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Study of bioavailability of capsules with *Scutellaria baicalensis* roots and rhizomes powder

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Abstract

The purpose of the work was to study the bioavailability of the sum of biologically active flavanoids of capsulated *Scutellaria baicalensis* root powder. In order to objectively evaluate the results of the experiment, it is necessary to know the true content of flavanoids in terms of baicalin in the analyzed samples of root and rhizomes powder of *Scutellaria baicalensis*. For this purpose, we have determined the optimal solvent. Proceeding from the fact that the sum of flavanoids was well extracted with a 0.1 M solution of chloride acid, it can be assumed that the optimum extractant would be an aqueous solution of ethanol at a sufficiently low concentration.

Keywords: *Scutellaria baicalensis*, flavonoids, biorelevant media.

Introduction

Among the most important tasks of biomedicine and biopharmacy is understanding of the process of medicinal substance delivery to organs or target cells. One of the key stages of this process is the behavior of the dosage form (DF) in the gastrointestinal tract (GIT). At the same time the medicine passes through the following stages: the release of API from DF, dissolution of the API in biological fluids of the gastrointestinal tract and its absorption through the wall of the intestine. The solubility test is one of the most important elements of drugs' quality control. One of the most promising methods for determining the solubility for today is the use of biorelevant media. Biorelevant media are buffer solutions with the addition of natural surfactants, which, by chemical composition and physical and chemical properties, such as pH, osmolarity, buffer capacity, surface tension are as close as possible to the internal fluids of the human body [1-4]. In previous studies, the possibility of quantitative determination of flavonoids in acid and media [5] has been proved.

Materials and Methods

In a flask an exact sample of the *Scutellaria baicalensis* root powder was placed, after that 100 ml of 30%, 50% or 70% ethanol solution were added and heated for 20 minutes. The solutions were filtered, diluted to the required concentration, and the adsorption spectrum was recorded. As the control solution, ethyl alcohol of appropriate concentration was used. The obtained results are presented in fig. 1.

The solvent that showed the maximum optical density in the analytical maximum was used for exhausting extraction of the sum of biologically active flavanoids of *Scutellaria baicalensis* root powder. To do this, in 250 ml conical flasks placed about 0.15 g of the analyzed samples of the *Scutellaria baicalensis* root powder (accurate weight), 50 ml of 50% ethanol was added and left to soak for night. The flasks were then placed on a water jacket under a reflux condenser and heated for 20 minutes. The extracts were cooled a bit and cautiously, leaving the broth in the flask, decanted into a volumetric flask of 100 ml capacity. Extraction of the meal was repeated twice in portions of 25 ml, decanting the extracts into the same flask. The third extract in all cases was already colorless. The volume of the solution in the volumetric flasks was adjusted to mark with 50% ethyl alcohol and stirred. After thorough settling, 1.0 ml of the resulting extract was transferred to 50 ml volumetric flasks, added to the mark with the same solvent and stirred. The optical density of the obtained solutions was determined on Evolution 60-S spectrophotometer at 317 nm in a cell with layer thickness of 10 mm. As the control solution, ethyl alcohol of appropriate concentration was used.

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The analysis of experimental data presented in Fig. 1 shows that at transition from 0.1 M hydrochloric acid to aqueous

solutions of ethyl alcohol the nature of the spectra did not change - in the range from 220 to 360 nm they also consist of two main absorption bands - the absorption band of

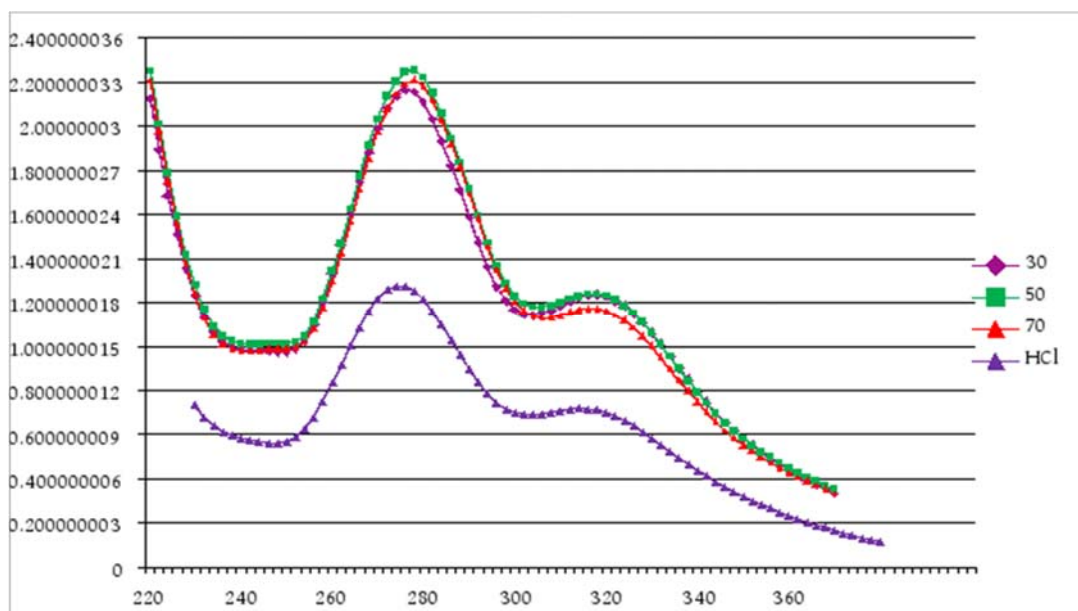


Fig 1: Adsorption spectra of extracts obtained by extraction of rhizome and root powder of *Scutellaria baicalensis* with solutions of ethyl alcohol of different concentrations and 0.1 M solution of hydrochloric acid.

Aromatic compounds with a maximum in the region of 274-276 nm and a less intense band in the near ultraviolet, indicating that the change of solvent and its concentration does not lead to a change in the profile of the substances being extracted. The specific band in the near ultraviolet in alcoholic extracts becomes slightly more distinct. The analytical maximum is also arranged at a wavelength of 316-318 nm. The maximum optical density (and hence the concentration) has an extract obtained by extraction with 50% ethanol.

According to the developed method, the determination of the actual content of the sum of flavanoids in the specimens of the powder of the *Scutellaria baicalensis* root has been performed. The results of the flavonoids quantification were calculated by the formula:

$$X = \frac{A \cdot V_1 \cdot V_3 \cdot m_{cm} \cdot V_{2cm} \cdot 100}{A_{cm} \cdot m_u \cdot V_2 \cdot V_{1cm} \cdot V_{3cm}}$$

where \hat{A} - optical density of the investigated solution;

$\hat{A}_{\hat{n}o}$ - optical density of the reference solution;

m_s - weight of analyzed sample of the *Scutellaria* root powder;

V_1 - the volume of the measuring flask;

V_2 - the volume of the aliquot for the second dilution;

V_3 - the volume of the measuring flask for the second

dilution;

m_{cm} - weight of the standard sample (SS) of baicalin in grams (0,0501 g);

V_{1cm} - the volume of the measuring flask for the first dilution of baicalin SS (50 ml)

V_{2cm} - volume of aliquot of baicalin SS ;

V_{3cm} - the volume of the measuring flask for the second dilution;

Thus, the content of the sum of flavanoids in terms of baicalin in the first sample of root and root powder of *Scutellaria baicalensis* is 26,502%, and in the second sample - 23,305%.

As a result of previous studies, a spectrophotometric method was developed for the determination of bioflavanoids in terms of baicalin in solutions obtained at determining the bioavailability of biologically active substances of the *Scutellaria baicalensis* root powder [5]. The technique was used to determine the concentration of solutions in the experiment. The results of the experiment are presented in the table. 1.

The analysis of the obtained results shows that into the solution passes from 9, 76 to 20, 98% of the weight of the powder of the root of the *Scutellaria*.

The obtained data were used to calculate the relative amount of flavanoids that passes into the solution at extraction with 0.1 M solution of hydrochloric acid and biorelevant media FaSSIF and FeSSIF with a pH of 6, 5 or 6, 8. The data obtained are presented in Table 2.

Table 1: Biological availability of flavonoids of rhizome and roots powder of *Scutellaria baicalensis* at extraction with 0.1 M solution of hydrochloric acid and biorelevant media FaSSIF and FeSSIF, %

Medium of dissolution	0,1 M hydrochloric acid	FaSSIF with a pH of 6,5	FaSSIF with a pH of 6,8	FeSSIF with a pH of 6,5	FeSSIF with a pH of 6,8
Sample 1 crushed by rolling	15,76	19,74	19,60	20,98	19,36
Sample 2 crushed	11,80	9,76	13,26	14,97	9,98

Table 2: The relative quantity of flavonoids that passes into the solution at extraction with 0.1 M solution of hydrochloric acid and biorelevant media FaSSIF and FeSSIF with a pH of 6.5 or 6.8, %

Medium of dissolution	0,1 M hydrochloric acid	FaSSIF with a pH of 6,5	FaSSIF with a pH of 6,8	FeSSIF with a pH of 6,5	FeSSIF with a pH of 6,8
Sample 1 crushed by rolling	59,47	74,48	73,96	79,16	73,05
Sample 2 shredded	50,63	41,88	56,90	64,24	42,82

The analysis of the data presented in tables 1 and 2 shows that a shredded sample of *Scutellaria baicalensis* roots and rhizomes powder No. 1 (crushed by rolling) showed a higher bioavailability of active substances. Into solution passes from 60 to 79 % of the available amount of flavonoids.

These results show the prospectiveness of use of medicines with native powder of the *Scutellaria* root, without extraction of active substances.

Thus, studies conducted have shown that *capsules with shredded roots and rhizomes of Scutellaria baicalensis* are a promising dosage form, and the best bioavailability indices has rolled raw material.

Conclusions

1. Extraction of the sum of flavanoids of *Scutellaria baicalensis* roots and rhizomes powder with solutions of ethyl alcohol of different concentrations was investigated. It has been established that the change of the solvent does not lead to a change in the profile of the substances that pass into the extract (aglycones, monozytes, biosides). The maximum amount of flavanoids is extracted with 50% ethanol.
2. Exhaustive extraction of the sum of flavanoid from the analyzed samples of *Scutellaria baicalensis* roots and rhizomes powder was carried out. The calculation of the quantitative composition showed that the content of the sum of flavanoids in terms of baicalin in the first sample of the powder of *Scutellaria baicalensis* roots and rhizomes is 26,502%, and in the second sample - 23,305%.
3. As a result of the conducted research, a method was developed for spectrophotometric determination of bioflavanoids in terms of baicalin in solutions obtained at determining the bioavailability of biologically active substances of *Scutellaria baicalensis* root and rhizomes powder. The technique was used to determine the concentration of solutions in the experiment.
4. An analysis of experimental data showed that a crushed sample of *Scutellaria baicalensis* roots and rhizomes powder No. 1 (crushed by roll) showed a higher bioavailability of active substances. Into solution passes from 15, 76 to 20,98% by weight of powder, which is from 60 to 79% of the available amount of flavanoids.
5. The obtained data show the prospects of using drugs with native powder of roots and rhizomes of *Scutellaria baicalensis*. The results will be used to justify the creation of a new drug.

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