Study of the dynamics of the accumulation of water-soluble polysaccharides in the rhizomes and roots of elecampane during the growing season

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Study of dynamics of accumulation of water-soluble polysaccharides in rhizomes and roots of high elecampane during vegetation

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SUMMARY

Currently, in medical and pharmaceutical practice, water extracts from rhizomes and roots of elecampane are used, while the pharmacological effect is due to water-soluble compounds, which are based on water-soluble polysaccharides. The terms of harvesting rhizomes and roots of elecampane high regulated by the State Pharmacopoeia of the Russian Federation are autumn, without specifying a specific period.

The aim of the research is to study the dynamics of the accumulation of water-soluble polysaccharides in the rhizomes and roots of elecampane.

The procurement of medicinal plant materials was carried out in an ecologically clean place in a natural thicket, far from large cities, highways and industrial enterprises, monthly, from May to November 2020 (in the middle of the month) in the Novousmansk district of the Voronezh region. The determination of the amount of water-soluble polysaccharides in the selected samples of rhizomes and roots of elecampane was carried out according to a previously developed, validated and patented express gravimetric method using ultrasonic extraction. Each determination was carried out three times. It was revealed that the maximum accumulation of this group of biologically active substances in the studied medicinal plant material occurs in October and reaches 30.29 ± 0.46%, which is approximately 1.5 times more, than the content of water-soluble polysaccharides in the rhizomes and roots of elecampane high in May (21.75 ± 0.38%) and September (22.81 ± 0.39%). The smallest content of the sum of water-soluble polysaccharides in the rhizomes and roots of high elecampane is observed during the period of its active flowering and the beginning of fruiting in July (11.15 ± 0.40%), which is explained by the significant energy metabolism in the plant organism during this period and as a result of the consumption of spare nutrients.

Key words: water-soluble polysaccharides, inulin, rhizomes and rootselecampane high.

RESUME

Currently, in medical and pharmaceutical practice, aqueous extracts from the rhizomes and roots of the high elecampane are used, the pharmacological effect being due to watersoluble compounds based on water-soluble polysaccharides. The State Pharmacopoeia of the Russian Federation suggests harvesting of rhizomes and roots of high elecampane during autumn, without specifying a specific period. The purpose of the study is to study the dynamics of the accumulation of water-soluble polysaccharides in the rhizomes and roots of the high elecampane. The preparation of medicinal vegetal raw materials was carried out in an

environmentally friendly place in a natural thicket, away from large cities, transport highways and industrial enterprises, monthly, from May to November 2020 (in the middle of the month) in the Novousmansky district of the Voronezh region. The sum of the water-soluble polysaccharides in the selected rhizome and root samples of the high elecampane was determined by a previously developed, validated and patented express gravimetric procedure using ultrasonic extraction. Each determination was carried out three times. It was revealed that the maximum accumulation of this group of biologically active substances in the studied medicinal plant raw materials occurs in October and reaches 30.29 ± 0.46%, which is about 1.5 times more than the content of water-soluble polysaccharides in the rhizomes and roots of the high elecampane in May (21.75 ± 0. 38%) and September (22.81 ± 0.39%). The lowest content of the sum of water-soluble polysaccharides in the rhizomes and roots of the high elecampane is noted during its active flowering and the beginning of fruiting in July (11.15 ± 0.40%), which is explained by the significant energy exchange in the plant body during this period, and as a result, consumption of spare nutrients.

Keywords: water-soluble polysaccharides, inulin, rhizomes and roots of the high elecampane.

INTRODUCTION

Elecampane high (Ínula helenium L.) is a perennial herb of the genus Elecampane (Inula) of the Asteraceae family, up to 1.5–2 m. In the wild, it is widely found in meadows, quarries, near water bodies in Europe, Asia and Africa. Due to its beautiful appearance and medicinal properties, it is actively used in landscape design and introduced into culture. The rhizomes and roots of elecampane are distinguished by their rich chemical composition and contain water-soluble polysaccharides, which are based on inulin (up to 44%), as well as essential oil, bitter substances, saponins, resins, gums, alkaloids, organic acids, micro- and macroelements [1, 2].

Rhizomes and roots elecampane high possess expectorant anti-inflammatory, antiseptic, choleretic, antispasmodic, hemostatic, diuretic, anthelmintic action, improve appetite, reduce gastric acid secretion. Due to the wide spectrum of pharmacological activity, rhizomes and roots of elecampane are widely used as medicinal plant raw materials in the form of a decoction, and are also included in the collections ("Alfit-4", "Alfit-18", "Alfit-20") and syrups (Syrup elecampane with vitamin C, Syrup with elecampane for joints). Thus, in medical and pharmaceutical practice, water extracts from medicinal plant raw materials of elecampane are used, and the pharmacological effect is due to water-soluble compounds, which are based on water-soluble polysaccharides [3, 4].

The terms of harvesting rhizomes and roots of elecampane are regulated by the State Pharmacopoeia of the 14th edition - autumn, without specifying a specific period [5].

The purpose of the study is to study the dynamics of the accumulation of water-soluble polysaccharides in rhizomes and roots of elecampane high.

MATERIALS AND RESEARCH METHODS

The procurement of medicinal plant materials was carried out in an ecologically clean place in a natural thicket, far from large cities, transport

highways and industrial enterprises, monthly from May to November 2020 (in the middle of the month) in the Novousmansky district of the Voronezh region. Earlier (April) procurement of raw materials was not possible due to the difficulties in identifying the plant, the aboveground part of which was undeveloped during the indicated periods. The dug out rhizomes and roots of a tall elecampane were cleared of aerial parts and remnants of the earth, cut into pieces of 5–10 cm, and dried in a shady way.

The determination of the amount of water-soluble polysaccharides in the selected samples of rhizomes and roots of elecampane was carried out according to the previously developed, validated and patented express gravimetric method using ultrasonic extraction [6, 7, 8]. This technique makes it possible to intensify the process of isolating water-soluble polysaccharides from the rhizomes and roots of elecampane and to reduce the time spent on it to 4–5 hours. The analysis method is reduced to the fact that an analytical sample of raw materials is crushed to particles with a size of 0.5–1.0 mm. About 1 g (accurately weighed) of the crushed raw material is placed in a flask with a capacity of 50 ml, 15 ml of purified water heated to the boiling point are added, placed in an ultrasonic bath with a frequency of 35 kHz at a temperature of 80 ° C, extracted for 15 minutes. The extraction is repeated 2 more times, adding 15 ml of water. Aqueous extracts are combined and filtered into a volumetric flask with a capacity of 50 ml through 3 layers of gauze with a cotton swab placed in a glass funnel 5 cm in diameter and previously washed with purified water. The filter is washed with water and the volume of the solution is made up to the mark (solution A). 12.5 ml of solution A is placed in a 50 ml conical flask, 37.5 ml of 95% ethyl alcohol are added, stirred, cooled in a freezer at -18 ° C for 30 minutes. Then the contents of the flask are filtered through a pre-dried and weighed ashless paper filter inserted into a POR 16 glass filter with a diameter of 40 mm under vacuum at a residual pressure of 0.4–0.8 atm. The filter cake is sequentially washed with 15 ml of a solution of 95% ethyl alcohol in purified water (3: 1), 10 ml of a mixture of ethyl acetate and 95% ethyl alcohol (1: 1).

The content of the sum of water-soluble polysaccharides in terms of absolutely dry raw materials is calculated using the standard formula:

$$X = \frac{(m_2 - m_1) \cdot 4 \cdot 100 \cdot 100}{m \cdot (100 - W)}, \quad (1)$$

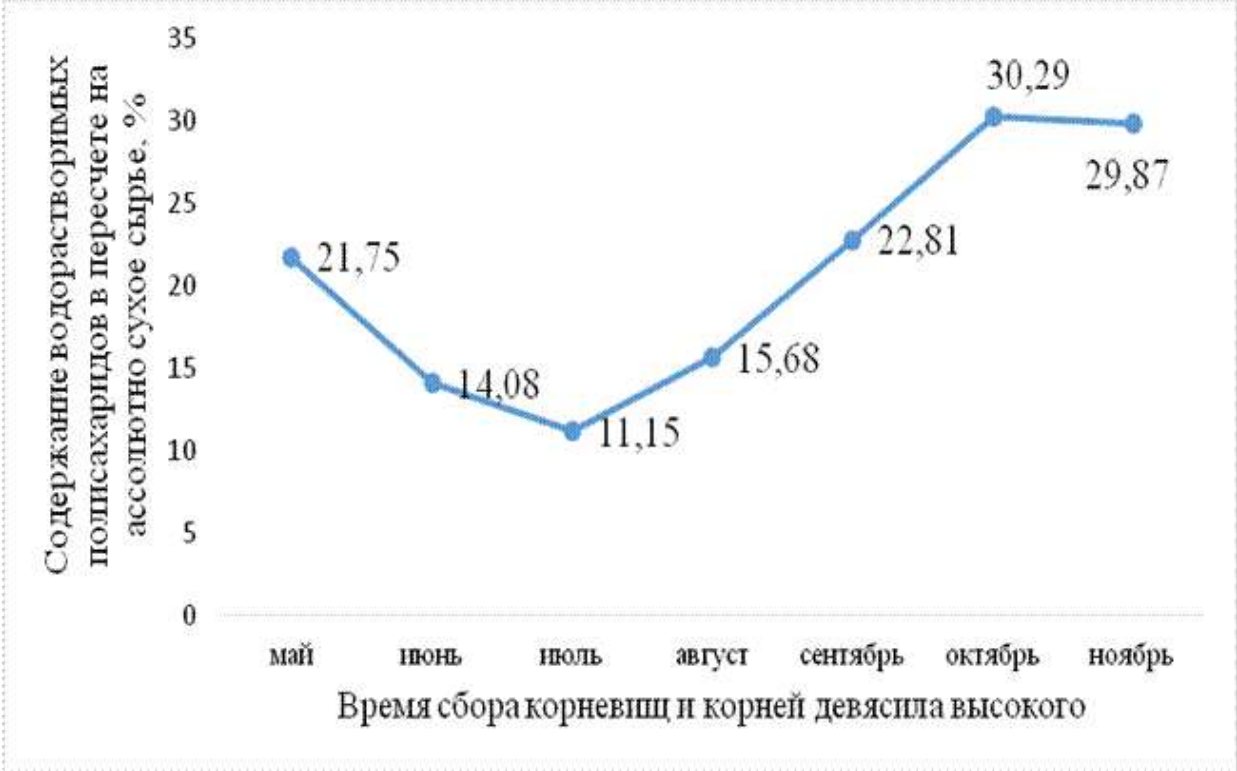
where m_1 - weight of the dried filter, g; m_2 - weight of the dried filter with sediment, g; m - weight of raw materials, g;

W is the loss in the mass of the raw material upon drying,%.

To extract the amount of water-soluble polysaccharides used ultrasonic bath "Grad 40-35", weighing was carried out on an analytical balance "A&D GH-202", drying to constant weight was carried out in a dry heat cabinet "Vityaz GP-40". Each determination was carried out three times. The data obtained during the experiment were statistically processed using the Microsoft Excel software package using the Student's t-test at a confidence level of 0.95 [9].

RESULTS AND ITS DISCUSSION

The results obtained in studying the dynamics of the accumulation of water-soluble polysaccharides in the rhizomes and roots of elecampane are shown in Fig. 1.



Rice. 1. Content of water-soluble polysaccharides
in terms of absolutely dry raw materials in the rhizomes and roots of high elecampane

From fig. 1 that the maximum accumulation of the sum of water-soluble polysaccharides in the rhizomes and roots of high elecampane (30.29 ± 0.46%) occurs in October, when the content of this group of biologically active substances is approximately 1.5 times higher than their concentration in May (21, 75 ± 0.38%). By June (the period of budding and the beginning of high flowering elecampane), the content of the total water-soluble polysaccharides in the rhizomes and roots decreases markedly (14.08 ± 0.42%). The minimum content of the sum of water-soluble polysaccharides in the rhizomes and roots of elecampane is observed during the period of its active flowering and the beginning of fruiting in July (11.15 ± 0.40%), which is explained by the significant energy metabolism in the plant organism during this period, and as a result, increased expenditure of spare nutrients. By August, the stock of water-soluble polysaccharides in the rhizomes and roots of the plant increases again (15.68 ± 0.33%), by September their content reaches approximately the level of May (22.81 ± 0.39%) and the accumulation process continues until October. The concentration of the sum of water-soluble polysaccharides in the rhizomes and roots of elecampane in November, when the aerial part of the plant had already completely withered, was 29.87 ± 0.34%, which is slightly lower than the October content of this group of biologically active substances in the raw material - by 0.42%. but at the same time it fits into an experimental error, and can also be explained by a small waste of reserve nutrients by the plant on metabolic processes in the absence of photosynthesis. 39%) and the accumulation process continues until October. The concentration of the sum of water-soluble polysaccharides in the rhizomes and roots of elecampane in November, when the aerial part of the plant had already completely withered, was 29.87 ± 0.34%, which is slightly lower than the October content of this group of biologically active substances in the raw material - by 0.42%. but at the same time it fits into an experimental error, and can also be explained by a small waste of reserve nutrients by the plant on metabolic processes in the absence of photosynthesis. 39%) and the accumulation process continues until October. The concentration of the sum of water-soluble polysaccharides in the rhizomes and roots of elecampane in November, when the aerial part of the plant had already completely withered, was 29.87 ± 0.34%, which is slightly lower than the October content of this group of biologically active substances in the raw material - by 0.42%. but at the same time it fits into an experimental error, and can also be explained by a small waste of reserve nutrients by the plant on metabolic processes in the absence of photosynthesis.

CONCLUSION

A study of the dynamics of the accumulation of water-soluble polysaccharides in the rhizomes and roots of elecampane was carried out during the growing season of the plant from May to November. It was revealed that the maximum accumulation of this group of biologically active substances in the studied medicinal plant raw materials harvested in the Voronezh region occurs in October and reaches 30.29 ± 0.46%, which is approximately 1.5 times more than the content of water-soluble polysaccharides in the rhizomes. and roots of elecampane high in the same region in May (21.75 ± 0.38%) and September (22.81 ± 0.39%).

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LITERATURE

1. Yanitskaya, A.V. Elecampane high is a promising source of new medicinal funds / A.V. Yanitskaya, I. Yu. Mitrofanova // Bulletin of the Volgograd State Medical University. - 2012. - No. 3 (43). - pp. 24–27.

2. Zakharenko, V.G. Elecampane high - medicinal and ornamental plant / V.G. Zakharenko // Bulletin of the State Nikitsky Botanical Garden. - 2006. - No. 93. - pp. 17–20.

3. Konishi, T. Antiproliferative sesquiterpene lactones from the roots of Inula helenium / T. Konishi, Y. Shimada // Biol. Pharm. Bull. - 2010. - Vol.25, №10. - P.1370-1371.

4. Kurkin, V.A. Pharmacognosy / V.A. Kurkin. - Samara: SamSMU, 2004. - Pp. 414-417.

5. State Pharmacopoeia of the Russian Federation. Edition XIV. Volume 4. - M .: FEMB, 2018. –S.6012–6019.

6. Patent 2712094 (RF). Method of obtaining purified inulin from vegetable raw materials / N.A. Dyakova, A.A. Mindra, A.I. Slivkin. - 2020. Bul. No. 3. - 7 p.

7. Development and validation of an express technique for isolation and quantitative determination of water-soluble polysaccharides from roots of Taraxacum officinale Wigg / NA Dyakova, AI Slivkin, SP Gaponov [et al.] // Pharmaceutical Chemistry Journal. -2018. - Vol. 52.No 4. - pp. 343-346.

8. Development and validation of an express method for assay of water-soluble polysaccharides in common burdock (Arctium lappa L.) roots / NA Dyakova, AI Slivkin, SP Gaponov [et al.] // Pharmaceutical Chemistry Journal. -2015. - Vol.49. No. 9. - pp. 620-623.

9. Statistical analysis of medical data. Application of the package of applied programs STATISTICA / O.Yu. Rebrov. - M .: MediaSfera. - 2000 .-- 312 p.

REFERENCES

1. Anickaya, AV Devyasil vysokij - perspektivnyj istochnik novyh lekarstvennyh sredstv [Devyasil high - a promising source of new medicines] / AV Anickaya, I.Yu. Mitrofanova //Vestnik Volgogradskogo gosudarstvennogo medicinskogo universiteta. -2012. - No 3 (43). - pp.24–27.

2. Zaharenko, VG Devyasil vysokij - lekarstvennoe i dekorativnoe rastenie [Devyasil tall - medicinal and ornamental plant] / VG Zaharenko // Byulleten 'Gosudarstvennogo Nikitskogo botanicheskogo sada. -2006. - No. 93. - pp. 17–20.

3. Konishi, T. Antiproliferative sesquiterpene lactones from the roots of Inula helenium / T. Konishi, Y. Shimada // Biol. Pharm. Bull. - 2010. - Vol.25. No. 10. - pp. 1370-1371.

4. Kurkin, VA Farmakognoziya [Pharmacognosy] / VA Kurkin. - Samara: Ofort, 2004. - pp. 414-417.

5. Gosudarstvennaya farmakopeya Rossijskoj Federacii. Izdanie XIV [State pharmacopeia of the Russian Federation. Edition XIV], 2018, Vol. 4, Moscow, FEMB, pp. 6012-6019.

6. Patent 2712094 (RU) Method for production of purified inulin from vegetable raw materials / NA Dyakova, AA Myndra, AI Slivkin. -2020. - No 3. - 7 p.

7. Development and validation of an express technique for isolation and quantitative determination of water-soluble polysaccharides from roots of Taraxacum officinale Wigg / NA Dyakova, AI Slivkin, SP Gaponov [et al.] // Pharmaceutical Chemistry Journal. -2018. - Vol. 52. No 4. - pp. 343–346.

8. Development and validation of an express method for assay of water-soluble polysaccharides in common burdock (Arctium lappa L.) roots / NA Dyakova, AI Slivkin, SP Gaponov [et al.] // Pharmaceutical Chemistry Journal. -2015. - Vol. 49. No 9. - pp. 620-623.

9. Rebrova, OY Statisticheskij analiz medicinskih dannyh. Primenenie paketa prikladnyh programm STATISTICA [Statistical analysis of medical data. Application of the STATISTICA application package] / OY Rebrova. - Moscow: MediaSphere, 2000 .-- 312 p.

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