UDC 615.322:582.975:615.453.4.014.2

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To cite this article: Hudz N., Rybak O., Yakymiv O., Filipska A., Shapovalova N., Korytniuk O., Korytniuk R. (2025). Naukove i eksperymentalne obgruntuvannia skladu i aptechnoi tekhnolohii kapsul iz poroshkom koreniv valeriany [Scientific and experimental justification of the composition and pharmacy technology of capsules with Valerian root powder]. *Fitoterapiia. Chasopys – Phytotherapy. Journal, 4,* 250–261, doi: https://doi.org/10.32782/2522-9680-2025-4-250

SCIENTIFIC AND EXPERIMENTAL JUSTIFICATION OF THE COMPOSITION AND PHARMACY TECHNOLOGY OF CAPSULES WITH VALERIAN ROOT POWDER

Actuality. *The development of herbal medicinal products with a calming effect is a relevant area of the research for the prevention and treatment of human neurological disorders. Herbal preparations based on finely ground medicinal plant raw materials in the form of tablets, capsules and granules are increasingly being used in medicine. Their technology has many technical and economic advantages, in particular, the absence of extraction, evaporation and purification stages. Therefore, the development of herbal medicinal products with powdered herbal substances in tablets and capsules of industrial manufacture and capsules of pharmacy production, is a promising direction of the research in the field of phytopharmacology and pharmaceutical technology.*

The study aims to justify the composition of hard capsules with valerian root powder, to develop the technology of their manufacture in pharmacy conditions, and to propose fast procedures for the quality control of the filled capsules based on non-destructive testing, to work out a procedure for the identification of the capsule content using a microscopic method, which can be considered to be the main identification of the developed capsules produced in large quantities in a pharmacy.

Material and methods. *Valerian roots were the main material of the studies. Among the used methods were the technological method of filling capsules, the fraction analysis of raw materials, the method of measurement of tapped density, the nondestructive method of the determination of the average content of the filled capsules, the microscopic method for the evaluation of the content of the filled capsules, and the method of the determination of time of the degradation of capsules.*

Research results. *The composition and pharmacy technology of sedative capsules with valerian root powder of 350 mg were proposed. Other dosages like these 500 mg in capsules 0 or 700 mg in capsules 00 also are possible to incapsulate with considering a volume of a capsule and tapped density of the powder. The same technology can be used for them. Fractional analysis of the raw material before grinding was performed. A fraction of 0,5 mm or less was selected for filling the capsules. The consumption coefficient for the valerian root powder was determined, which should be 1,03–1,045 to compensate for the powder losses during encapsulation. A non-pharmacopoeial non-destructive method for determining the average mass of capsule contents was developed, which is accepted for producing pharmacies. It was established that the capsule samples manufactured using the above technology met the requirements of the specification in terms of appearance, average mass of a capsule, and capsule contents, and the time of degradation of capsules. According to the results of microscopic evaluation of the content of the capsules, it was established that the valerian root powder met the requirements of the State Pharmacopoeia of Ukraine to identification B (monograph "Valerianae radix roots").*

Conclusion. *The composition and pharmacy technology of capsules with powdered Valerian roots and the methodology of the preparation of capsules in pharmacy conditions were proposed.*

Key words: *hard capsules, valerian root powder, technology of preparation, pharmaceutical manufacturing, stress.*

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Бібліографічний опис статті: Гудзь Н., Рибак О., Якимів О., Філіпська А., Шаповалова Н., Коритнюк О., Коритнюк Р. (2025). Опрацювання складу й аптечної технології капсул із порошком коренів валеріани. *Фітотерапія. Часопис, 4,* 250–261, doi: https://doi.org/10.32782/2522-9680-2025-4-250

НАУКОВЕ Й ЕКСПЕРИМЕНТАЛЬНЕ ОБҐРУНТУВАННЯ СКЛАДУ Й АПТЕЧНОЇ ТЕХНОЛОГІЇ КАПСУЛ ІЗ ПОРОШКОМ КОРЕНІВ ВАЛЕРІАНИ

Актуальність. *Розроблення рослинних лікарських засобів із заспокійливою дією є актуальним напрямом досліджень для профілактики та лікування неврологічних розладів людини. Рослинні препарати на основі дрібноподрібненої лікарської рослинної сировини у формі таблеток, капсул і гранул все частіше використовують у медицині. Їх технологія має багато технічних і економічних переваг, зокрема відсутність стадій екстракції, випаровування і очищення. Тому розроблення рослинних лікарських засобів з порошкоподібними рослинними речовинами в таблетках і капсулах промислового виробництва та капсулах аптечного виробництва є перспективним напрямом досліджень у галузі фітофармакології та фармацевтичній технології.*

Мета дослідження *– обґрунтування і дослідження складу твердих капсул з порошком кореня валеріани, розроблення технології їх виготовлення в аптечних умовах, пропонування швидких процедур контролю якості наповнених капсул, на основі неруйнівного контролю визначення середньої маси вмісту наповнених капсул, розроблення процедури ідентифікації вмісту капсули за допомогою мікроскопічного методу, який можна вважати основним методом ідентифікації розроблених капсул, які виробляють у великих кількостях в аптеці.*

Матеріал і методи. *Корені валеріани були основним матеріалом досліджень. Серед використаних методів були: технологічний метод наповнення капсул, фракційний аналіз сировини, метод вимірювання насипної щільності порошку, неруйнівний метод визначення середнього вмісту наповнених капсул, мікроскопічний метод для оцінювання вмісту наповнених капсул, метод визначення часу розпаду капсул.*

Результати дослідження. *Було запропоновано склад і технологію капсул седативної дії з порошком кореня валеріани по 350 мг. Інші дозування також можна розробити, з урахуванням об'єму капсули й насипної щільності порошку. Для них можна використовувати цю ж технологію. Було проведено фракційний аналіз сировини перед подрібненням. Для наповнення капсул було обрано фракцію розміром 0,5 мм або менше. Визначено коефіцієнт витрати порошку кореня валеріани, який має становити 1,03–1,045 для компенсації втрат порошку під час капсулювання. Розроблено нефармакопейний неруйнівний метод визначення середньої маси вмісту капсул, який прийнятний для виробничих аптек. З'ясовано, що зразки капсул, виготовлені за вищевказаною аптечною технологією, відповідають вимогам опрацьованої специфікації за зовнішнім виглядом, середньою масою капсули та середнім вмістом капсул, а також часом розпаду капсул. За результатами мікроскопічної оцінки вмісту капсул встановлено, що порошок кореня валеріани повністю відповідав вимогам Державної фармакопеї України до ідентифікації В (монографія «Корені валеріани»).*

Висновок. *Запропоновано склад і аптечну технологію капсул з порошком коренів валеріани, методологію виготовлення капсул в умовах виробничої аптеки.*

Ключові слова: *тверді капсули, порошок коренів валеріани лікарської, технологія виготовлення, аптечне виготовлення, стрес.*

Introduction. Actuality. The World Health Organization has described stress as a "21st century health epidemic", as 45% of all diseases are related to stress (Rybachuk, 2018; Savelyuk, 2022). Stress hurts people's performance, impairs mental concentration of people, exhausts the body and thus accelerates people's fatigue, reduces their immunity and performance, causes difficulties in making decisions, the deterioration of social reationships, including with the close environment, increases the chances of different conflicts, and reduces level of creative thinking. Finally, stress can lead to many serious diseases (diabetes, cardiovascular diseases, gastric ulcer, affective disorders, aging, etc.) (Siczek-Przybyła and Wyszyńska, 2014; Jung, 2014; Predko, 2022).

In Ukraine, the level of stress is increasing annually (Predko and Somova, 2022). It was primarily due to the COVID-19 pandemic, which was the cause of the depletion of physical and mental health of people because of this disease itself, the loss of members of family, relatives and job, prolonged isolation of people from society, traveling, etc. The conducted studies have proven that in 2021 at least two-thirds of all the respondents experienced a stressful situation (Savelyuk, 2022; Marchshyn, 2025). No sooner had Ukrainians eliminated significant quarantine restrictions and the consequences of COVID-19 than they were forced to enter the terrible realities of the war (russian atrocities, forced displacement both within the country itself and abroad, constant missile attacks of Ukrainian civilian and energy infrastructure, loss of relatives, blackouts, etc.) (Predko, 2022; Savelyuk, 2022). The full-scale russian war against Ukraine has led to a significant deterioration of the stress situation, and Ukrainians have been already living for more than 36 months under a high level of constant stress. The human psyche can reach a stage of exhaustion, at which there is a decline in strength, maladaptation begins, and the human body runs out of resources to overcome stress (Predko, 2022). A symptomatic solution to this problem is based on the development of herbal medicinal products that combine a high degree of safety with a mild therapeutic effect, in particular with the regulation of emotions considering the lasted administration (Marchshyn, 2025). According to the cognitive concept of Lazarus and Folkman, overcoming stress is initiated and controlled by a person's cognitive assessment (Siczek-Przybyła, 2014). The Valerian administration significantly reduced increased plasma corticosterone levels after both physical and psychological stress (Jung, 2014).

The development of herbal medicinal products with a calming effect is a relevant area of the research for the prevention and treatment of human neurological disorders, including stress situations (Marchshyn, 2025).

Herbal preparations based on finely ground medicinal plant raw materials in the form of tablets, capsules and granules are increasingly being used in medicine (Modern pharmaceutical technologies, 2015; Sznitowska, 2017; Spiridonova, 2019; Vasiuk, 2025). Their technology has many technical and economic advantages, in particular, the absence of extraction, evaporation and purification stages (Sznitowska, 2017), which are available in the technology of extraction preparations. Moreover, the development of herbal preparations is one of the current research areas in phytopharmacology and pharmaceutical technology (Spiridonova, 2019; Ostrovsky, 2024). In addition, the list of herbal medicinal products in capsules containing powdered herbal substances is quite limited and needs to be expanded (Spiridonova, 2019), which can be achieved through their manufacture in producing pharmacies. Therefore, the development of herbal medicinal products with powdered herbal substances in tablets and capsules of industrial manufacture and capsules of pharmacy production is a promising direction of the research in the field of pharmaceutical technology.

Valerian roots are a pharmacopoeial herbal substance (State Pharmacopoeia of Ukraine (SPU, 2018), containing bicyclic monoterpenoids, iridoids (valepotriates – valtrate and dihydrovaltrate), essential oil (bornyl isovalerianate, borneol, bornyl acetate, camphene, limonene, pinene, isovaleric acid, etc.), sesquiterpenes, lignans, alkaloids (valerine and hatinine), flavonoids (Chen, 2015). Gamma-aminobutyric acid (GABA), tyrosine, arginine and glutamine have also been identified (Nandhini, 2022). The essential oil of valerian roots has an antioxidant, sedative and vasorelaxant effects. Valepotriates have a regulatory effect on the autonomic nervous system. Although more than 150 components were identified in the chemical composition of valerian roots essential oil, none of them was individually responsible for their pharmacological action (Valeriana officinalis, 2004; Chen, 2015). The mechanisms of the pharmacological action of valerian roots have not been fully studied. It is assumed that there is a synergistic effect of their various components. Biologically active substances (BAS) of valerian roots interact with neurotransmitters, such as GABA, and cause a dose-dependent release of GABA. BAS of valerian roots also inhibit the induced enzymatic decomposition of GABA in the brain (Valeriana officinalis, 2004).

Among the features of the pharmaceutical development of medicinal products in hard capsules are the study of the physicochemical and technological properties of the active substance, the choice of the size of a hard capsule, which is determined by the volume of an empty

capsule, the development of the technology (grinding a crushed herbal substance, sieving of a powder, the choice of a particle size, the method of filling capsules, the study of the compatibility of active substances with excipients and capsule material, etc.) (Modern pharmaceutical technologies, 2015; Rybachuk, 2018; Spiridonova, 2019; Semchenko, 2020).

By and large, the technology of encapsulation of herbal substances in the form of powder or granulate is easier compared to tableting. If tablets or capsules contain crushed herbal substances, the required dose may be higher and it may be necessary to use even several tablets or capsules per day compared to solid dosage forms with extracts, as dry extracts are produced at ratio of a herbal substance to a final product at a ratio at least 2 to 1 or even 10 to 1. One more feature of capsules and tablets with powdered herbal substances is that active substances are extracted in the gastrointestinal tract, which is a prerequisite for considering the particle size of the powder in the pharmaceutical technology. The administration of powdered herbal substances without selective preliminary extraction of BAS is justified by the fact that powdered herbal substances provide a synergistic effect of the entire complex of BAS (Sznitowska, 2017).

The study aims to substantiate the composition of hard capsules with valerian root powder, to develop the technology of their manufacture in pharmacy conditions, and to propose fast procedures for the quality control of the filled capsules based on non-destructive testing, to work out a procedure for the identification of the capsule content using a microscopic method, which can be considered to be the main identification of the developed capsules produced in large quantities in a pharmacy.

Materials and research methods. To study the composition and technology of hard capsules of crushed valerian roots from Pharmaceutical Factory "Viola" (Ukraine) were used, as well as the hard gelatine capsules of size 1 (volume 0,48–0,50 ml).

A high-speed knife (blade) mill was used to grind the roots of valerian. The fractional composition of the raw material and ground raw material was determined using a set of sieves with aperture sizes of 5, 4, 3, 2, 1, 0,5 and 0,25 mm.

The tapped density of valerian root powder was determined by determining the mass of the sample that occupies a certain volume in the cylinder after tapping the cylinder with the powder on a hard surface several times to a constant mark of a volume (Cabbibo, 2025).

The capsules were filled using a manual capsule machine Eprus® (Poland) by pressing. The appropriate amount of the powder was applied to the plate of the pharmacy capsule machine, and the capsule bodies were filled, trying to evenly distribute the powder on the surface of the plate. The powder was pressed into capsules with a special punch. The powder remained on the plate was redistributed on the surface again and crammed into the capsules with a special punch.

In laboratory batches 1 and 2, a consumption factor of 1,030 and 1,045, respectively, for valerian root powder was taken into consideration. The powder with a fraction of less than 0,5 mm was used to fill hard capsules of size 1. At the tapped densities of 0,720 and 0,753 g/ml for a dose of 0,35 g, the volume of the powder in one capsule was 0,486 and 0,465 ml, respectively.

Procedure for the determination of the average mass of capsule contents (non-pharmacopeial procedure). Twenty filled capsules were selected. The filled capsules were weighed each individually. Then the average mass of the filled capsule was calculated. In addition, twenty empty capsules from the batch of the capsules from which the preparation was manufactured were weighed. The average mass of the empty capsule was found. The mass of the contents of each capsule was calculated from the difference between the weighed filled capsule and the average mass of an empty capsule, from the batch of which the preparation was prepared.

The time of capsule degradation was performed according to the monograph 2.9.1 of the State Pharmacopeia of Ukraine (the SPU) (The SPU, vol. 1).

Research results and their discussion. The first stage of pharmaceutical development is the justification of the choice of the active substance, its dose and dosage form. Based on the published data of the preclinical studies on rats, there was an effect of valerian roots on increasing the concentration of serotonin and norepinephrine, reducing in the concentration of their corresponding metabolites in the homogenates of the hippocampus and amygdala, which are most vulnerable areas to stress and the main targets for corticosterone, serotonin and norepinephrine (Jung, 2014). Moreover, according to the European Union (the EU) monograph, the sedative effect of valerian root preparations, which was known on the basis of empirical data, was confirmed in controlled clinical trials. Dry extracts of valerian root prepared in 70% ethanol (v/v) at the recommended dosage improved sleep latency and quality. According to this monograph, a single dose of a powdered plant raw material is 0,3–2,0 g. This single dose is used up to 3 times a day for the relief of mild symptoms of mental stress. A single dose and a previous dose in the evening, if necessary, is used for aiding sleeping 30 minutes before bedtime (European Union herbal monograph on *Valeriana officinalis* L., radix, 2016). For our studies we chose the first dose 0,35 g of valerian root powder. In

addition, such a dose is in the composition of the authorised product in Ukraine (State Register of Medicinal Products of Ukraine). However, from available information nothing is known about the particle size of powdered valerian root in a capsule. Moreover, among the advantages of our product is the absence of hydrophobic excipients such as lubricants. In addition, further studies will be directed at the development of the capsules with higher doses of powdered roots of Valerian.

Since capsules are characterized by its content in millilitres, a set of pharmaceutical factors should be considered when developing the composition and technology of capsule preparations. Among them is the tapped density of the powder, the available capsule size, and the equipment for filling capsules in laboratory or pharmacy conditions.

For the studies we determined the particle size of the raw material. For this purpose, 50,2 g of the crushed Valerian roots were sieved through a set of the sieves with the following hole sizes: 5, 4, 3, 2, 1, 0,5 and 0,25 mm according to the pharmacopeial procedure 2.9.12 (The SPU, vol. 1). The obtained results of determining the fractional composition of crushed valerian roots were as follows: 3,1% of the fraction 0,5–1,0 mm, 69,3% of the fraction 1,0–2,0 mm and 27,5% of the fraction 2,0–3,0 mm. After grinding about 50% of the taken mass were grinded to the fraction less than 0,5 mm, which was chosen for the preparation of capsules (Rybachuk, 2018). It is necessary to note that there are companies in Ukraine which sell powder of herbal raw materials in order to avoid grinding in producing pharmacies.

To fill capsules with powders in a production pharmacy, we used the method of filling capsules by cramming a powder, which is usually used for manual filling of capsules when using the simplest semi-automatic machines. Considering the tapped density of the valerian root powder and the required dose, we chose the optimal capsule size – 1, the volume of which ranged from 0,48 ml to 0,50 ml. The valerian root powder was placed in a mortar and mixed. After mixing, the powder was applied to the surface of the capsule machine plate, into which the lower parts of the capsules (capsule bodies) had been previously inserted, and was distributed as evenly as possible on the surface of the plate. The powder mass was pressed into hard capsules with a punch. The powder remained on the plate between the holes for the capsule bodies was again crammed into the required number of capsules with the punch. Then the upper and lower parts of the capsules were joined, and the preparation in capsules was obtained.

According to the requirements of the monograph of the SPU for capsules, this dosage form must meet the test for mass uniformity for a unit of dosage (The SPU, vol. 1). However, the pharmacopeial method, in our opinion, is unsuitable for laboratory studies, as well as for pharmacy production, primarily because of the destruction of capsules, i.e. this method of quality control is destructive. Secondly, this method involves weighing 20 capsules, which is also not entirely suitable for laboratory or pharmacy small batches (a significant part of the batch can be subjected to destructive control). That is, the pharmacopeial method of checking the mass of the content of capsules is suitable for the industrial manufacture of capsules, when a batch consists of several or even tens of thousands of filled capsules. For this reason, the procedure for determining the mass uniformity for a unit of dosage form without destroying the capsules is proposed. In this way, filled capsules can be used for other studies for assessing the composition, chemical analyses, pharmaco-technological tests, biological studies, etc. in the case of developing laboratory technology or the capsules can be dispensed to the patient in the case of pharmacy production. The average mass of the empty capsules was 77,4 mg ± 1,36 mg and is within the range declared by the capsule manufacturer (69–84 mg or 76,5 mg±9,8%). The deviation from the average mass was insignificant (1,76%) taking into consideration the analysis uncertainty analysis (3,2% at the range of 90–110%) (The SPU, vol. 1).

The experimental data also confirmed the view of point that the correct selection of the capsule size is of decisive importance in the development of the composition and technology of hard capsules. The calculated mass of the content was in the range of 300,7 mg to 358,9 mg ($X_{average}$ ± SD = 341,5 mg ± 12,93 mg or 341,5 mg ± 3,79%), while the mass of chosen 20 capsules was in the range of 378,1 mg to 436,3 mg ($X_{average}$ ± SD = 418,9 mg ± 12,93 mg or 418,9 mg ± 3,09%). Only 1 capsule out of 20 did not meet the requirements, but the deviation from the average mass of the capsule content did not exceed ±15%. Thus, the capsules were uniformly filled with the powder and, accordingly, the deviation from the average mass of the capsule content for 20 capsules is within the permissible range: the deviation for two capsules should not exceed 15%, and for the other 18 capsules should not exceed ±7,5%. The result of this experiment was that there were losses in the average mass of the capsule, namely, with a calculation of 350 mg, an average mass of 341,5 mg, which can be explained by losses due to the fact that part of the powder went into the pores of the mortar and out of the capsules during their filling, which must be taken into consideration when preparing capsules. That is, the consumption factor for valerian root powder of 1,030 was slightly low to provide the stated

capsule content (350 mg). However, it provided an average mass of content that was in the range from 95 to 105% of the stated capsule content (350 mg).

Fig. 1 and 2 show deviations of 20 capsules from the average content of the capsule and stated content of a capsule.

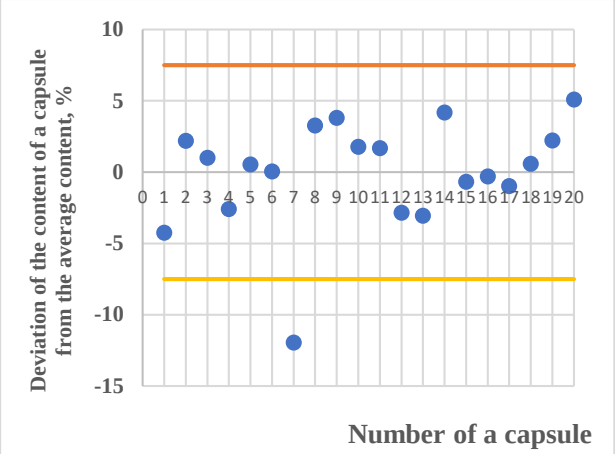


Fig. 1. Deviations of the content of 20 capsules from the average content (341,5 mg)

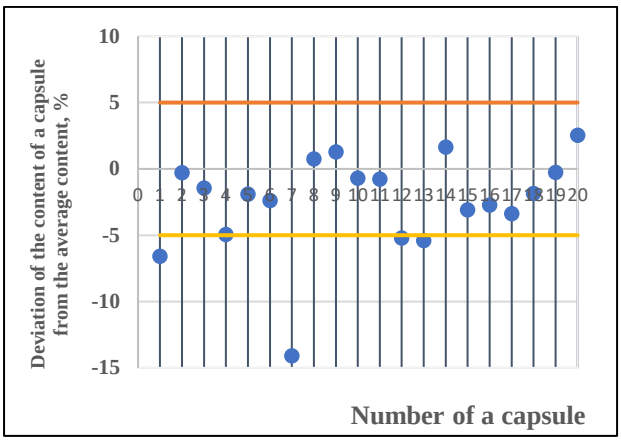


Fig. 2. Deviations of the content of 20 capsules from the stated content (350 mg)

Fig. 2 demonstrates that the deviations from the stated content do not requirements of the Guide CT-H МОЗУ 42-4.5:2015. Some capsules had the deviations which exceeded ±5% from the stated content.

Similar results were obtained in laboratory batch 2, using the consumption factor of 1,045. It was shown that at this consumption coefficient of the valerian root powder, the average mass of the content was 354,4 mg or 101,26% of the stated dose (350 mg). The calculated mass of the content was in the range of 335,6 mg to 358,9 mg ($X_{average}$ ± SD = 354,1 mg ± 14,84 mg or 354,1 mg ± 4,19%), while the mass of chosen 20 capsules was in the range of 413 mg to 465,1 mg ($X_{average}$ ± SD = 431,5 mg ± 14,84 mg or 431,5 mg ± 3,44%).

The consumption coefficients for valerian root powder of 1,030 and 1,045 provided a deviation of the average content of capsules in accordance with the requirements of the specification (±5% from the stated content).

Other dosages like these 500 mg in capsules 0 or 700 mg in capsules 00 also are possible to prepare with considering a volume of a capsule and the tapped density of the powder. The same technology can be used for them. Our previous studies demonstrated that it was necessary to pay attention to a tapped density and a size of capsules in order to prepare the preparate which would meet the requirements of the specification. In addition, it is worth mentioning that a tapped density of the powdered Valerian roots can be different for different batches of the powder.

In our opinion, another important indicator of quality is the identification of the content of capsules, especially in conditions of small-scale production. To identify the content of the hard capsules, it was proposed to determine the characteristic diagnostic microscopic features of valerian root powder. The study was carried out on the surface micropreparations of the powder using a microscope of the Biolam Lomo brand with lenses x8, x40. The microscopic features were recorded using a 5,0 mpx MICROmed CCD video camera, enlarging the image on the camera monitor by 20–250%. In the process of the microscopic analysis, the features of the anatomical structure of the powder elements were studied, examining them first at low (10x8), then at high (10x40) magnification of the microscope in accordance with the monograph SPU 2.0 “Microscopic study of medicinal plant raw materials” (2.8.23) (The SPU, vol. 1).

Under the microscope, after using the chloral hydrate solution R, the following diagnostic structures were found in the studied powder: fragments of integumentary tissue, conductive, mechanical elements, the main parenchyma of the cortex and the central axial cylinder with a large number of starch grains, which are present in all the preparations in groups and singly in large quantities both in the cells and outside them.

The fragments of integumentary tissue with brown content are often found. The fragments of the integumentary tissue of the root have the clearly expressed root hairs (fig. 3-a), which were often found in the micropreparations separately, especially their fragments (fig. 3-b and fig. 3-c).

Fragments of the parenchyma of the cortex are visible, which are filled with a large number of starch grains (fig. 4).

image magnification on the camera monitor 200% in the micropreparation (80 x) (a)

image magnification on the camera monitor 50% in the micropreparation (400 x) (b and c)

Fig. 3. Root hairs

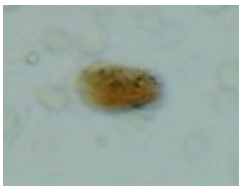
Fig. 4. Cortical parenchyma cells with numerous starch grains in a micropreparation (80 x) (image magnification on the camera monitor 100%)

There are bright brown or bright yellow cells of the hypodermis of the roots with essential oil (fig. 5). The presence of the essential oil was observed in all the micropreparations in the form of bright yellow and bright brown spots, which acquire an orange colour after treating the preparation with Sudan III solution (fig. 6).

50%

1

Fig. 5. Fragment of hypodermis with essential oil in a micropreparation (80 x) (image magnification on the camera monitor 50-150%)



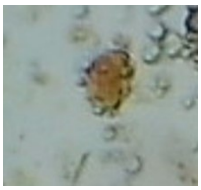


Fig. 6. Drops of essential oil in a micropreparation (80 x) (image magnification on the camera monitor 150%)

Fragments of mechanical and conductive tissues of the lower part of the stem are occasionally found as well (fig. 7).

The distinct fragments of tangentially elongated endoderm cells with uneven walls were often observed (fig. 8).

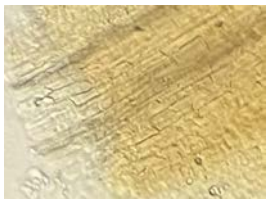


Fig. 7. Fragment of the stem base in a micropreparation (80 x) (image magnification on the camera monitor 150%)

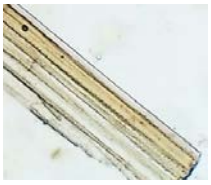
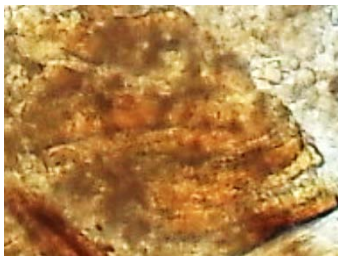


Fig. 8. Endoderm cells in a micropreparation (80 x) (image magnification on the camera monitor 100%)

The conducting elements are often found both in the form of groups of vessels with lignified wood parenchyma and wood fibres (fig. 9–10), and singly in the form of separate fragments of various vessels (fig. 11).



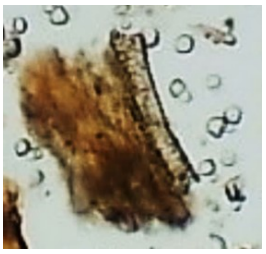
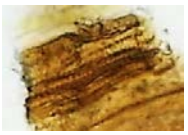
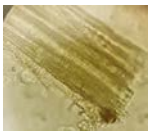


Fig. 9. Group of vessels with lignified wood parenchyma in a micropreparation (80 x) (image magnification on the camera monitor 100%)

100%



150%



100%

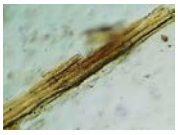


Fig. 10. Group of vessels with fibers in a micropreparation (80 x) (image magnification on the camera monitor 100–200%)

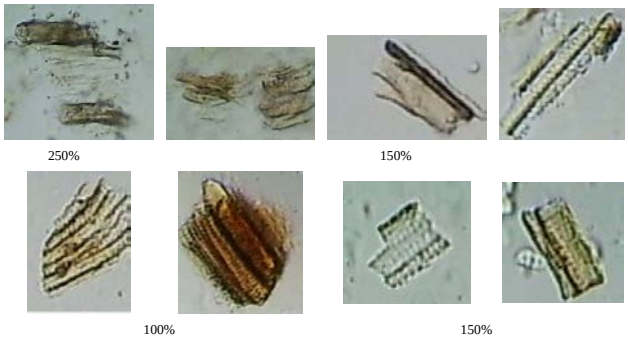


Fig. 11. Vascular fragments in a micropreparation (80 x) (image magnification on the camera monitor 100-250%)

Most often, fragments of vessels with reticular thickening and bordered pores are visible (fig. 12), they have a larger diameter than others, annular (fig. 13) and spiral (fig. 14) vessels are also found.

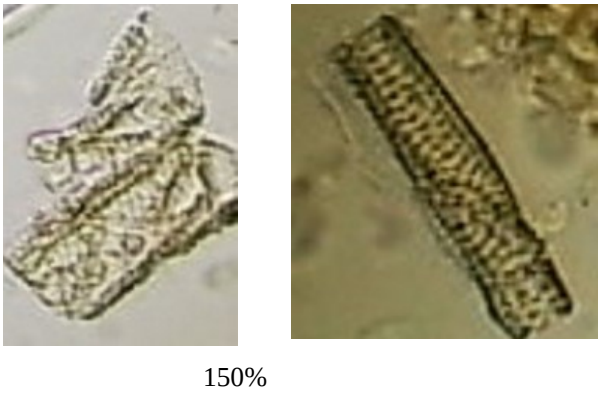


Fig. 12. Fragments of a reticular vessel with bordered pores in a micropreparation (80 x) (image magnification on the camera monitor 100-150%)

Fig. 13. Fragment of an annular vessel in a micropreparation (80 x) (image magnification on the camera monitor 150–250%)

Fragments of fibers with thickened walls are found in groups and more often as single fragments of torn fibers (fig. 15).

Clearly visible cells of the main parenchyma, elongated with somewhat thickened membranes, often have a resinous content (fig. 16). Sclereids (stony cells) are found in groups both on the transverse and longitudinal sections, which have thick membranes and narrow, furrow-branched cavities (fig. 17–18). Also, occasionally there are groups of large thin-walled sclereids of the stem base (fig. 19).

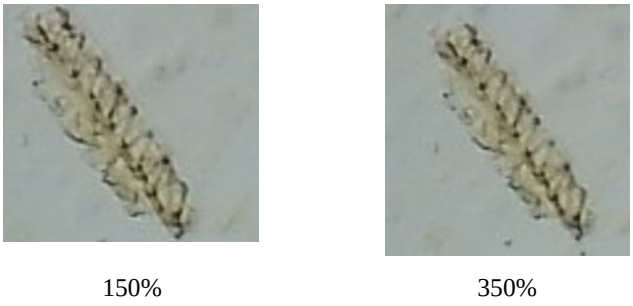


Fig. 14. Fragment of a spiral vessel in a micropreparation (80 x) (image magnification on the camera monitor 150-350%)

Fig. 15. Fibers in a micropreparation (80 x) (image magnification on the camera monitor 100-150%)

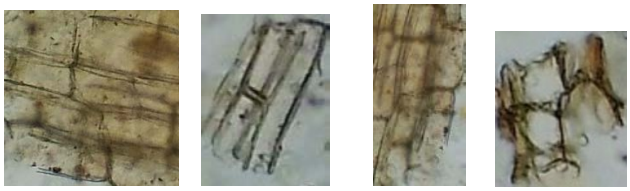


Fig. 16. Cells of the main parenchyma in a micropreparation (80 x) (image magnification on the camera monitor 100-150%)

Fig. 17. Stone cells of roots and rhizomes (sclereids with thin membranes) in a micropreparation (80 x) (image magnification on the camera monitor 150%)

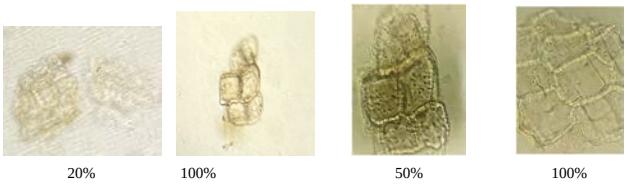


Fig. 18. Stone cells of roots and rhizomes (sclereids with thick membranes) (image magnification on the camera monitor 20–100%)

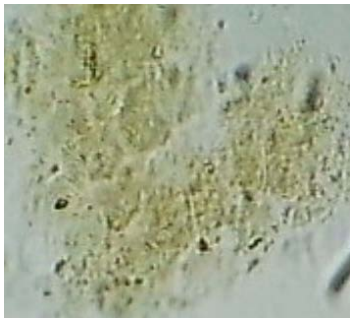


Fig. 19. Stone cells of the stem base in a micropreparation (80 x) (image magnification on the camera monitor 150%

Under the microscope, after using a 50% (v/v) solution of glycerol R, numerous starch grains were found in the powder: simple, rounded or irregularly shaped, often consisting of 2-6 components (fig. 20), most grains have an indistinct or radiant center of starch formation (fig. 21).

Fig. 20. Numerous starch grains in a micropreparation (80 x) (image magnification on the camera monitor 100%)

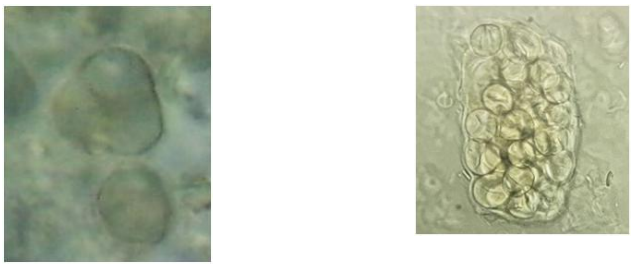


Fig. 21. Starch grains with a predominantly indistinct or radiating center of starch formation in a micropreparation (400 x) (image magnification on the camera monitor 100%)

When identifying the powder of the filled capsules, all the detected and above-mentioned diagnostic structures of the anatomical structure corresponded to the description of the microscopic study of valerian root powder, given in the section "Identification B" of the monographs of the SPU 2.0 "Valerian roots" (The SPU, vol. 3).

The preparation met the requirements of the monograph of the determination of the degradation time.

We proposed the specification for capsules with powders of Valerian for producing pharmacies (table).

Conclusions. 1. Based on the conducted studies, the composition and pharmacy technology of sedative capsules with valerian root powder of 350 mg were proposed. Other dosages like these 500 mg in capsules 0 or 700 mg in capsules 00 also are possible to develop with considering a volume of a capsule and tapped density of the powder. The same technology can be used for them.

2. Fractional analysis of the raw material before grinding. A fraction of 0,5 mm and less was selected for the studies. The consumption coefficient for valerian root powder was determined, which should be 1,03–1,045 to compensate for its losses during encapsulation.

3. A non-pharmacopoeial method for determining the average mass of capsule contents was developed, which is accepted for producing pharmacies. It was established that the capsule samples manufactured using the above technology met the requirements of the specification in terms of appearance, average mass of a capsule and capsule contents and time of the degradation of capsules.

4. According to the results of microscopic studies, it was established that the valerian root powder met the requirements of the SPU according to identification B (monograph "Valerianae radix roots").

Table

Specification for capsules with powders of Valerian

N	Quality index	Limits of acceptability	Batch 1	Batch 2
1	Appearance	Blue capsules with brown content	Meets the requirements	Meets the requirements
2	Average mass of the capsule content	350,0 mg ± 5%	341,5 mg (97,6% from the stated content)	354,1 mg (101,2% from the stated content)
3	Average mass of the capsule	427,4 mg ± 5%	418,9 mg (98,0% from the stated content)	431,5 mg (101,0% from the stated content)
4	Time of the capsule degradation	Less 30 min	Meets the requirements	Meets the requirements
5	Microscopic evaluation	According to SPU	Meets the requirements	Meets the requirements

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Стаття надійшла до редакції 25.08.2025
Стаття прийнята до друку 30.10.2025
Опублікована 29.12.2025

Acknowledgement. The coauthors are thankful to Olga Kalenikova for the helping with the experiment. Nataliia Hudz is thankful to the Krzysztof Skubiszewski Foundation (Poland) for financial helping with the equipment for the studies.

Conflict of interest: authors have no conflict interest to declare.

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Rybak O. – experiment, participation in writing the article;

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