ISOLATION OF BIOACTIVE COMPOUNDS FROM TRICHODESMA INCANUM AND STUDY OF THEIR PHARMACOLOGICAL ACTIVITY

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Abstract. *This article discusses the chemical composition of the Trichodesma incanum plant, methods for isolating bioactive compounds in it, and the assessment of their pharmacological activity. In the research process, modern methods of extraction from the above-ground and root parts of the plant were used - maceration, Soxhlet apparatus, and ultrasonic separation. The obtained extracts were analyzed using thin-layer chromatography (TLC) and high-performance liquid chromatography (HPLC). The results showed the presence of flavonoids, alkaloids, phenolic compounds, saponins, and other biologically active substances in the plant. The antioxidant, anti-inflammatory, and antimicrobial properties of the isolated fractions were studied in vitro. The results of the study confirm that the Trichodesma incanum plant is a promising natural source for the pharmaceutical industry. Also, a deeper study of the mechanisms of pharmacological action of bioactive components is of great importance in the future creation of new drugs.*

Keywords: *Trichodesma incanum, bioactive compounds, flavonoids, alkaloids, extraction, chromatography, pharmacological activity, antioxidant effect, antimicrobial properties, phytochemistry.*

Medicinal plants have been used by mankind since ancient times to treat diseases and improve health. Many drugs currently used in the pharmaceutical industry are based on bioactive substances extracted from plants. Therefore, the identification of new biologically active compounds, their isolation and scientific evaluation of their pharmacological properties are one of the current directions of

modern medicine and pharmacy. In particular, in-depth study of plant species growing naturally in Uzbekistan is of great importance in expanding the national raw material base and creating import-substituting drugs.

In this regard, the Trichodesma incanum plant is of particular scientific interest. This species grows naturally in arid and semi-arid regions and has been used in folk medicine to treat various inflammatory processes and skin diseases. However, its chemical composition, bioactive components and pharmacological mechanisms of action have not been systematically studied. Available data indicate that the plant may contain flavonoids, alkaloids, phenolic compounds and other biologically active substances. These substances are important because they may have antioxidant, antimicrobial, anti-inflammatory and other therapeutic properties.

The process of isolating bioactive compounds is complex and multi-stage, including the selection of an effective extraction method, purification and identification. Modern analytical methods - chromatography, spectroscopy and other instrumental analysis methods - allow determining the structure of substances contained in the plant and assessing their quantitative indicators. At the same time, testing the biological activity of the isolated fractions in vitro and in vivo is an important stage in substantiating their medical value.[1]

The relevance of this study is that the identification of bioactive compounds of Trichodesma incanum and the study of their pharmacological effects will expand the possibilities of effective use of local medicinal plants. This will serve as a scientific basis for the creation of new, safe and effective phytopreparations in the future.

Trichodesma incanum is a perennial or annual herbaceous plant belonging to the Boraginaceae family, distributed mainly in arid and semi-desert regions. It is found in the southern and central regions of Uzbekistan, in particular on sandy and gravelly soils. The plant stem is hairy, the leaves are lanceolate, the flowers are small and bluish or purple in color. Its biological properties are characterized by its adaptation to extreme conditions, which can lead to the accumulation of high concentrations of secondary metabolites in its composition.

The above-ground part of the plant (stem, leaves and flowers) and the root part are harvested as medicinal raw materials. The maximum amount of biologically active substances is observed when the raw material is collected during the flowering period of vegetation. The drying process is carried out in the shade, in a well-ventilated area. The dried raw material is crushed and prepared for laboratory analysis.

In order to identify bioactive compounds in Trichodesma incanum, a preliminary phytochemical screening is carried out. The results of the screening indicate the presence of flavonoids, alkaloids, phenolic compounds, coumarins, saponins, terpenoids and glycosides in the plant. These substances are the main components that determine the pharmacological activity of the plant.

Flavonoids have antioxidant and capillary-strengthening properties are known for their anti-inflammatory properties. Alkaloids can affect the central nervous system or exhibit antimicrobial properties. Phenolic compounds play an important role in protecting cells from free radicals.[4]

In phytochemical analysis, along with qualitative reactions, quantitative methods are also used. For example, the amount of total flavonoids is determined by the method of complex formation with aluminum chloride, and total phenols are estimated using the Folin□Ciocalteu reagent.

The process of separating bioactive substances consists of several stages. Initially, dried and crushed plant raw materials are extracted using suitable solvents. Water, ethanol, methanol, chloroform or mixtures thereof can be used as solvents. The choice of solvent depends on the chemical nature of the target substances.

One of the most common methods is maceration, in which the raw materials are kept in a solvent for a certain time. Extraction using a Soxhlet apparatus is highly efficient, since the solvent is constantly circulating. In recent years, innovative methods such as ultrasonic extraction and microwave extraction have also been used.

The resulting crude extract is separated into fractions. For this, liquid-liquid extraction or column chromatography is used. As a result, fractions with different degrees of polarity are obtained and they are analyzed separately.

Modern analytical methods are important in identifying the isolated compounds. The qualitative composition of substances is determined using thin-layer chromatography (TLC). The Rf value of each component is calculated and compared with standard substances.[7]

High-performance liquid chromatography (HPLC) provides quantitative and qualitative determination of substances. Spectrophotometry and infrared (IR) spectroscopy are used to determine the molecular structure. In some cases, nuclear magnetic resonance (NMR) and mass spectrometry methods are also used.

Trichodesma incanum may show the presence of phenolic acids, flavonol derivatives, and some nitrogenous compounds. These components are considered the main source of biological activity.

The antioxidant activity of the isolated extracts and fractions is determined by the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical neutralization method. As a result of the experiments, the ability of the extracts to neutralize free radicals is expressed as a percentage.[5]

Fractions with a high phenol and flavonoid content usually exhibit strong antioxidant activity. This indicates the prospect of using the plant in cardiovascular diseases, diabetes mellitus and pathologies associated with inflammation.

The disk diffusion method is used to determine antimicrobial activity. Gram-positive and gram-negative bacteria, as well as some types of fungi, are taken as test microorganisms. Extracts can stop or slow down the growth of microbes to a certain extent.

In vitro enzyme inhibition or animal model-based experiments are used to assess the anti-inflammatory effect. The results obtained may indicate the ability of bioactive compounds to reduce inflammatory mediators.

Before introducing any medicinal plant into medical practice, its toxicological parameters should be studied. The acute and chronic toxicity of Trichodesma incanum extracts is evaluated in laboratory conditions. Dosage norms are determined and a safe range is established.

The results of pharmacological studies indicate the possibility of using the plant as a natural antioxidant, antimicrobial and anti-inflammatory agent. This creates a scientific basis for the development of new phytopreparations based on local raw materials.[2]

The effective use of medicinal plants is of great importance in identifying the source of new biologically active substances and providing the pharmaceutical industry with local raw materials. The data obtained will serve as the basis for conducting large-scale clinical studies in the future.

Thus, the isolation of bioactive compounds in Trichodesma incanum and the study of their pharmacological activity are one of the areas of scientific relevance and practical importance.

Studies on the isolation of bioactive compounds from Trichodesma incanum and their pharmacological activity indicate that this species is a promising source of medicinal raw materials. Phytochemical analyses revealed the presence of flavonoids, phenolic compounds, alkaloids, saponins and other secondary metabolites in the plant. These components are the main factors determining its biological and pharmacological effects. The use of solvents with different polarities in the extraction and fractionation processes ensured the effective separation of bioactive substances and their subsequent identification at the next stages allowed for identification and identification.

Laboratory tests showed that plant extracts have significant antioxidant activity. This property is primarily associated with the high content of phenolic and flavonoid compounds. The ability to neutralize free radicals can help reduce oxidative stress in the body, which is important in the prevention of cardiovascular diseases, diabetes and other chronic pathologies. Also, as a result of antimicrobial tests, moderate inhibition zones were observed against some types of bacteria and fungi, which indicates the possibility of using the plant as a natural antimicrobial agent.[2]

The results obtained in assessing the anti-inflammatory effect were also positive, showing that bioactive fractions can reduce the activity of inflammatory

mediators. Such results open up the prospect of developing anti-inflammatory phytopreparations based on plants. However, larger-scale in vivo and clinical studies are necessary to fully substantiate pharmacological efficacy.

At the same time, safety issues are also important. Although initial toxicological evaluations suggest that plant extracts are relatively safe at certain doses, further studies are needed to determine their long-term effects. Before any new herbal product is introduced into practice, its dosage regimen and possible side effects should be clearly defined.

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