Summary

During everyday life, huge amounts of municipal sewage are generated all over the world. They contain significant amounts of biogenic elements, i.e. nitrogen and phosphorus, which have a negative impact on the aquatic environment. Their discharge without treatment into surface waters is currently unacceptable. After a standard treatment process, they can still contain high concentrations of soluble nitrogen and phosphorus compounds at a level that causes eutrophication of waters and excessive growth of aquatic vegetation and algae. This is a serious ecological problem and contributes to the deterioration of the quality of inland and marine waters. In addition, it directly affects the deterioration of the living conditions of aquatic organisms and the suitability of such waters for economic use by humans. It is therefore necessary to develop effective methods for removing nutrients using the most environmentally friendly technological processes.

The aim of this work was to determine the efficiency of removing soluble forms of nitrogen and phosphorus from municipal sewage using selected species of prokaryotic (Cyanophyta) and eukaryotic (Chlorophyta) microalgae and the possibility of later obtaining biomass from this process. The subject of the study was to determine the differences between individual species of prokaryotic and eukaryotic microalgaein terms of their growth efficiency in a culture solution containing municipal sewage and the suitability of these organisms in the process of purifying municipal sewagefrom biogenic elements. After obtaining selected species of prokaryotic and eukaryotic microalgae, preliminary studies were conducted to optimize the conditions for microalgae cultivation in bioreactors. In the next stage of the study, raw municipal sewage was used as a source of biogenic elements for microalgae growth in doses of 4%, 8% and 16%. This was to simulate partially purified sewage discharged into surface waters. Osram Biolux lamps were used to illuminate three bioreactors, the parameters of which allow for obtaining conditions similar to natural lighting. The period of illumination of the algae culture was 15 h per day. The culture suspension was aerated to force its movement and gas exchange. Samples were taken from the above cultures every 24 hours and the concentration of nitrates V, nitrates III, ammonium ions and phosphates V was determined. At the same time, optical density was measured using the spectrophotometric method for the maximum absorbance of chlorophyll a at 663 nm, which is a measure of the increase in the biomass of microalgae cells. On the last day of culture, the dry mass of the samples was determined in relation to the sample volume unit.

The obtained data showed that municipal sewage is a source of biogenic elements that intensify the growth of most of the microalgae species studied. Not all species were able to grow in such a medium. Of the 19 species of eukaryotic algae studied, growth was demonstrated in 16. However, of the 11 prokaryotic algae studied, only four species were resistant to harmful substances contained in sewage, and only one, Oscillatoria lutea, showed growth efficiency that allowed it to be considered useful. During the studies, significant differences appeared in the growth intensity of individual species, as well as between the analyzed groups of microorganisms. Among the eukaryotic microalgae studied, the highest increases in terms of dry cell mass were obtained for *Haematococcus* sp. *Desmodesmus* sp. *Scenedesmus acutus*, *Chlorella vulgaris* and *Chlorella sorokiniana*, above 0.100 mg s.m/dm3 per day. The smallest differences in growth intensity at individual concentrations of sewage in the medium were observed for *Chlorella vulgaris*, *Chlamydomonas* sp. and *Scenedesmus acutus*. The highest efficiency in removing nitrate ions V was characterized by *Scenedesmus acutus* and *Scenedesmus bifidus*, amounting to over 90% in relation to the initial value. The highest efficiency in removing ammonium ions, amounting to over 95%, was achieved for *Chlamydomonas* sp., *Chlorella fusca*, *Chlorella sorokiniana*, *Chlorococcum macrostigmatum*, *Coelastrella oocystiformis*, *Desmodesmus* sp., *Monoraphidium contortum* and *Scenedesmus acutus*. As for phosphate ions V, they were most efficiently removed from the culture solutions by *Haematococcus* sp. *Scenedesmus bifidus*, *Muriella terrestris*, *Chlorella vulgaris*, *Coelastrella oocystiformis* and *Monoraphidium contortum*. A reduction value of over 80% was achieved for them compared to the initial value. In most of the tested species that grew in the medium with the addition of municipal sewage, a strong negative correlation was observed between the increase in the biomass of the tested microalgae and the reduction in the concentration of nitrate ions V, ammonium and phosphate ions V. The obtained data also indicate that *Chlamydomonas* sp., *Chlorella vulgaris*, *Chlorococcum macrostigmatum*, *Desmodesmus* sp. and *Scenedesmus acutus* probably use nitrate ions III. Algae can therefore be an alternative to chemical methods of removing biogenic elements from municipal sewage in the process of its treatment. The obtained biomass can act as a raw material used for energy purposes, including biogas plants. Plant pigments such as chlorophyll or carotenoids obtained from algae biomass, while maintaining an appropriate level of microbiological and chemical purity, can also be obtained for industrial purposes.