

DETERMINATION OF THE QUALITATIVE COMPOSITION OF BIOLOGICALLY ACTIVE SUBSTANCES IN SALSOLA COLLINA PALL. HERB

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Abstract. The article presents a brief information about the most common species of *Salsola* – *Salsola collina* Pall., *Salsola Richteri* and *Salsola Paletziana*, the possibility of their use and differences in the composition of the main groups of active substances. To study the qualitative composition *Salsola collina* Pall. has been selected in order to standardize the plant raw material and substantiate the choice of marker substances. Identification of the groups of biologically active substances has been carried out by qualitative reactions and thin layer chromatography.

According to the results of the study conducted the following groups of compounds of *Salsola collina* Pall. herb have been determined: alkaloids, reducing substances, phenols and tannins, steroid compounds, flavonoids.

Therefore, the qualitative composition of the main groups of active substances in *Salsola collina* Pall. herb has been determined. According to the results of the data obtained flavonoids have been chosen as marker substances when standardizing the raw material and herbal products based on the herb. The rationality of the choice of this group of compounds has been confirmed by the own docking studies conducted, as well as by the information presented in the scientific literature.

Keywords: *Salsola collina* Pall., biologically active substances, herb, identification.

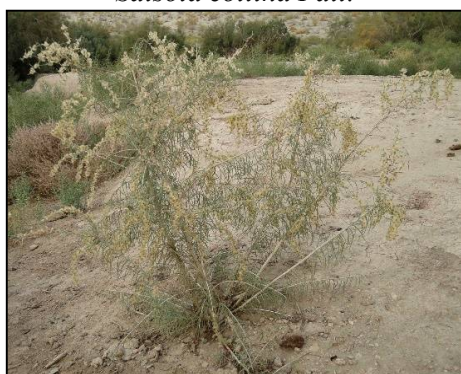
Introduction. *Salsola collina* Pall. belongs to the genus of *Salsola* herbaceous and shrubby plants of *Amaranthaceae* family. According to various data this genus includes from 80 to 150 species of plants. *Salsola collina* Pall., *Salsola Richteri* and *Salsola Paletziana* are the most common (Fig. 1) [3].



Salsola collina Pall.



Salsola Richteri



Salsola Paletziana

Fig. 1. The appearance of the most common species of *Salsola*

Salsola Richteri is the most studied, it is the raw material for obtaining such alkaloids as salsolidine and salsoline. The herb of the plant contains 0.3 % of salsoline alkaloid, when administered intravenously it determines the reduced blood pressure, which lasts 20-30 min. Its toxicity is insignificant. With a daily oral administration the steady parameters of blood pressure are achieved. In cases of benign hypertension of arteriosclerotic order a long-term reduction in blood pressure can be achieved. This plant is used in arteriosclerotic hypertension and malignant renal hypertension; it is also indicated for headache and dizziness [3]. Salsoline hydrochloride is included in the Pharmacopoeia of the USSR [2]. *Salsola Paletzkiiana* is very similar to *Salsola Richteri* in appearance, but it has no medical value; a black paint is obtained from its leaves and wood. The fruits of *Salsola Paletzkiiana* are the related impurity when collecting *Salsola Richteri* [1]. There is information about the content of salsoline in *Salsola subaphylla*. In Tibetan medicine the herb of annual *Salsola collina* Pall., which is less studied compared to *Salsola Richteri*, is used.

Salsola collina Pall. grows on loamy, stony or dry sandy soils. The range of the plant extends from the Volga to the Far East and includes Kazakhstan, the Baikal region, southern Siberia and Central Asia [3, 6].

Salsola collina Pall. (other common names: tumbleweed, Tartar thistle, common Russian thistle, camel's-thorn) is an annual, spherical, semi-shrub plant with threadlike leaves covered with spiny bristles along the whole length, a weed that does not form regular thickets; therefore, for industrial use, the plant is specially grown on plantations located in the Altai Territory. This plant is a powerful hepatoprotector, it also has the immunomodulatory, antioxidant, choleric, lipotropic, and hypoglycemic properties [3, 7].

Despite the fact that *Salsola collina* Pall. not a pharmacopoeial plant, its therapeutic properties as a hepatoprotector are known, i.e. normalization of the function, structure and metabolism of the liver parenchyma. *Salsola collina* Pall. is recommended in cirrhosis, cholecystitis, hepatitis, acute viral and toxic hepatitis. It is taken to protect the liver when treating various diseases with drugs of the hepatotoxic action, in helminthiasis and infectious processes in the liver. The plant has the insulin-like action, i.e. can reduce the sugar content in the blood [9, 10]. As a dietary supplement *Salsola collina* Pall. helps to strengthen bones, has the immunostimulatory action, is used for prevention of disorders of the lipid and cholesterol metabolism, as well as early forms of atherosclerosis, and cardiovascular diseases. Such dietary supplements as "Askohol", "Hepatosol", "Lokhein", "Extractol" (produced in Russia) containing *Salsola collina* Pall., as well as tea and extract of the herb are known. The latter is widely used as an alcoprotector for the treatment of the abstinence syndrome [4]. The concentrated infusion of the plant has a laxative effect; it is used in hemorrhoids, gastric ulcer and duodenal ulcer.

In cosmetology *Salsola collina* Pall. is used in the manufacture of various creams and lotions. It has antiseptic and wound healing properties, is effective in the treatment of acne, promotes skin hydration. Sunscreens with *Salsola collina* Pall. provide safe, smooth and long-lasting tan.

Despite the widespread use of *Salsola collina* Pall. by folk and traditional medicine the study of the qualitative composition of its herb is of current interest.

Thus, the aim of our work was to determine the qualitative composition of the main groups of active substances of *Salsola collina* Pall. herb, namely alkaloids, reducing substances, phenols and tannins, steroid compounds, flavonoids in order to standardize the plant raw material and substantiate the choice of marker substances.

Materials and methods. The presence of alkaloids in *Salsola collina* Pall. herb was determined by the characteristic reactions of identification with Mayer and Wagner reagents and the method of thin layer chromatography (TLC). Determination of alkaloids was performed by TLC in the solvent systems of butanol – glacial acetic acid (100:5) and toluene – acetone – concentrated ammonia – ethanol (40:52:2:6) using the solution of potassium tetraiodobismuthate (Dragendorff reagent) for development. Chromatograms were examined before and after developing by the reagent; the salsoline hydrochloride reference standard (RS) was used.

To identify flavonoids the following qualitative reactions were conducted: the cyanide sample in the modification according to Briant; the reaction with 2 % alcoholic solution of aluminium chloride; with the solution of basic lead (II) acetate; with 10 % alcoholic solution of alkali; with the concentrated sulfuric acid.

To determine reducing substances the copper tartrate reagent was used.

To determine phenols and tannins the reaction of identification with the solution of iron (III) chloride was carried out.

The presence of steroid compounds in extracts was proven by the reactions with concentrated acids [5].

Results and discussion. The positive reactions with Mayer and Wagner reagents showed the presence of alkaloids in *Salsola collina* Pall. herb. On the chromatograms of the test solution there was the area similar to the area on the chromatogram of salsoline hydrochloride *RS* of characteristic coloration. The presence of other areas of different size and coloration can be also present.

The presence of phenolic hydroxyls determines the acidic properties of flavonoids and their ability to form phenolates in the alkaline medium. It is thanks to the presence of phenolic hydroxyls that flavonoids are easily oxidized. It was confirmed by the cyanide sample in the modification according to Briant. As a result of the reaction a pink coloration indicating the presence of flavans and flavonols was formed.

The presence of flavones was confirmed by forming a precipitate of an orange color when carrying out the reaction with the solution of basic lead (II) acetate.

The reaction with 2 % alcoholic solution of aluminium chloride is the common method for identification of flavonoids. As a result, a bright greenish-yellow color was formed.

The reaction of 10 % alcoholic solution of alkali is the most specific for flavonoids; it allows distinguishing various types of compounds. It is known that when interacting with dilute alkali flavanones form colorless or yellowish solutions, which become bright yellow or red with time due to their isomerization with chalcones. Chalcones and aurones immediately form red or purple solutions with alkalis. It is used as a specific reaction for these compounds. Flavones and flavonols form yellow solutions with alkalis, while polyhydroxyflavonols (six or more groups) give red or blue solutions. The red color formed when carrying out the reaction with the extracts studied using the alkaline solution may indicate the presence of chalcones and aurones.

The concentrated sulfuric acid interacts with the majority of flavonoid compounds with formation of colored solutions. Flavones and flavonols form oxonium (flavylium) salts. Flavanones in sulphuric acid become bright orange or crimson due to appearance of salts of the corresponding chalcones, which have conjugated double bonds in ions. Chalcones and aurones with sulphuric acid form an intense color – from red to crimson coloration, and it is also explained by appearance of quinoid structures. In our case when studying aqueous and 30 % alcoholic extracts a bright yellowish-red color was observed, while in 50 % and 70 % alcoholic extracts there was a bright yellow color indicating the presence of flavanones.

When heating the reaction mixture with the copper tartrate reagent the formation of a red precipitate was observed. It indicates the presence of reducing substances.

To determine phenols and tannins the reaction of identification with the solution of iron (III) chloride was carried out. This reaction with obtaining a characteristic color is common for all classes of polyhydroxy compounds.

The presence of substances with the steroid structure in the extracts was confirmed by reactions with the concentrated acids. When adding the concentrated sulphuric acid to the chloroform extract of the raw material a characteristic red color was formed.

Terpenoids were also determined in the chloroform extract. After removal of chloroform and subsequent heating of the dry residue with the concentrated sulphuric acid a grayish color was observed.

Conclusions. Therefore, the qualitative composition of the main groups of biologically active substances in *Salsola collina* Pall. herb, namely alkaloids, reducing substances, phenols and tannins, steroid compounds, flavonoids, has been determined. According to the results of the data obtained flavonoids have been chosen as marker substances when standardizing the raw material and herbal products based on the herb. The rationality of the choice of this group of compounds has been confirmed by the own docking studies conducted [8], as well as by the information presented in the scientific literature [11].

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