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Research Article

Representatives of the Genus Goryanka (*Epimedium* L) – a Promising Source of Raw Materials for the Creation of Medicines for the Treatment of Erectile Dysfunction in Men

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ABSTRACT

Erectile dysfunction and multiple mechanisms of its development are one of the most pressing problems of modern medicine. In the twenty-first century, millions of men around the world suffer from sexual disorders, and the number of such patients is only growing from year to year. The flavonoid icariin, contained in plants of the genus *Epimedium* L., is a promising pharmacologically active substance used for erectile dysfunction, due to its ability to affect type 5 phosphodiesterase, inhibiting its activity. To date, domestic and foreign pharmaceutical companies produce biologically active food additives and herbal preparations, which include Goryanka extract. But the range of standardized herbal medicines is very small.

Key words: Drug, *Epimedium* Estrellita, Icariin, Impotence.

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INTRODUCTION

Erectile dysfunction (ED) is one of the most pressing problems of modern medicine. According to who, after 21 years of age, erectile dysfunction is detected in every 10 men, and after 60 years of age, every 3 men are not able to perform sexual intercourse at all.[1-17] Erectile dysfunction in the age group of 40-49 years is more than 2 times more common compared to men under 30 years of age, at the age of 50-59 years almost 3 times more common and almost 4.5 times more common in men over 60 years of age, over 70 years of age ED is observed in all cases.[18] These statistics are explained by the reasons for the development of ED: a decrease in blood flow to the penis as a result of damage to the arteries and nervous system, which begin to predominate with age, as well as the presence of these population groups of the main risk factors for ED: age, diabetes, hypertension, atherosclerosis, hormonal disorders, prostate diseases, bladder, prostatectomy, spinal cord damage, nervous system damage: multiple sclerosis, Parkinson's disease, Alzheimer's disease, peyronie, psychological factors: stress, depression, alcohol intake and smoking, taking certain medications — antipsychotic, anxiolytic agents, antidepressants, hormonal drugs, histamine H2-receptor antagonists, diuretics, with the exception of loop medications.

Today, the pharmaceutical market offers the consumer a large number of medications of various pharmacological groups, phytopreparations, as well as biologically active additives (BAA) used for ED, the mechanism of action of which is associated with the influence on various links of the emergence of an erection.

The purpose of this work is to theoretically substantiate the possibility of using medicinal plant raw materials of the genus Goryanka (*Epimedium* L) to create medicines for the treatment of erectile dysfunction in men.

MATERIALS AND METHODS

There are about 50 plant species in the genus *Epimedium* L. Most of them are endemic. On the territory of Russia, the Goryanka is found only in the South-Eastern part of the Primorsky territory in the Sikhote-Alin mountains. It grows in Japan, Korea, North-Eastern China, India (on the slopes of the Western Himalayas), southern Europe and North Africa. There are 41 species in China, 40 of which are endemic plants. Representatives of the genus *Epimedium* L. grow in light broad-leaved and oak forests on gentle slopes, on dry soils.

As a medicinal plant raw material, herba Epimedii is prepared from plants of the barberry family (Berberidaceae) of the following species presented in Table 1.[2,3]

Medicinal plant raw materials of Goryanka containers are harvested from wild and cultivated plants of the above-mentioned Pharmacopoeia species during the maximum accumulation of biologically active substances — during the entire summer and autumn during the period of abundant leaf growth.

DISCUSSION

On the basis of the neurohumoral mechanism of an erection when sexual stimulation occurs activation of the parasympathetic nervous system. The release of mediators, in particular nitric oxide (NO, endothelial relaxing factor), from the endothelium of the vessels of cavernous bodies leads to the accumulation of

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Table 1: Pharmacopoeia species of plants of the genus *Epimedium* L.

Epimedium brevicornum Maxim.

Epimedium pubescens Maxim

Epimedium grandiflorum C. Morren

Epimedium sagittatum Maxim

Epimedium wushanense T. S. Ying

Epimedium koreanum Nakai

cyclic guanosine monophosphate (cGMP) in the cavernous tissue and the relaxation of smooth muscle cells of the walls of the bearing arteries and cavernous bodies. Filling the cavernous bodies with arterial blood causes compression of the venules and blocking the outflow of blood from the penis (veno — occlusive mechanism) - an erection occurs. Vascular smooth muscle cells metabolize cGMP using phosphodiesterase type 5 (PDE5). When there is a reduction relaxation of smooth muscle cells, reduction of blood flow through the arteries and increasing venous outflow. ED may be due to insufficient vasodilation due to cGMP deficiency or decreased vascular sensitivity to cGMP, lack of penile vein compression due to connective tissue overgrowth, or a combination of these causes. Thus, medications can be directed to inhibit PDE5, activate no synthesis, or use α-blockers, due to the increased content of α-adrenoreceptors in the cavernous tissue (more than 10 times more than β-adrenoreceptors).

Also, herbal preparations and dietary supplements have proven themselves in ED, one of the components of which is the extract of Goryanka (lat. *Epimedium* L), which has been used for many centuries in medicine in East and South-East Asia for sexual dysfunction, decreased libido and infertility in both men and women.[4,5]

Most researchers believe that the pharmacological effect of Goryanka is due to the flavonoids contained in it.[2,6,12,13] icariin, epimedine A, epimedine B, epimedine C, sagittatoside, 2" - O-rhamnosilicarizide II and baohuoside I (Figure 1). The content of these flavonoids varies depending on the type of mountain ash, climate zone and growing conditions. Icariin is the main pharmacologically active substance. The flavonoids epimedine A, epimedine B, epimedine C, and baohuoside I have the same pharmacological activity as icariin.[6]

Clinical studies have shown that icariin, being the main pharmacologically active substance of Goryanka extract, inhibits all isoforms of phosphodiesterase type 5 by 80 % and increases the level of cGMP in smooth muscle cells of cavernous bodies. To enhance the inhibitory effect, icariin derivatives were obtained, among which 3,7-

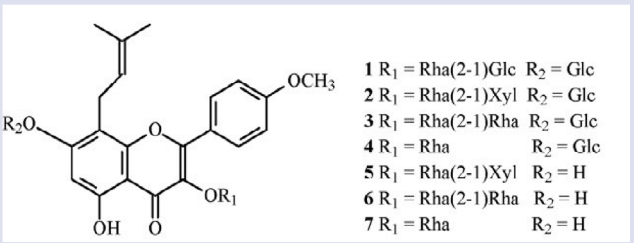

Figure 1: Chemical structure of 7 mountaineer flavonoids: 1-epimenide A, 2-epimenide B, 3-epimedine C, 4-icariin, 5-sagittatoside B, 6-2" - Oramnosilicarizide II, 7-baohuoside I.

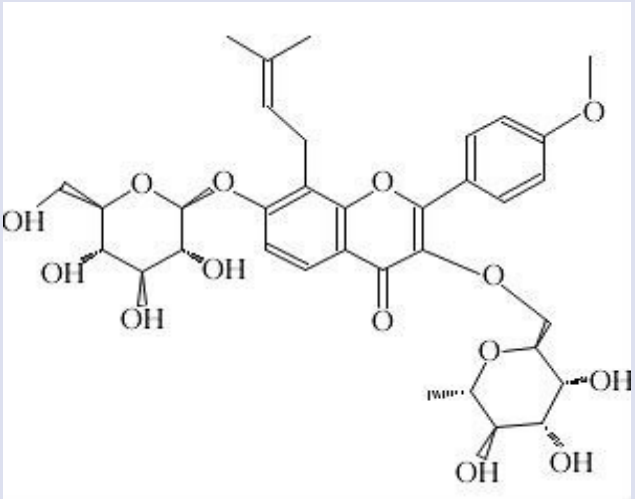

Figure 2: Chemical structure of icariin.

bis (2 hydroxyethyl) icaritin inhibited PDE5 like Sildenafil. It was also noted that in comparison with Sildenafil, the selectivity of this derivative for PDE 6 and the camp - PDE bond was significantly higher.[8,9]

Icariin causes the expression of the endothelial NO-synthase gene, which in turn increases the synthesis of nitric oxide by endothelial cells.[10]

The above mechanisms of action prove the scope of icariin-erectile dysfunction. In addition, it contributes to the production of testosterone.[9,14]

Also, icariin and other flavonoids of Goryanka grass have estrogenic activity, stimulating the formation of bone tissue and preventing bone resorption and osteoporosis in women during menopause. At the same time, there are no phenomena of endometrial hyperplasia.[15] Recent pharmacological studies have also shown that Goryanka flavonoids exhibit anti-inflammatory, immunostimulating effects and certain hypotensive activity.[13]

However, when taking high doses or in combination with other medications with a similar effect, Goryanka herb can cause heart rhythm disorders (tachycardia), insomnia, anxiety, a significant increase in activity with the subsequent development of fatigue, hypotension, dizziness, vomiting.[11]

It is not recommended for use by pregnant and nursing women, since there is no data on the safety and effectiveness of medicinal herbal preparations based on this plant due to the fact that studies on pregnant women have not been conducted.

There is not enough information about the toxicity of medicines based on Goryanka. During the study of this plant on animals, mutagenicity was not detected, but its long-term use led to a decrease in the activity of the thyroid gland.[12] drugs such as Captopril, enalapril, Losartan, Diltiazem, Amlodipine, hydrochlorothiazide, Furosemide enhance the hypotensive effect of the mountain grass. When taken simultaneously with anticoagulants (Aspirin, Clopidogrel, Warfarin), the risk of bleeding increases.

To date, domestic and foreign pharmaceutical companies produce biologically active food additives and herbal preparations, which include Goryanka extract. But the range of standardized herbal medicines is very small.

CONCLUSIONS

Representatives of the genus Goryanki (*Epimedium* L) containing icariin are promising medicinal raw materials for the creation of standardized medicines for the treatment of erectile dysfunction in men, since they are currently mainly represented by biologically active additives.

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GRAPHICAL ABSTRACT

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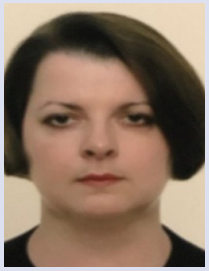

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