## SUMMARY

**Introduction.** Numerous scientific reports indicate a number of benefits resulting from fruit consumption, mainly in preventing chronic non-communicable diseases such as obesity, diabetes and cardiovascular diseases. Over the years, it has been shown that the health-promoting properties of plant raw materials are positive correlated with the profile and content of bioactive compounds, i.e. polyphenolic compounds, carotenoids, vitamins, amino acids and others. Fruit, however, are only one morphological part of the whole species, there are also - seeds, leaves, tree bark or shoots. Based on own research and other authors, a general conclusion can be drawn that the above-mentioned ones are also a valuable source of bioactive compounds, however, their profile and composition are completely different from that which can be defined in fruit or products obtained from them. Thus, the leaves or seeds form a separate, complex plant matrix with specific health-promoting properties. However, a common feature of all plants and their parts is that the compounds they contain are sensitive to environmental factors, under the influence they are transformed or degraded. In addition, in an extensive plant matrix, they are characterized by poor bioavailability in the human body.

Therefore, for several years new methods of effective protection of natural bioactive compounds, and giving them specific physical and chemical propertieshave been investigated. One of them is the emulsification process, which has the potential to design complex microstructures with programmed health-promoting properties. Although the data presented thus far are extremely promising, there is a lack of information that could extend the application of this process to complexes of compounds, including those derived from different plant matrices with different characteristics and degree of saturation.

**Project objectives and hypothesis.** Therefore the main objective of the proposed project is to assess the possibility of using combined emulsification and drying techniques (vacuum or freeze-drying) to obtain multi-component, stable plant microstructures with programmed health-promoting properties and bioavailability. It is planned to use various types of berries species (raspberry, blackcurrant), seed species (quince, apple) and stone species (sour cherry, peach) in this work. The fruit juices, seed/seed oils and leaves obtained from these plants will be used to create the emulsion and then the microstructures.

Thus, the formulated research objective will allow to completely verify the research hypothesis that assumes that (1) the combination of emulsification techniques with a properly selected drying process is the optimal solution for the development of multi-component, complex microstructures carrying the features of various metabolic parts of the plant and/or plant matrices (2) the use of inulin and fructo-oligosaccharides will significantly reduce the addition of emulsifiers and surfactants in the emulsification process, at the same time ensuring the stability of the resulting emulsion and providing the obtained microstructure with prebiotic features (3) emulsification techniques in combination with drying process are an excellent tool to protect unstable plant compounds from environmental degradation and to modulate their health-promoting properties and bioavailability.

**Work plan.** To fully realize the main objective, 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, antioxidant, anti-inflammatory, and probiotics activities), and bioavailability of the selected plant matrix by using an in vitro metod.
2. Use of single emulsification process to encapsulate compounds isolated from various morphological parts of pome, stone and berry species.
3. Use of different drying techniques (freeze-drying and vacuum-drying) to obtain plant microstructures with programmed health-promoting properties.
4. Identification and analysis (LC-MS-QTof and UPLC-PDA-FL) of the content of bioactive compounds, health-promoting properties (antidiabetic, antioxidant, anti-inflammatory, and probiotics activities), and bioavailability of the obtained microstructures and their comparison with reference samples, and single semi-products used in emulsification process.
5. Determination of shelf-life stability of the selected microstructures and their comparison with reference samples.

**Expected results.** Thus far such a complex microstructure has not been obtained, and thus examined in such a system. The obtained microcapsules will enable an accurate identification of the emulsification process of a complex plant matrix, they will indicate the interaction between biosurfactants and emulsifiers in the form of inulin and FOS, both on the course and dynamics of the capsule formation process, as well as health-promoting properties and bioavailability of the resulting formations. Moreover, the interactions that may occur in the system: fruit juice - fruit seed oil; oil - bioactive compounds isolated from leaves; juice - bioactive compounds isolated from leaves, as well as the interaction of the above components with emulsifiers and surfactants will be extremely interesting from the research point of view.