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DETERMINATION OF PLANT COLLECTION QUALITY INDICATORS FOR SELECTING STANDARDIZATION PARAMETERS

Actuality. *In previous studies, we developed a composition of a plant collection with anti-inflammatory and immunomodulatory effects. It is relevant to study its qualitative composition with the determination of the quantitative content of the main groups of biologically active substances for selecting standardization parameters.*

The aim *is to determine numerical indicators of the quality of a plant collection for selecting its standardization parameters.*

Materials and methods. *The plant raw material was harvested in the Kharkiv and Vinnytsia regions or purchased at a pharmacy. The study of the component composition of phenolic compounds was carried out by high-performance liquid chromatography on an Agilent 1200 3 D LC System Technologies chromatograph (USA). The numerical parameters of the collection were determined according to the methods of the State Pharmacopoeae of Ukraine 2.0.*

Research results. *In the plant collection, 5 phenolcarboxylic acids, 4 flavonoids and 5 catechins were identified. Of the identified substances, the collection accumulated catechins in the largest amount: epigallocatechin and epicatechin gallate. Loss in mass upon drying was not more than 15.0%, total ash content was not more than 7.2%, extractives was not less than 28.0%. The quantitative content of total organic acids in terms of malic acid was not less than 1.2%, the total hydroxycinnamic acids in terms of chlorogenic acid was not less than 1.4%, the total polyphenols in terms of pyrogallol was not less than 3.4%.*

Conclusions. *For the first time, the component composition of phenolic compounds was studied for a plant collection with anti-inflammatory and immunomodulatory effects (5 phenolcarboxylic acids, 4 flavonoids and 5 catechins were identified), such quality indicators as weight loss upon drying, total ash, extractives were established, the quantitative content of the total organic acids, the total hydroxycinnamic acids and the total polyphenols was determined. The obtained research results will be used in the development of quality control methods for plant collection with anti-inflammatory and immunomodulatory effects.*

Key words: *plant collection, standardization, numerical indicators, quantitative determination.*

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ВИЗНАЧЕННЯ ПОКАЗНИКІВ ЯКОСТІ РОСЛИННОГО ЗБОРУ ДЛЯ ВИБОРУ ПАРАМЕТРІВ СТАНДАРТИЗАЦІЇ

Актуальність. *У попередніх дослідженнях нами було розроблено склад рослинного збору з протизапальною та імуномодуляторною дією. Актуальним є вивчення його якісного складу з визначенням кількісного вмісту основних груп біологічно активних речовин для вибору параметрів стандартизації.*

Мета роботи *– визначити числові показники якості рослинного збору для вибору параметрів його стандартизації.*

Матеріали та методи. *Сировина заготовлена в Харківській та Вінницькій областях або придбана в аптеці. Вивчення компонентного складу сполук фенольної природи проводили методом високоефективної рідинної хроматографії на хроматографі Agilent 1200 3 D LC System Technologies (США), Числові параметри збору визначали за методиками ДФУ 2.0.*

Результати дослідження. *У рослинному зборі ідентифіковано 5 фенолкарбонових кислот, 4 флавоноїди та 5 катехінів. З ідентифікованих речовин у найбільшій кількості збір накопичував катехіни: епігалокатехін та епікатехінгалат. Втрата в масі після висушування не більше ніж 15,0 %, вміст загальної золи не більше ніж 7,2 %, вихід екстрактивних речовин не менше ніж 28,0 %. Кількісний вміст суми органічних кислот у перерахунку на яблучну кислоту становив не менше ніж 1,2 %, суми гідроксикоричних кислот у перерахунку на хлорогенову кислоту – не менше ніж 1,4 %, суми поліфенолів, у перерахунку на пірогалол – не менше ніж 3,4 %.*

Висновки. *Уперше для рослинного збору з протизапальною та імуномодуляторною дією вивчено компонентний склад сполук фенольної природи (ідентифіковано 5 фенолкарбонових кислот, 4 флавоноїди та 5 катехінів), встановлені такі показники якості, як втрата у масі після висушування, загальний попіл, екстрактивні речовини, визначено кількісний вміст суми органічних кислот, суми гідроксикоричних кислот і суми поліфенолів. Отримані результати дослідження будуть використані для розробки методів контролю якості рослинного збору з протизапальною та імуномодуляторною дією.*

Ключові слова: *рослинний збір, стандартизація, числові показники, кількісне визначення.*

Actuality. Medicinal plant collections attract special attention among the range of plant medicines. Analogues of medicinal plant collections are medicinal plant tea and herbal tea. Medicinal plant collection and medicinal plant tea, according to the State Pharmacopoeia of Ukraine 2.0, are medicinal products while herbal tea is sold as a dietary supplement (Derzhavna Farmakopeia Ukrainy. V. 1, 2015).

Plant collections and herbal tea is one of the most common products, the prevalence of which is associated with ease of use (an aqueous extract is prepared from the collection for consumption as indicated in the monograph of the State Pharmacopoeia of Ukraine 2.6 "Aqueous extracts made in pharmacies"; herbal tea is brewed or infused according to the manufacturer's recommendations), suitable for any age category of consumers, exhibits a wide range of activity, is affordable, etc. (Derzhavna Farmakopeia Ukrainy. Dop. 6, 2023; Vasiuk V., 2025).

In addition, the collection or herbal tea is the basis for obtaining other medicinal products of plant origin: infusions, decoctions, tinctures, liquid, thick and dry extracts, which leads to a significant expansion of the range of such products (Derzhavna Farmakopeia Ukrainy. V. 1, 2015).

Having analyzed the market of medicinal plant preparations, we found that it is insignificant and the manufacturers of such medicines are PrJSC "Liktravy" (19 preparations), LLC "Scientific and Production Pharmaceutical Company "AIM" (5 preparations), Pharmaceutical Factory "Viola" (5 preparations), JSC "Lubnypharm" (1 preparation). The range of herbal teas is much wider (Derzhavnyi reiestr likarskykh zasobiv, 2026; Kompendium, 2026).

In previous studies, we developed a plant collection with anti-inflammatory and *immunomodulatory* effects/ it consist of leaves of *Corylus avellana*, roots of *Rosa majalis* or Rosa canina, roots of *Arctium lappa*, herb of *Polygonum aviculare*, herb of *Solidago canadensis*, flowers of *Calendula officinalis* and rhizomes with roots of *Inula helenium* in the ratio 2:2:2:1:1:1:1. An infusion, tincture and liquid extract were obtained from this collection and their *immunomodulatory* activity was proven. Also an anti-inflammatory activity was established in the zymosan edema model for the liquid extract (Fedchenkova Yu., 2015). The collection includes pharmacopoeial and non-pharmacopoeial plant raw materials, which contain phenolic compounds, organic acids, fatty acids, vitamins and minerals (Yosri N., 2023; Shahane K., 2023; Oproshanska T., 2021; Jang C., 2024; Masullo M., 2021; Wei R., 2026). Therefore, it is advisable to study the qualitative composition of the collection with the determination of the quantitative content of the main groups of biologically active substances to select the parameters of its standardization.

The aim is to determine numerical indicators of the quality of a plant collection for selecting its standardization parameters.

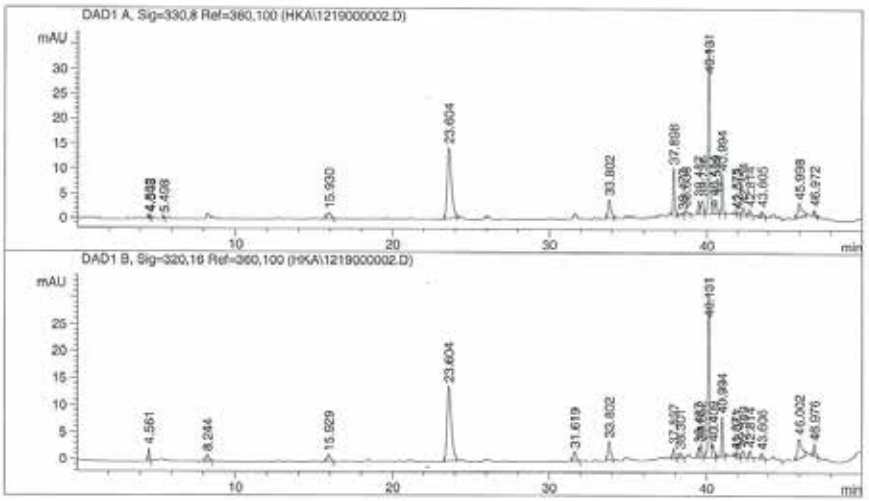
Materials and methods. The study of the component composition of phenolic compounds was carried out by high-performance liquid chromatography on an Agilent 1200 3 D LC System Technologies chromatograph (USA) which is equipped with a G1322A flow-through vacuum degasser, a G13111A 4-channel low-pressure gradient pump, a G1329A autosampler (automatic injector), a G 1316A column thermostat, a G1315C diode array and a G1362A refractometric detector (Marchyshyn S., 2024; Budniak L., 2024). The numerical parameters of the collection were determined according to the methods of the State Pharmacopoeia of Ukraine 2.0: loss on drying, total ash content, content of extractive substances, quantitative content of total polyphenols in terms of pyrogallol according to the monograph *"Millefolii herba*^{N}*"*, the total hydroxycitric acids in terms of chlorogenic acid according to the monograph *"Urticae folium"* (Derzhavna Farmakopeia Ukrainy. Dop. 5, 2021; European Pharmacopoeia 11th ed., 2026; Derzhavna Farmakopeia Ukrainy. Dop. 1, 2016).

Results of the study. Since the main group of biologically active substances of the collection are compounds of phenolic nature, the study of the component composition of phenolcarboxylic acids, flavonoids and catechins is relevant. The results of the study are presented in table and Fig. 1.

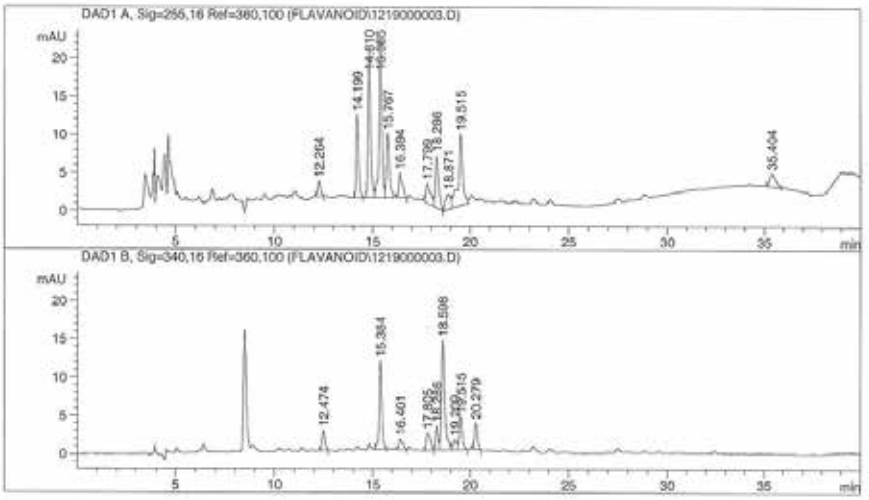
According to the table, 5 phenolcarboxylic acids, 4 flavonoids and 5 catechins were identified in the plant collection. Of the identified substances, the collection accumulated catechins in the largest amount (96% of the total of identified compounds of phenolic nature). Of the identified catechins, the content of epigallocatechin and epicatechin gallate prevailed, which, respectively, amounted to 39% and 29% of the total of identified catechins. Of the phenolcarboxylic acids in the collection, the content of gallic and rosmarinic acids prevailed, and the content of chlorogenic acid was slightly inferior to them. The lowest content of flavonoids was 1% of the total of identified phenolic compounds. Of the identified flavonoids, the highest content is inherent in quercetin-3-D-glucoside (58% of the total of identified flavonoids).

Therefore, given the quantitative content of the identified phenolic components, the Identification C in quality control methods of plant collections it is advisable to do by determining the presence of hydroxycinnamic acids and catechins, using such marker substances as rosmarinic or chlorogenic acids and epicatechin or epicatechin gallate, respectively.

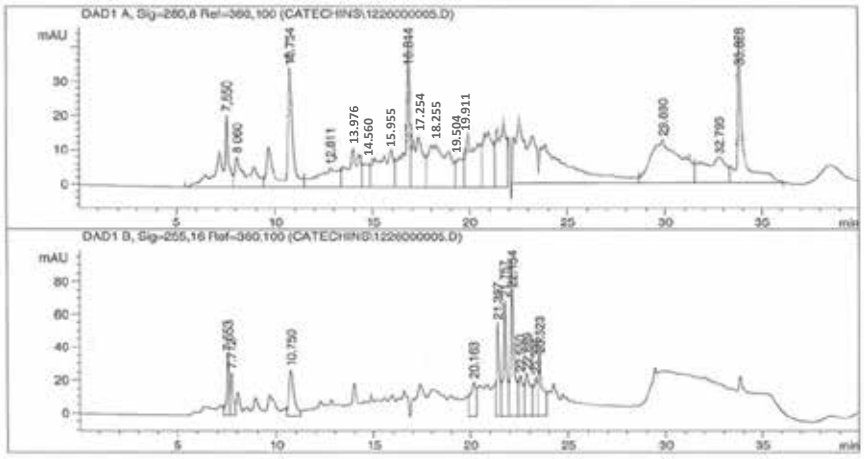
The results of determining numerical indicators in 3 collection series are shown in Fig. 2.



A



B



C

Fig. 1. HPLC chromatograms of the collection: A – phenolcarboxylic acids, B – flavonoids, C – catechins

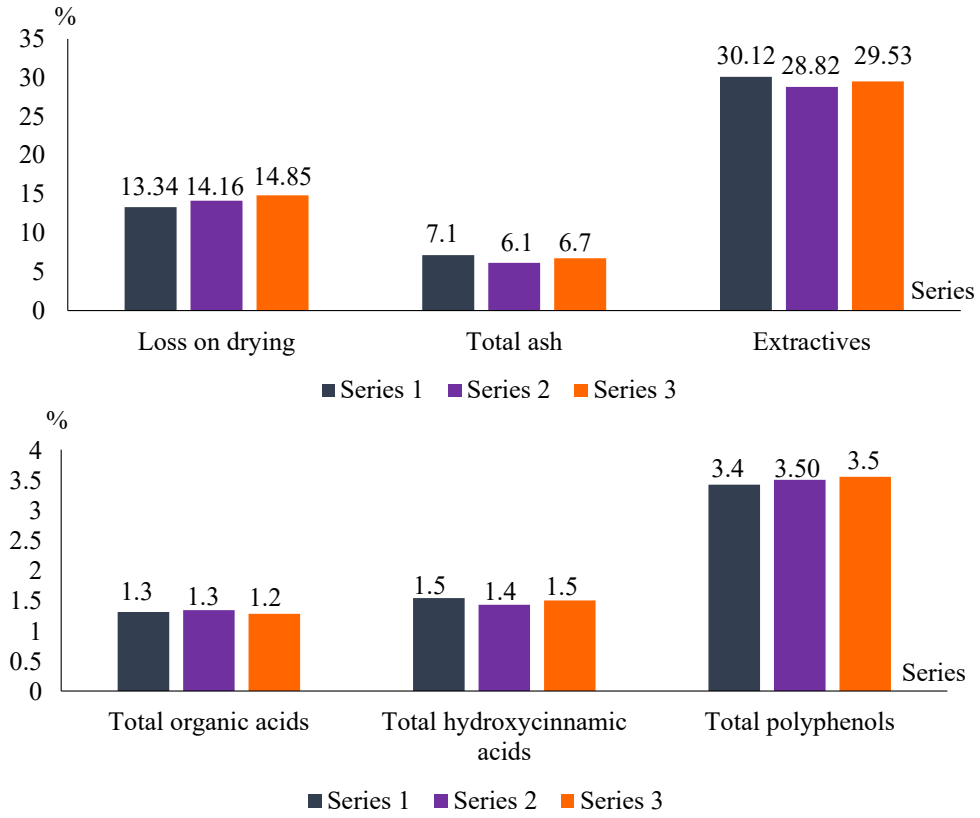


Fig. 2. Numerical indicators of the collection: loss on drying, total ash, extractives, quantitative content of total organic acids, total hydroxycinnamic acids and total polyphenols

Table

Component composition of phenolic compounds in plant collection

Substance	Holding time	Content, μg/g
Phenolcarboxylic acids		
Gallic acid	10.754	50.74
Chlorogenic acid	23.604	39.97
Rosmarinic acid	40.131	43.52
p-Coumaric acid	31.619	1.18
Ferulic acid	33.802	4.52
Flavonoids		
Luteolin	18.286	11.54
Quercetin-3-D-glucoside	19.52	29.98
Coumarin	35.404	6.89
Apigenin	40.994	2.89
Catechins		
Halocatechin	13.976	640.10
Epigallocatechin	16.844	1823.37
(+)-Catechin	18.255	244.25
Epicatechin	19.911	650.19
Epicatechin gallate	29.880	1349.15

When determining the loss on drying for 3 series of collection, it was found that this indicator fluctuated slightly and did not exceed 15.0%. Fluctuations in the content of total ash in 3 series were insignificant and did not exceed 7.2%. The yield of extractives also fluctuated slightly and was not less than 28.0%. When determining the quantitative content of total organic acids, total hydroxycinnamic acids and total polyphenols in 3 series of collection, fluctuations in the indicators from 0.06% (for the total organic acids) to 0.13% (for the total polyphenols) were noted. At the same time, the quantitative content of total organic acids in terms of malic acid was not less than 1.2%, the total hydroxycinnamic acids in terms of chlorogenic acid was not less than 1.4%, the total polyphenols in terms of pyrogallol was not less than 3.4%.

Therefore, when developing methods for quality control of plant collection, it is rational to standardize it by quantitative determination of the content of the total hydroxycinnamic acids in terms of chlorogenic acid and by the content of the total polyphenols in terms of pyrogallol.

Conclusions

1. For the first time, the component composition of phenolic compounds was studied for a plant collection with anti-inflammatory and immunomodulatory

effects (5 phenolcarboxylic acids, 4 flavonoids and 5 catechins were identified), such quality indicators as loss on drying, total ash, extractives were established, and the quantitative determination of the total organic acids, the total hydroxycinnamic acids and the total polyphenols was carried out.

2. As a result of the work to develop quality control methods in the Identification C section, it is advisable to use the marker substances rosmarinic and chlorogenic acids or epicatechin or epicatechin gallate, since the content of these compounds was the highest among the identified phenolic compounds.

3. In the Testing section, we suggest indicating: loss on drying not more than 15.0%, total ash content not more than 7.2%, extractives not less than 28.0%. In the Quantitative determination section, determine the quantitative content of the total hydroxycinnamic acids in terms of chlorogenic acid (not less than 1.4%) and the total polyphenols in terms of pyrogallol (not less than 3.4%).

4. The results of the study will be used in the future to develop quality control methods for plant collection with anti-inflammatory and immunomodulatory effects.

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