 (03). P. 29–36. DOI: 10.7324/JABB.2020.80306.

2. Anti–inflammatory and Antioxidant Agents from Salvia Genus (Lamiaceae): An Assessment of the Current State of Knowledge / M. Bonesi et al. *Anti–Inflammatory & Anti–Allergy Agents in Medicinal Chemistry*. 2017. Vol. 16 (2). P. 70–86. DOI: 10.2174/1871523016666170502121419.

3. Comparative study of antioxidant properties and total phenolic content of 30 plant extracts of industrial interest using DPPH, ABTS, FRAP, SOD, and ORAC assays / S. Dudonne et al. *J. Agric. Food Chem*. 2009. Vol. 57. P. 1768–1774. DOI: 10.1021/jf803011r.

4. Constituents from Salvia Species and Their Biological Activities / Y.–B. Wu et al. *Chemical Reviews.* 2012. Vol. 112 (11). P. 5967–6026. DOI: 10.1021/cr200058f.

5. Гудзь Н. І., Шанайда М. І., Дармограй Р. Є. Шавлія лікарська (Salvia officinalis L.): перспективи використання сировини як джерела рослинних препаратів антиоксидантної та антимікробної дії. *Вістник фармації.* 2020. № 2(100). С. 11–19.

6. Порівняльне фармакогностичне та фармакологічне дослідження листя Salvia verticillata та Salvia officinalis для встановлення перспективи створення нового лікарського засобу / М. М. Мига та ін. Актуальні питання фармацевтичної і медичної науки та практики. 2020. Т. 13. № 1(32). С. 61–71. DOI: 10.14739/2409-2932.2020.1.198136.

7. Cytotoxic, antioxidant and antimicrobial activities and phenolic contents of eleven Salvia species from Iran / O. Firuzi et al. Iran. J. Pharm. Res. 2013. Vol. 12. № 4. P. 801–810.

8. Extraction of phenolics and essential oil from dried sage (Salvia officinalis) using ethanol–water mixtures / N. E. Durling et al. Food Chemistry. 2007. Vol. 101. № 4. P. 1417–1424. DOI: 10.1016/j.foodchem.2006.03.050.

9. Verkhovodovoda Y., Kireyev I., Koshovyi O., Osolodchenko T. P. In vitro antimicrobial study of new modifications of salvia officinalis extracts. Annals of Mechnikov Institute. 2019. № 1. P. 31–35. DOI: 10.5281/zenodo.2639493.

10. Верховодова Ю. В., Кіреєв І. В., Кошовий О. М., Мига М. М. Дослідження антиексудативної активності екстрактів з листя Salvia officinalis. Медична та клінічна хімія. 2019. Т. 21. № 4. С. 54–60. DOI: 10.11603/mcch.2410-681X.2019.v.i4.10839.

11. Comparative Antioxidant, Anti–Acetylcholinesterase and Anti–α–Glucosidase Activities of Mediterranean Salvia Species / M. Mervić et al. Plants. 2022. Vol. 11(5). P. 625. DOI: 10.3390/plants11050625.

12. Anti–inflammatory effect of the Salvia sclarea L. ethanolic extract on lipopolysaccharide–induced periodontitis in rats / M. Kostić et al. Journal of Ethnopharmacology. 2017. Vol. 199. P. 52–59. DOI: 10.1016/j.jep.2017.01.020.

13. Antioxidant Phenolic Compounds in Salvia officinalis L. and Salvia sclarea L. / I. Jasicka–Misiak et al. Ecological Chemistry and Engineering S. 2018. Vol. 25(1). P. 133–142. DOI: 10.1515/eces-2018-0009.

14. Development of a target quality profile for capsules containing a dry extract of Salvia sclarea L. grown in Tajikistan / S. B. Kholov et al. Social Pharmacy in Health Care. 2023. Vol. 9. № 4. P. 55–61. DOI: 10.24959/sphhcj.23.309.

15. Kholov S. B., Lytkin D. V., Musozoda S. M. Study of anxiolytic activity of Tajikistan-grown Salvia sclarea dry extract. Механізми розвитку патологічних процесів і хвороб та їх фармакологічна корекція : матеріали VI наук.-практ. internet-конф. з міжнар. участю, м. Харків, 16 листопада 2023 р. Харків : НФаУ, 2023. С. 45–46.

16. Kholov S. B., Musozoda S. M., Safarzoda R. S., Yusufi S. J. Assay of the amount of flavonoids in raw Tajikistan-grown clary sage. Належні рішення для прогалин у фармації: відповідно до європейських пріоритетів : зб. наук. пр. Міжнар. студентської наук.-практ. конф., м. Львів, 23–24 листопада 2023 р. Львів : Львівська політехніка, 2023. С. 42–43.

17. Державна фармакопея України : у 3-х т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». 2-е вид. Харків : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. Т. 1. 1128 с.

18. Державна фармакопея України : у 3-х т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». 2-е вид. Харків : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. Т. 3. 732 с.

19. Kholov S. B., Musozoda S. M. Evaluation of hygroscopic properties of Tajikistan-grown Salvia sclarea dry extract. Хімія, біо- і фармтехнології, екологія та економіка в харчовій, косметичній та фармацевтичній промисловості : зб. матеріалів XI Міжнар. наук.-практ. конф., м. Харків, 18–19 листопада 2023 р. Харків : НТУ "ХПІ", 2023. С. 76–77.

20. Kholov S. B., Musozoda S. M. The study of some technological properties of Salvia sclarea dry extract, obtained from Tajik raw material. The 3rd International Scientific and Practical Internet Conference: Modern Pharmacy Science and Practice, Kutaisi, Georgia, 05.09.2023-30.09. Kutaisi, 2023. P. 16–17.

REFERENCES

1. Koshovyi O., Raal A., Kovaleva A., Myha M., Ilina T., Borodina N. et al. (2020). The phytochemical and chemotaxonomic study of Salvia spp. growing in Ukraine. Journal of Applied Biology & Biotechnology, 8(03), 29–36. doi: 10.7324/JABB.2020.80306.

2. Bonesi M., Loizzo M. R., Acquaviva R., Malfa G. A., Aiello F., Tundis R. (2017). Anti–inflammatory and Antioxidant Agents from Salvia Genus (Lamiaceae): An Assessment of the Current State of Knowledge. Anti–Inflammatory & Anti–Allergy Agents in Medicinal Chemistry, 16 (2), 70–86. doi: 10.2174/1871523016666170502121419.

3. Dudonné S., Vitrac X., Coutière P., Woillez M., Mérillon J.-M. (2009). Comparative study of antioxidant properties and total phenolic content of 30 plant extracts of industrial interest using DPPH, ABTS, FRAP, SOD, and ORAC assays. J. Agric. Food Chem, 57, 1768–1774. doi: 10.1021/jf803011r.

4. Wu Y.–B., Ni Z.-Y., Shi Q.-W., Dong M., Kiyota H., Gu Y.-C. et al. (2012). Constituents from Salvia Species and Their Biological Activities. Chemical Reviews, 112(11), 5967–6026. doi: 10.1021/cr200058f.

5. Hudz N. I., Shanaida M. I., Darmohrai R. Ye. (2020). Shavliia likarska (Salvia officinalis L.): perspektyvy vykorystannia syrovyny yak dzherela roslynnykh preparativ antyoksydantnoi ta antymikrobnoi dii [Medicinal sage (Salvia officinalis L.): prospects for the use of raw materials as a source of herbal preparations with antioxidant and antimicrobial action]. Vistnyk farmatsii, 2(100), 11–19. [In Ukrainian]

6. Myha M. M., Koshovyi O. M., Hamulia O. V., Verkhovodova Y. V., Kireiev I. V., Komisarenko A. M. (2020). Porivnialne farmakohnostychne ta farmakolohichne doslidzhennia lystia Salvia verticillata ta Salvia officinalis dlia vstanovlennia perspektyvy stvorennia novoho likarskoho zasobu [Comparative pharmacognostic and pharmacological study of the leaves of Salvia verticillata and Salvia officinalis to establish the prospect of creating a new medicinal product]. Aktualni pytannia farmatsevtychnoi i medychnoi nauky ta praktyky, 13, 1(32), 61–71. doi: 10.14739/2409-2932.2020.1.198136 [In Ukrainian]

7. Firuzi O., Miri R., Asadollahi M., Eslami S., Jassbi A. R. (2013). Cytotoxic, antioxidant and antimicrobial activities and phenolic contents of eleven Salvia species from Iran. Iran. J. Pharm. Res, 12, 4, 801–810.

8. Durling N. E., Catchpole O. J., Grey J. B., Webby R. F., Mitchell K. A., Foo L. Y. et al. (2007). Extraction of phenolics and essential oil from dried sage (Salvia officinalis) using ethanol–water mixtures. Food Chemistry, 101, 4. 1417–1424. doi: 10.1016/j.foodchem.2006.03.050.

9. Verkhovodovoda Y., Kireyev I., Koshovyi O. Osolodchenko T. (2019). In vitro antimicrobial study of new modifications of Salvia officinalis extracts. Annals of Mechnikov Institute, 1, 31–35. doi: 10.5281/zenodo.2639493.

10. Verkhovodova Yu. V., Kireiev I. V., Koshovyi O. M. Мига M. M. (2019). Doslidzhennia antyeksudatyvnoi aktyvnosti ekstraktiv z lystia Salvia officinalis. [Study of the antiexudative activity of extracts from the leaves of Salvia officinalis] Medychna ta klinichna khimiia, 21, 4, 54–60. doi: 10.5281/zenodo.2639493. [In Ukrainian].

11. Mervić M., Bival Štefan M., Kind M., Blažeković B., Marijan M., Vladimir-Knežević S. (2022). Comparative Antioxidant, Anti–Acetylcholinesterase and Anti–α–Glucosidase Activities of Mediterranean Salvia Species. Plants, 11 (5), 625. doi: 10.3390/plants11050625.

12. Kostić M., Kitić D., Petrović M. B., Jevtović-Stoimenov T., Jović M., Petrović A. et al. (2017). Anti–inflammatory effect of the Salvia sclarea L. ethanolic extract on lipopolysaccharide–induced periodontitis in rats. Journal of Ethnopharmacology, 199, 52–59. doi: 10.1016/j.jep.2017.01.020.

13. Jasicka–Misiak I., Poliwoda A., Petecka M., Buslovych O., Shlyapnikov V. A., Wieczorek P. P. (2018). Antioxidant Phenolic Compounds in Salvia officinalis L. and Salvia sclarea L. Ecological Chemistry and Engineering S., 25(1), 133–142. doi: 10.1515/eces-2018-0009.

14. Kholov S. B., Musozoda S. M., Lytkin D. V., Yuldasheva U. P., Kukhtenko H. P. (2023). Development of a target quality profile for capsules containing a dry extract of Salvia sclarea L. grown in Tajikistan. Social Pharmacy in Health Care, 9, 4, 55–61. doi: 10.24959/sphhcj.23.309.

15. Kholov S. B., Lytkin D. V., Musozoda S. M. (2023). Study of anxiolytic activity of Tajikistan-grown Salvia sclarea dry extract. Mekhanizmy rozvytku patolohichnykh protsesiv i khvorob ta yikh farmakolohichna korektsiia : materialy VI nauk.-prakt. internet-konf. z mizhnar. uchastiu, m. Kharkiv, 16 lystop. 2023 r. Kharkiv: NFaU, 45–46.

16. Kholov S. B., Musozoda S. M., Safarzoda R. S. Yusufi S. J. (2023). Assay of the amount of flavonoids in raw Tajikistan-grown clary sage. Nalezhni rishennia dlia prohalyn u farmatsii: vidpovidno do yevropeiskykh priorytetiv : zb. nauk. pr. Mizhnar. studentskoi nauk.-prakt. konf., m. Lviv, 23–24 lystop. 2023 r. Lviv: Vyd–vo Lvivskoi politekhniky, 42–43.

17. Derzhavna Farmakopeia Ukrainy [State Pharmacopoeia of Ukraine] : v 3 t. (2015). / DP "Ukrainskyi naukovyi farmakopeinyi tsentr yakosti likarskykh zasobiv". 2–e vyd. Kharkiv: Derzhavne pidpryiemstvo "Ukrainskyi naukovyi farmakopeinyi tsentr yakosti likarskykh zasobiv", 1128 [In Ukrainian].

18. Derzhavna Farmakopeia Ukrainy [State Pharmacopoeia of Ukraine] : v 3 t. (2014). / DP "Ukrainskyi naukovyi farmakopeinyi tsentr yakosti likarskykh zasobiv". 2–e vyd. Kharkiv: Derzhavne pidpryiemstvo "Ukrainskyi naukovyi farmakopeinyi tsentr yakosti likarskykh zasobiv",732 [In Ukrainian].

19. Kholov S. B., Musozoda S. M. (2023). Evaluation of hygroscopic properties of Tajikistan-grown Salvia sclarea dry extract. Khimiia, bio- i farmtekhnolohii, ekolohiia ta ekonomika v kharchovii, kosmetychnii ta farmatsevtychnii promyslovosti : zb. materialiv XI Mizhnar. nauk.-prakt. konf., m. Kharkiv, 18–19 lystop. 2023 r. Kharkiv: NTU "KhPI", 76–77.

20. Kholov S. B., Musozoda S. M. (2023). The study of some technological properties of Salvia sclarea dry extract, obtained from Tajik raw material. The 3rd International Scientific and Practical Internet Conference: Modern Pharmacy Science and Practice, Kutaisi, Georgia, 05.09.2023-30.09. Kutaisi, 16–17.