

Polysaccharides of the herb *Gynostemma pentaphyllum* (*Gynostemma pentaphyllum* Thunb.)

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#### SUMMARY

The article presents the results of a study of polysaccharides in the herb of *Gynostemma pentaphyllum*, introduced on the territory of the Republic of Bashkortostan. Several polysaccharide fractions were isolated: water-soluble polysaccharides (WSPP), pectin substances (PV), hemicellulose A and hemicellulose B (HCA and HCB). In the course of the research, the physicochemical properties of the isolated fractions (description, solubility, chemical properties) were established and their quantitative content was determined (VRPS = 23.3%; PV = 13.5%; HCA = 16.4%; HCB = 17.0 %). Water-soluble polysaccharides are the dominant fraction in the raw material of *Gynostemma pentaphyllum*.

Key words: *Gynostemma pentaphyllum*, water-soluble polysaccharides, pectin substances, hemicellulose, solubility.

#### RESUME

The article presents the results of the study of polysaccharides in the grass of the *Gynostemma pentaphyllum*, introduced in the Republic of Bashkortostan. Polysaccharide complexes in the form of fractions were isolated from the medicinal plant: water-soluble polysaccharides (VRPS), pectin substances (PV), hemicellulose A, and hemicellulose B (HCA and HCB). The physicochemical properties of the isolated fractions are described (external description, solubility, chemical reactions) and their quantitative content is presented (VRPS = 23.3%; PV = 13.5%; HCA = 16.4%; HCB = 17, 0%). Water-soluble polysaccharides are dominant in the raw materials of the *Gynostemma pentaphyllum*.

Keywords: *Gynostemma pentaphyllum*, water-soluble polysaccharides, pectin, hemicellulose, solubility.

#### INTRODUCTION

*Gynostemma pentaphyllum* is a perennial vine belonging to the pumpkin family (Cucurbitaceae), which is a food and medicinal plant that is common in China (south of the Qinling Mountains and the Yangtze River), Japan and many other Asian countries. In our country, it is found in the wild on the island of Kunashir. *Gynostemma pentaphyllum* is called "Jiao-Gu-Lan" in China, "Cha-Satun" in Thailand and "Amachazuru" in Japan (Fig. 1).



Rice. 1. *Gynostemma five-leafed*

*Gynostemma five-leafed* in clinical practice in China is used as a drug to lower cholesterol and blood sugar levels, regulate blood pressure, strengthen immunity, treat chronic bronchitis and gastritis, and reduce inflammatory reactions [7]. It should be noted that the plant exhibits minimal toxicity. It is also claimed that regular consumption of *Gynostemma* tea can promote health and reduce the severity of many diseases. Therefore, *Gynostemma* tea is currently being promoted in China and sold in Europe as a herbal tea "beneficial to health and beauty" [9]. Due to the similarity of biologically active components with the expensive ginseng root (dammaran derivatives), cheap *Gynostemma five-leafed* was named "second ginseng".

researchers as a potentially new medicinal plant.

Along with the saponins of the dammaran group, *Gynostemma pentaphyllum* contains a large amount of biologically active substances that also determine the pharmacological effects of the plant: flavonoids, tannins, vitamins, organic acids, polysaccharides, etc. [8, 10].

Most of the dry matter of the plant is made up of polysaccharides, which exhibit various biological activities: reparative, antiradiation, antiviral, adaptogenic, wound healing and antitumor. These compounds increase the overall resistance of the body, thereby stimulating the reticulo-endothelial system. It is known that polysaccharides enhance humoral and cellular immunity, exhibiting immunomodulatory properties in immunodeficiency states [5]. Since polysaccharides can make an undoubted contribution to the complex pharmacotherapeutic activity of the herb *Gynostemma pentaphyllum*, it would be interesting to conduct a deeper study of this group of biologically active compounds. In the literature there are data from a number of authors on studies in the polysaccharide complex of amino acids, since along with polysaccharides, water will also extract other hydrophilic compounds, for example, proteins or amino acids [1]. Recently, amino acids have been used as dietary supplements with various types of pharmacological activity: in pathologies of the cardiovascular and hematopoietic system (lysine, arginine), for the work of the brain and central nervous system (glycine, tryptophan), to slow down the growth of tumors (arginine) and others [6].

The aim of the study was to isolate the total fraction of polysaccharides from the raw material of *Gynostemma pentaphyllum* and determination of their fractional composition.

#### MATERIALS AND METHODS

The object of the study was the five-leaved *Gynostemma pentaphyllum* grass harvested during the growing season, grown on the territory of the Republic of Bashkortostan. The herb was dried under natural conditions by the air-shadow method, storage was carried out according to the General Pharmacopoeia of the XIV edition "Storage of medicinal plants and herbal medicines" [2].

Before isolating the polysaccharide complex, lipophilic compounds were removed from the raw material by extraction with a polar solvent in a Soxhlet apparatus. For this, 10 g of *Gynostemma pentaphyllum* herb (analytical mass), crushed to a particle size of 0.5 mm, was loaded into a bag of filter paper, which was placed in a Soxhlet apparatus. It was extracted with chloroform until the raw material was completely depleted [2].

The removal of phenolic substances in the same raw material (after its preliminary drying) was carried out by extraction with ethyl alcohol 70% for 30 min.

Then, polysaccharide fractions were obtained in turn: water-soluble polysaccharides (WSP); pectin substances (PV); hemicellulose A and hemicellulose B (HCA and HZB).

WSP was isolated by the method of extraction of purified raw materials (from lipophilic substances and phenolic compounds) with hot water in a ratio of 1:10 when heated to 90 °C for 2 hours. The extraction process was repeated three times. The resulting extracts were combined and concentrated in evaporation dishes in a water bath. The deposition of WSP was carried out by treatment with ethyl alcohol 95% in 3 times the volume. During the day, an amorphous flocculent precipitate formed, which was filtered off, washed with ethyl alcohol 70% and 95%, chloroform, dried and weighed.

The extraction of pectin substances (PV) was carried out from air-dry meal, which remained after receiving the WSP. For this, the method of infusion in a mixture of oxalic acid and ammonium oxalate 0.5% in a 1: 1 ratio for 2.5 hours at a temperature of 80–85 °C was used. The PV content was also determined gravimetrically. To do this, they were precipitated from the extraction with a 5-fold amount of 95% ethyl alcohol. The resulting precipitate was filtered off and washed with ethyl alcohol of various concentrations and chloroform, dried and weighed.

For HZ extraction and HZB Air-dry meal after extraction of WSP and PV was treated with a solution of sodium hydroxide 10% in a ratio of 1: 5 at room temperature for a day and filtered. Glacial acetic acid was added to the filtrate to pH 6–7 (checked with litmus paper) and the precipitate of HCA was filtered through a filter for finely porous sediments. Further, for the formation of HZ sediments the resulting filtrate was precipitated with a 2-fold volume of ethyl alcohol 95%. HZ precipitate formed also washed with ethyl alcohol and dried [3].

Determination of the amino acid composition of the water-soluble fraction of polysaccharides by produced the X-ray fluorescence method [4].

#### RESULTS AND ITS DISCUSSION

Analysis of the results of the study showed that the freshly prepared complexes showed different colors and solubility (Table 1). The yield of polysaccharides of the herb *Gynostemma pentaphyllum* and the metrological characteristics of the method are presented in table. 2. The studied amino acid composition of the water-soluble polysaccharide fraction is presented in table. 3.

Table 1

## Characteristics of polysaccharide fractions isolated from the herb of gynostemma pentafia

Name fractions	Description	Solubility	Chemical reactions
VRPS	amorphous flaky light brown powder	forms in water unclear milky color solution; * "+" In acids and alkalis; * "-" in organic solvents	reactions deposition with acetone, alcohol
PV	amorphous powder light gray	* "++" in water with the formation of a viscous solution	reaction deposition with solution aluminum sulfate 1%
HZA and HZB	amorphous powders yellowish brown colors	* "++" in water and alkali	-

Notes: soluble - "+", well soluble - "++", insoluble - "-"

table 2

Basic metrological characteristics  
the quantitative content of polysaccharides in the herb of gynostemma pentaphyllum

Fractions	F	$\bar{x}$	S	P,%	t (P, f)	Eabs	Erel,%
VRPS	nine	23.3	0.00004	95	2.26	0.00009	0.04
PV		13.5	0.00005			0.00012	0.09
HZA		16.4	0.00007			0.00017	0.10
HZB		17.0	0.00005			0.00011	0.06

As a result of the performed gravimetric analysis of the gynostemma herb, the five-leafed yield of the carbohydrate complex was: VRPS - 23.3%; PV - 13.5%; GCA and GS - 16.4% and 17.0%, respectively. The experiment showed the predominance of the water-soluble fraction in the studied polysaccharide complex.

In the course of the study, 14 amino acids were identified, of which 9 are essential. From the results of the study of the amino acid composition of the water-soluble fraction, presented in table. 3 that the highest accumulation of valine, proline, glycine, and arginine is characteristic of the herb gynostemma pentaphyllum.

Table 3

## Amino acid composition of the water-soluble fraction of gynostemma quintuple

Amino acid	Content, %	Amino acid	Content, %
lysine*	0.6 ± 0.03	isoleucine *	0.17 ± 0.008
proline	2.23 ± 0.04	arginine *	1.23 ± 0.06
methionine *	0.39 ± 0.02	leucine *	0.40 ± 0.02
glycine	1.25 ± 0.06	threonine *	0.68 ± 0.03
cysteine	0.56 ± 0.03	tyrosine	0.28 ± 0.014
valine *	1.11 ± 0.06	serine	0.87 ± 0.04
histidine *	0.23 ± 0.01	phenylalanine *	0.77 ± 0.04

Note: essential amino acids - "\*".

Analyzing the studies carried out, one can judge the significant content of polysaccharides in the herb of gynostemma pentaphyllum and suggest the possibility of using this plant not only as an adaptogenic, antioxidant drug, but also as a therapeutic and prophylactic agent for poisoning with heavy and radioactive elements, as well as for gastrointestinal pathologies for restoration of normal intestinal microflora.

1. For the first time from the herb of *Gynostemma pentaphyllum*, introduced on the territory of the Republic Bashkortostan, the polysaccharide fractions were extracted, characterized and quantitatively determined: water-soluble polysaccharides, pectin substances, hemicelluloses A and B. In the raw materials under study, water-soluble polysaccharides are predominant.

2. Established the amino acid composition of the water-soluble fraction. X-ray fluorescence method identified 14 amino acids, of which 9 are "irreplaceable".

3. The data obtained prove the promise of further study of grass polysaccharides *Gynostemma five-leafed*, since they can make a significant contribution to the pharmacological activity of the plant.

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