Development of a method for the quantitative determination of anthracene derivatives in the roots of Tangut rhubarb

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Development of the technique of quantitative determination of antracene derivatives in roots of Rheum palmatum

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SUMMARY

This paper discusses current aspects of improving the methodology for standardizing the roots of Tangut rhubarb (Rheum palmatum L.). New approaches have been proposed for the quantitative analysis of the content of anthracene derivatives in the roots of Tangut rhubarb, which consist in the use of spectrophotometry at an analytical wavelength of 510 nm in terms of frangula-emodin, the use of ultrasound to maximize the yield of anthracene derivatives from raw materials, and a reduction in the extraction time in a water bath. The existing method for the determination of anthracene derivatives in the roots of Tangut rhubarb, presented in the State Pharmacopoeia of the Russian Federation of the XIV edition, provides for long-term extraction in a water bath. Using exposure to physical factors such as ultrasound,

Key words: Tangut rhubarb, Rheum palmatum L., roots, anthracene derivatives, frangula-emodin, standardization, spectrophotometry.

RESUME

This paper discusses the current aspects of improvement of methods of standardization of roots of Rheum palmatum. The new approaches are proposed for the quantitative analysis of the content of anthracenederivatives of roots of Rheum palmatum, which involves spectrophotometry at analytical wavelength of 510 nm calculated on Frangula-emodin and the use of ultrasound for the maximum yield of anthracenederivatives of raw materials and reducing the time of extraction in a water bath. The existing method for the determination of anthracenderivatives in the roots of Rheum palmatum presented in the State Pharmacopoeia of the Russian Federation, XIV edition, is based on a long extraction in a water bath. The use of physical factors, such as ultrasound,

Keywords: Rheum palmatum L., roots, anthracenderivatives, frangula-emodin, standardization, spectrophotometry.

INTRODUCTION

Tangut rhubarb (Rheum palmatum L.) this. Buckwheat (Polygonaceae) is a medicinal plant, widely used in traditional medicine of the countries of the European Union, homeopathy, Chinese medicine, is promising for use in domestic medicine due to the high content of both anthracene derivatives, which cause laxative effect, and tannins, which have an opposite effect on the gastrointestinal tract. Moreover, the nature of the action of extracts from rhubarb roots on the gastrointestinal tract depends on the dosage: an astringent, anti-inflammatory effect is exerted by small amounts of extracts, while, on the contrary, large amounts have a laxative effect [1, 2, 3]. State Pharmacopoeia of the Russian Federation XIV edition in FS.2.5.0092. 18 contains a method for the quantitative determination of anthracene derivatives in rhubarb roots by the spectrophotometric method in terms of frangulaemodin and provides for the infusion of crushed rhubarb roots in a boiling water bath for 60 minutes at a raw extract ratio of 1 to 50 to 70% alcohol [4]. In order to reduce the research time, infusion under the influence of ultrasound was introduced into the methodology, which increases the speed and completeness of the extraction of biologically active substances from medicinal plant materials. Under the influence of ultrasound, a more active destruction of the cellular structures of plant tissues occurs, which leads to an increase in the concentration of biologically active substances in the extraction. The intensification of extraction is based on dispersion processes, violation of the micellar structure of the extractable substance and an increase in the interfacial specific surface area of the reacting components. [5-7]. The use of infusion of extraction under the influence of ultrasound for 15 minutes made it possible to reduce the time of infusion in a water bath by 2 times, and the ratio

raw extractant 1 to 100 made it possible to obtain the highest concentrations of anthracene derivatives in the extraction.

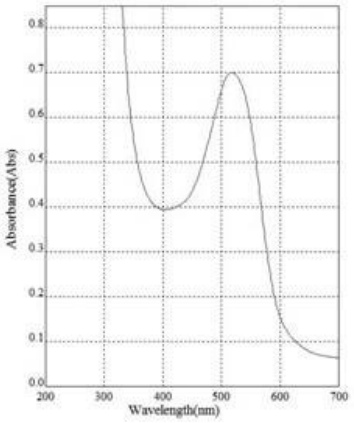
Purpose of the study: development of a method for the quantitative determination of the amount of anthracene derivatives in roots of Tangut rhubarb and determination of optimal conditions for the extraction of anthracene derivatives from the roots of Tangut rhubarb.

MATERIALS AND METHODS

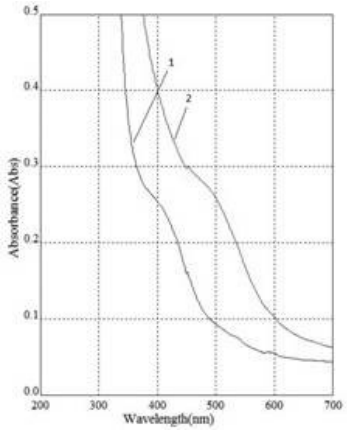
The objects of the study were the roots of the rhubarb of the Tangut LLC "Staroslav", Russia, Novosibirsk region, Berdsk, 2017. Electronic spectra were measured on a UNICO 2800 UV spectrophotometer.

RESULTS AND ITS DISCUSSION

The roots of Tangut rhubarb contain various anthracene derivatives, including frangulaemodin, rheumodin, chrysophanol and rhein [1, 8, 9]. Using a Unico 2800 spectrophotometer, the UV spectra of solutions of hydroalcoholic extracts from raw materials were studied. The use of frangulaemodine as a standard, which gives an absorption maximum at a wavelength of about 510 nm (Fig. 1), is the most optimal. The extraction was carried out at different ratios of "raw-extractant", and also varied the extraction time in a water bath and the effect of ultrasound (Table 1). When modifying the method for quantitative determination of the amount of anthracene derivatives in the roots of Tangut rhubarb, the optimal conditions for the extraction of anthracene derivatives were revealed: extractant - 70% ethyl alcohol; the ratio "raw material - extractant" - 1: 100; extraction time - 30 min. on a water bath at a temperature of 80–90 ° C, 15 minutes of extraction under the action of ultrasound (Fig. 2). For control, the amount of anthracene derivatives was determined by the previously proposed extraction method for 30 minutes in a water bath.



Rice. 1



Rice. 2

Table 1

Influence of Various Factors on the Completeness of Extraction of Anthracene Derivatives from the roots of Tangut rhubarb

Concentration extractant - ethyl alcohol,%	Ratio "Raw material: extractant "	Time extractions, min.	US, min.	Optical density	% content anthracene derivatives in terms of frangulo-emodin
40%	1:50	90	15	0.2824	1.71227328
50 %	1:50	90	15	0.3045	1.86382769
60%	1:50	90	15	0.3750	2.29444524
70%	1:50	90	15	0.4048	2.51133915
80%	1:50	90	15	0.3902	2.2407966
95%	1:50	90	15	0.3598	2.22279133
70%	1:50	60	15	0.2890	1.77881971
70%	1:50	thirty	15	0.2895	1.76885984
80%	1:50	60	15	0.3447	2.12674182
80%	1:50	thirty	15	0.3232	1.96989933
70%	1:50	60	-	0.3096	1.91018064
70%	1:50	thirty	-	0.2820	1.71878593
70%	1:25	90	15	0.6822	2.02099489
70%	1: 100	90	15	0.2399	2.9272612
70%	1: 100	15	-	0.2133	2.63415519
70%	1: 100	15	15	0.2307	2.84903705
70%	1: 100	thirty	-	0.2137	2.62649789
70%	1: 100	thirty	15	0.2439	2.99767354
70%	1: 100	60	-	0.2137	2.62571456
70%	1: 100	60	15	0.2230	2.73998291

DETERMINATION PROCEDURE

An analytical sample of raw materials is crushed to a particle size passing through a sieve with holes 1 mm in diameter. About 1 g of crushed raw materials (accurately weighed) is placed in a flask with a thin section with a capacity of 100 ml, add 100 ml of 70% ethyl alcohol. Stopper the flask, weigh to the nearest ± 0.01, connect to a reflux condenser and heat in a boiling water bath (moderate boiling) for 30 minutes. Then, within 15 minutes, extraction is carried out under the influence of ultrasound, after which it is weighed and the missing extractant is replenished to the initial mass. The extract is filtered through a paper filter (red band). The test solution is prepared as follows: 1 ml of the obtained extract is placed in a volumetric flask with a capacity of 50 ml and the volume of the solution is brought to the mark with an alkaline ammonia solution, prepared in accordance with the requirements of the USSR GF XI edition. After cooling, measure the optical density on a spectrophotometer at a wavelength of 510 nm. A solution obtained as follows is used as a reference solution: 1 ml of the extract is placed in a volumetric flask with a capacity of 50 ml and the volume of the solution is brought to the mark with water. The content of the sum of anthracene derivatives is carried out according to the formula:

,

where A is the optical density of the test solution;

- specific absorption index of CO frangulaemodine at a wavelength of 510 nm, equal to 465;

100 - extractant volume, ml; 50 - volume of solution A, ml; 1 - the volume of the aliquot pp A, ml;a - sample of raw materials, g; W - moisture content of raw materials,%.

The metrological characteristics of the method for quantitative determination of the content of the sum of anthracene derivatives in the roots of Tangut rhubarb are presented in table. 2. The results of statistical processing of the experiments carried out indicate that the error of a single determination of the amount of anthracene derivatives in the roots of Tangut rhubarb is ± 3.30.

table 2

Metrological characteristics of the quantitative determination procedure

the amount of anthracene derivatives in the raw material of Tangut rhubarb

f		S	P,%	t (P, f)	-X	E,%
ten	2.99	0.04472	95	2.23	± 0.100	± 3.30

CONCLUSIONS

A modification of the spectrophotometric technique for the quantitative determination of the amount of anthracene derivatives in the roots of Tangut rhubarb using ultrasound extraction has been developed. The content of the sum of anthracene derivatives in the raw material, equal to 3.00%, is achieved by a combination of extraction in a water bath and ultrasonic extraction. This technique allows one to obtain a high content of anthracene derivatives, reduce the extraction time in a water bath, and can be used to extract anthracene derivatives from other types of medicinal plant materials.

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