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SOME ASPECTS OF PHARMACOLOGICAL PROPERTIES OF SHIKONIN

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Abstract: Due to its value as a pharmacological agent, today many studies are also aimed at understanding the process of formation of these biologically active substances. The presented literature review is devoted to summarizing the long-term experience of foreign and domestic scientists in the field of studying the pharmacological properties of shikonin and its derivatives.

Keywords: Shikonin, red-rooted sparrow, naphthoquinones, borage family, shikonin derivatives.

INTRODUCTION

The result of the interaction of plants with environmental factors is the formation of various chemical substances. These secondary metabolites are often characteristic of specific plants and families. Thus, many representatives of the Boraginaceae family, for example, from the genus Alcanna, Arnebia, Sparrow, Onosma, Sinyak, form naphthoquinones mainly in root cells [1]. Over the past decades, due to its pronounced pharmacological properties, interest in shikonin, a biologically active substance of naphthoquinone nature, which is one of the active components of the roots of the red-rooted sparrow (Lithospermum erythrorhizon Sieb.), has increased.

MATERIALS AND METHODS

Shikonin was first isolated as acetate from the roots of Sparrow redroot by Japanese chemists Majima and Kuroda in 1922. However, their description of the structure of shikonin was inaccurate. A few years later, in 1936, Brockmann elucidated the structure of this molecule, which was identified as 5,8-dihydroxy-1,4-naphthoquinone [2].

The roots of Red-rooted Sparrow have long been used in East Asia and the Far East for dyeing wool and fabrics, and today shikonin remains relevant as a dye [1]. Its medicinal use dates back to the second century, but the first written mention of medicinal properties can be found in texts of traditional Chinese medicine from 1596 according to the correspondence of Tsao Kang Mu, who recommends the use of Sparrow roots to treat burns, ulcers, hemorrhoids and skin wounds [3]. Shikonin is the main component of "Zikao" – a Chinese herbal preparation, which is the dried roots of the red-rooted sparrow [4].

RESULTS AND DISCUSSION

A study conducted by Yao Xiong and colleagues examined the effects of β, β-dimethylacrylshikonine (at least 98% pure) on MCF-7 breast carcinoma cells. Breast carcinoma is the most commonly diagnosed cancer in women in all ethnic groups, and ranks second in terms of mortality in China. According to the results of the study, β,β-dimethylacrylshikonine dose-dependently inhibited the proliferation of MCF-7 carcinoma cells, presumably by stimulating apoptosis [2]. Therefore, β,β-dimethylacrylshikonine can be called a promising antitumor agent. The antitumor effect of Sparrowweed was also demonstrated in the experiment of Rajasekar S. et al. in vitro on the B16F10 mouse melanoma cell line, as well as in vivo in an experiment on mice with implanted tumors: the use of the extract led to a significant reduction in the growth (by 43%) and weight (by 36%) of the tumor. Thus, shikonin and its derivatives are capable of influencing a wide range of cellular targets associated with the development of cancer, and therefore are promising anticancer agents.

At the same time, they are inactive against gram-negative bacteria, such as Escherichia coli, Pseudomonas aeruginosa and Micrococcus luteus [2]. However, some studies do not deny the effectiveness against Escherichia coli and Pseudomonas aeruginosa [4]. Initially, it was believed that the antibacterial activity of shikonin was based on a bacteriostatic effect, but a study by Papageorgiou V.P. et al. showed that the compound has bactericidal properties. The same study suggested that shikonin may be a promising therapeutic agent against methicillin-resistant Staphylococcus aureus. Shen C.C. and colleagues analyzed the activity of shikonin and some of its derivatives against methicillin-resistant Staphylococcus aureus and vancomycin-resistant Enterococcus faecium and Enterococcus faecalis. In this study, shikonin showed a minimum inhibitory concentration (MIC) of 6.25 μg/ml against Staphylococcus aureus (both methicillin-resistant and non-resistant) and 50 and 25 μg/ml against Enterococcus faecium and Enterococcus faecalis, respectively [3]. Li et al. published a paper in which they gave a MIC value of 125 μg/ml against Staphylococcus aureus, but these authors did not study the effect of shikonin on methicillin-resistant strains. It can be seen that the difference in MIC in both studies is 20 times different, so it makes sense to conduct further research in this direction.

Acceleration of the healing process of wounds under the influence of Sparrow has been known since ancient times. However, the mechanism of wound healing action remains the subject of much debate. A study conducted by Shu-Yi Yin and colleagues showed that topical application of shikonin in vivo stimulates cell chemotaxis, adhesion, and cellular immune response, thereby accelerating the wound healing process. Zhuravlev Y.N. and colleagues established a positive therapeutic effect of shikonin oil for erysipelas, trophic ulcers, pyoderma, streptoderma and other infectious and inflammatory processes [2, 3].

CONCLUSION

Based on the analyzed material, we can conclude that at the present stage, shikonin and its derivatives are in the spotlight as promising biologically active compounds due to their pronounced pharmacological activity. Their healing properties have been proven by numerous independent studies. However, uncertainty remains on a number of issues, since the results of some studies contradict each other. Therefore, future studies should be aimed not only at elucidating the molecular targets of shikonin and some of its derivatives, but also at determining the clinical potential of these biologically active compounds.

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