

Popular science description of the project

Tumours are amongst the most serious diseases of modern civilization. Presently used chemotherapy, apart from disturbing the life cycle of neoplastically changed cells, destroys also healthy cells and causes a number of side effects, worsening overall condition of patients. For this reason, new, more effective and safe methods of cancer treatment are being sought, focused on selective elimination of cancer cells only. Natural compounds, due to their high application potential, currently play a significant role in the search for molecularly oriented drugs, dietary supplements or antimicrobial agents. With the development of biological treatment methods, natural substances started to be used as reference substances or as substrates to obtain their more active derivatives. They are the basis for many currently used chemotherapeutics, cardioprotectants, anti-inflammatory and antimicrobial agents. There are also increasing hopes for treatment based on a combination of different therapies or administration of at least two biologically active substances with different mechanisms of action. The use of biologically active compounds of different uptake sites in the cells is particularly important in the case of drug-resistant cancer cells. Easy availability of flavonoids with anticancer properties, which are present in daily diets, as well as relatively low cost of obtaining them, make them an important goal of scientific research all over the world. There is a constant search for new ways to use flavonoids in therapy based on increasing their bioavailability by improving their permeability through cell membranes and increasing their solubility in water. One of the methods of solving those problems may be synthesis of the so-called prodrugs, consisting in combining biologically active molecules with compounds facilitating their transport in the organism or increasing their affinity to subcellular structures. Another way of functionalization of pro-health substances which are difficult to dissolve under physiological conditions is the use of water-soluble, biologically inert carriers for their transport, which are transformed in vivo into harmless by-products and do not have a negative effects on the organism.

The studies planned under the project are aimed at development of new preparations based on biologically active hop flavonoids containing vitamin fragments, which are the ligands of integral membrane proteins of cancer cells, as well as at assessment of their biological activity: anticancer and antioxidant. Assessment of the biological activity in the different cell lines will inform about antiproliferative and genocytotoxic effects of the new molecules. The chemical structure modifications will include the three most important biologically active hop flavonoids: xanthohumol, 8-prenylnaringenin, isoxanthohumol and their selected structural analogues.

Implementation of main objectives of the project will lead to obtaining new modified flavonoids with an extended spectrum of therapeutic properties and will ensure effective transport of biologically active molecules to the target tissues. The research work carried out under the project, related to the search for innovative methods of cancer treatment, by using natural components, is an important contribution to the development of medical sciences, as well as biological and chemical sciences, with particular emphasis on medical chemistry, biochemistry and cell biology. The preparation and identification of new molecules with potential anticancer actions from hops phenolic compounds might have an important impact on the advancement of discipline.

Implementation of the supported project will make it possible to start a completely new research path related to obtaining flavonoids labelled with biotin, which in the future will also allow to develop non-invasive therapeutic methods based on their visualization under tissue conditions. The strategy based on combining in one molecule two groups with therapeutic activity may be a model in designing new anticancer and antimicrobial compounds also due to low probability of resistance to that type of structures. Availability of new derivatives will also allow in the future to expand the research on biochemical mechanism of their influence on cancer cells and dependence between biological activity and structure. These studies may mark new areas for the search for effective anticancer therapies and constitute an introduction to application-oriented research.