

## Summary

Oxidative stress is one of the main causes of many medical conditions including civilization diseases. A form of defense against free radicals is the action of antioxidants, both of synthetic and natural origin. Natural substances with antioxidant properties contain phenolic compounds. It is a group of organic compounds that are secondary metabolites of plants. They are mainly divided into two groups: phenolic acids and flavonoids. Due to their abundance and diversity, these compounds exhibit a wide range of biological properties. Above all, they have a strong antioxidant effect, which makes them potential therapeutic agents. For many years, plant extracts rich in phenolic compounds have been used for healing purposes. Therefore, interest in these bioactive substances has been observed in the food, cosmetic and pharmaceutical industries. In addition, the antioxidant activity of phenolic compounds has also been appreciated in agriculture. It is related to their beneficial influence on the growth and development of plants.

The literature data show that algae are a rich source of biologically active compounds, including antioxidants. The algae substances with antioxidant properties are mainly phenolic compounds and carotenoids. Algae biomass, especially marine, has been used in various industries for centuries. This is mainly due to their healing potential. In Poland, both saltwater and freshwater algae are mainly treated as waste. Therefore, it is important to look for methods that will allow the evaluation of algae extracts and other underestimated plant raw materials in terms of the content of biologically active compounds, as well as testing their biological properties. Proper disposal of algae biomass can contribute to the use of extracts as valuable components of various products, and thus improve the quality of water.

There are many methods for the isolation and determination of antioxidant substances, including phenolic compounds in plant extracts. Extraction techniques are mainly used to isolate these bioactive substances. However, their analysis (qualitative and quantitative) is usually carried out using spectrophotometric and chromatographic methods. Spectrophotometric and colorimetric methods, mainly based on reaction with free radicals, are used to evaluate the antioxidant activity of plant extracts.

Despite the wide range of methods, procedures that will allow for selective and effective separation of biologically active compounds, and at the same time will be inexpensive, simple, fast and, above all, environmentally friendly, are still in demand. In addition, the growing interest in preparations based on natural ingredients is constantly growing. Thus, deepening the knowledge of natural ingredients is a current and important topic.

The aim of the research conducted as part of the doctoral dissertation was to develop an effective method for the isolation and determination of antioxidant substances in selected plant extracts. The main research material was freshwater algae of the *Cladophora glomerata* species. The assessment of the chemical composition and biological (antioxidant) activity were to prove that it is an important raw material for the use of biomass in industry.

The use of various types of extraction and extractants made it possible to effectively separate phenolic compounds and/or other antioxidant substances from algae biomass. Spectrophotometric (Folin-Ciocalteu method, Christ-Müller method) and chromatographic methods (HPLC-PDA, HPTLC) allowed for qualitative and quantitative analysis of the examined extracts. The identification of the analyzed substances was facilitated by the development of a multi-stage extraction procedure, which enabled the isolation, purification, enrichment and fractionation of the tested compounds. The presence of compounds belonging to both phenolic acids and flavonoids was found in algal extracts of the *C. glomerata* species. Additionally, the high content of fatty acids was determined in the algae biomass, which made the raw material more interesting in terms of its chemical composition. The evaluation of the antioxidant activity was carried out using the DPPH, ABTS and FRAP tests. Regardless of the extraction conditions used, these methods made it possible to quickly and easily assess the biological activity of algal extracts. The developed methods were used to evaluate extracts obtained from various plant materials, and thus their versatility and repeatability were demonstrated.

Plant extracts, and in particular those obtained from freshwater algae, contain valuable ingredients, including those with antioxidant properties. The antioxidant activity of extracts of natural origin can be used in various industries. The developed extraction procedures enable the effective separation of bioactive compounds from matrices with a complex matrix composition, and the proposed procedures are suitable for the evaluation of antioxidant substances in plant extracts of various origins.