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Methods of obtaining biologically active complex and investigation of the chemical composition of some species of plant genus *Climacoptera* (*C. ambylostegio*, *C. subcrassa* and *C. korshinskyi*)

Annotation

Dissertation for the degree
Doctor of Philosophy (PhD) in the specialty
«6D072100–Chemical Technology of Organic Substances»

Urgency of the work:

Currently, 15-20% of drugs are produced by Kazakhstan's pharmaceutical companies, so increasing of domestic drugs and suggesting of new methods of isolation of biologically active complexes are a priority and actual task. Therefore, a great theoretical and practical interest play plants of *Chenopodiaceae* family, *Climacoptera* genus, which are widespread in Kazakhstan and some of them are endemic plants.

Consequently searching for new sources of biologically active compounds among the *Chenopodiaceae* family plants, growing in arid regions has not been exhausted. In this regard, study of the chemical composition of new species of plants, the development of flowcharts of isolation of biologically active compounds, the determination of their biological activity and achievements of new herbal remedies from Kazakhstan's species of wild plants is also socially significant, and provides an opportunity for expanding the range of medical drugs of Kazakhstan from local wild renewable sources of plant material.

The purpose and the objectives of the study: investigation of the chemical composition and method of production of biologically active complex of plants of the family *Chenopodiaceae* genus *Climacoptera* - *C. ambylostegio*, *C. subcrassa* and *C. korshinskyi*, which growing in the arid regions of the Republic of Kazakhstan.

To achieve the intended objective we will study the following **tasks**:

1. Comparative investigation and quantitative determination of the chemical composition of complex biologically active substances of the three growing in arid zones;
2. Development the technological scheme of optimal methods for the determination and isolation of biologically active substances. The optimize method of obtaining a complex of total flavonoids.
3. Identification and structure elucidation of individual substance with the assistance of modern chemical and physico-chemical methods of analysis;
4. Conduct biological screening of total extracts on different types of activity.

Scientific novelty of the work:

- For the first time in the framework of fundamental program quantification of the main groups of biologically active substances and a comparative study of the chemical composition of three plant species *Chenopodiaceae* family, the genus *Climacoptera* - *ambylostegio*, *C. subcrassa* and *C. korshinskyi* growing in arid zones.

- Development the technological scheme of optimal methods for the determination and isolation of biologically active substances. For the first time, using the method of supercritical fluid extraction - CO₂ lipophilic composition of plants investigated. As a result, from the genus *Climacoptera* allocated 70 lipophilic substances. For isolating total flavonoid complex from the plant genus *C.subcrassa*, proposed a flowchart and an optimal sorbent. A comparative analysis of the isolated flavonoid complex using HPLC was done.

- The scheme of extraction and separation of individual substances allocated 23 from *Climacoptera subcrassa*. Structures of the compounds were proved by chemical and physico-chemical (IR, UV, ¹H-NMR; ¹³C-NMR, 2D NMR: COSY - 45°, HMBC, HMQC; HRESI-MS, FAB, EI and FD-mass spectrometry and by GLC, atomic absorption spectroscopy) methods of analysis.

- For first time the biological activity of 9 biologically active complexes isolated from plants of the genus *Climacoptera*. Two of them are biologically active complex is showed high antioxidant and antibacterial activity.

Structure of the dissertation: The dissertation is consists of standard references, abbreviations, introduction, review of literature, materials and methods, results and discussion, conclusion and list of references. The work is formulated from 136 pages, contains 41 figures and 42 tables and list of 154 references used.

Results of work:

1. For the first time in the framework of fundamental program the aerial parts of the plant genus *C. ambylostegio*, *C. subcrassa* and *C. korshinskyi*, which growing in the Almaty region were studied. A comparative study of the component composition and quantitative content of three plants. As a result, allocated 9 macro - and microelements, 20 amino acids, 8 fatty acids, 35 lipophilic compound, 16 flavonoids, 1 carbohydrate, 1 purine substance and 5 saponins. According to the analysis of the genus *Climacoptera subcrassa* has a high content of flavonoids.

2. The scientific basis of extraction and separation of biologically active compounds from plants were developed for the first time. Investigation of lipophilic composition of the plants by using the method of supercritical fluid CO₂ extraction. A comparative analysis of essential oils using GC-MS. Establishment of the chemical composition of *Climacoptera* lipophilic compound revealed the presence of 70 compounds. In *C. subcrassa* identified 11 components, while in *C.korshinskyi* – 16 components were identified and *C. ambylostegio* – 8 component. For the isolation of biologically active complexes effective solvents, the optimal block scheme of separation of substances, material balance and laboratory regulations were proposed.

For effective separation of butanol extract of a plant of genus *C.subcrassa* used as a macroporous AB-8. A quantitative analysis of flavonoid complex by HPLC was done, as a result 8 flavonoids were determined.

3. As a result of scientific research isolated 23 individual substances, which structures established by modern spectral analysis methods (IR, UV, EI-MS, FAB-MS, ^1H , ^{13}C , 2D-NMR: HMBC, HMQC; COSY).

4. 9 biologically active complexes for bioscreening for various activities were elaborated. As a result of bioscreening of biologically active complex showed antioxidant and antibacterial activities. Main components of an antioxidant activity are flavonoids, quercetin glycosides and isorhamnetin. For antibacterial effect of biologically active complex are responsible arbutin, hypsogenin glycosides and adenine. First identified cytotoxic activity of the ethyl acetate extract of plants of the genus *Climacoptera*.

Publications: The main findings and results of the dissertation work were published in 13 scientific articles: 6 articles were published in international journals have impact factors (one in Thomson Reuter's database), 4 articles in local editions journals recommended by the Committee for Control of Education and Science of Ministry of education and science of Republic of Kazakhstan and 2 articles were published in the proceedings of the international/state conferences.

The results of the are decorated as an application for innovative patent RK "A method for producing phytopreparation with antioxidant activity" (№8, 15.08.2014). An official act of introduction in the educational process for the discipline "Chemical technology of of processing plant raw materials" a specialty «Chemical technology of organic substances», (№7, 23.01.2014) and the laboratory regulations were developed.