SUMMARY

Project objectives and hypothesis

Advances in medical sciences and results of the latest research have emphasized that bioactive compounds present in edible plants are of particular interest for the prevention of chronic and neurodegenerative diseases. The largest range of pro-health properties is attributed to secondary metabolites such as polyphenols, carotenoids, and chlorophylls, which exhibit strong antioxidative properties that protect the defense systems of the body against destructive effects of free radicals. However, natural, plant bioactive compounds are unstable and susceptible to oxidative degradation. Additionally, the application of pure bioactive compounds is very limited because of their rapid release, poor bioavailability, and easy deterioration in the presence of environmental stresses.

Therefore, for several years new methods of effective protection of natural bioactive compounds have been investigated. One of these methods is emulsification technique, especially single or multiple nanoemulssion methods. Nanoemulsions are method to improve the efficiency of the formation of emulsions, and they are emerging as a strong alternative to conventional emulsions to protect and deliver functional components.

Although the data presented thus far are extremely promising, there is a lack of information that could contribute to broaden the application of this process to other compounds, including mixtures of secondary metabolites. It is difficult to predict how the interactions between individual compounds will affect the efficiency, loading capacity, bioavailability, health-promoting properties, and stability of the resulting capsules.

Therefore, the main aim of the proposed project is to evaluate the possibility of using single and double nanoemulsions to encapsulate a mixture of polyphenolic and carotenoid compounds and to investigate how the emulsification technique affects the health-promoting properties, bioavailability, and stability of bioactive compounds isolated from different types of plant matrices.

Thus, the formulated research objectives will allow to completely verify the research hypothesis that assumes that (1) emulsification techniques are an excellent tool to protect bioactive compounds from environmental degradation and to modulate their health-promoting properties and bioavailability and (2) the use of natural biopolymers to create the outer coating is a modern approach that increases the efficiency of the encapsulation process.

Work plan

To fully realize the main objectives of this Project, the following research tasks have been defined

1. Identification and analysis (LC-MS-QTof and UPLC-PDA-FL) of the content of bioactive compounds, health-promoting properties (antidiabetic and antiaging activities), and bioavailability of the selected plant materials (chokeberry fruit, rose fruit, marigold, black hollyhock).
2. Isolation and determination of polyphenols and carotenoids, and analysis of health-promoting properties and bioavailability of the isolated compounds.
3. Use of the single emulsification process to encapsulate the isolated carotenoids and compare the health-promoting properties and bioavailability of the obtained nanoemulsions.
4. Use of the single emulsification process to encapsulate isolated polyphenols and compare the health-promoting properties and bioavailability of the obtained nanoemulsions.
5. Use of multiple emulsions to encapsulate isolated compounds and compare the health-promoting properties and bioavailability of the obtained nanoemulsions.
6. Shelf life research of the obtained nanostructures.

Expected impact of the research project on the development of science, civilization and socjety

The conducted investigations may contribute to the increased use of the emulsification technique to protect bioactive compounds against the destructive effects of environmental conditions and to modulate their bioavailability and health-promoting properties. To initiate this trend, it seems to be particularly important to develop a method that will enable encapsulation of any composition of biologically active ingredients, regardless of their structure and physicochemical properties. The development of this type of nanocapsules during this Project and demonstrating the advantages of this type of solutions will certainly help to use these structures as additives in food production. Therefore, the findings of this Project may in future yield measurable health-related and economic benefits.