

The objective of the project

Natural dyes are more and more often applied in the food technology. Compared with synthetic dyes, generally a greater admissibility is one of advantages of applying them for colouring of the food. They are not undergoing such meticulous toxicological screens as artificial dyes, which is a result of their often application e.g. in the form of extracts from edible fruits or other parts of plants. Betalains (red-violet betacyanins and yellow betaxanthins) from red beet roots are applied for colouring of certain types of food and in chemical environment ensuring the permanence of the dyes. These preparations are marked by a best quality in terms of the colour and its intensity. The need to consider the toxicological safety of synthetic dyes and restrictions concerning many artificial red dyes are factors stimulating research on betalains.

The colour of the food with the addition of betalains depends generally on the ratio of red-purple to yellow dyes, as it is taking place in the case of preparations containing dyes of red beet roots widely applied in Poland and in the world. A change of this ratio is possible while processing of these preparations. Taking into account formation of betalain derivatives of diversified colour properties we receive a complicated dependence of the final product on means of producing it.

In fact, the betalains from red beet have been relatively extensively studied. Therefore, this project aims to explore the activities and stabilities of different group of betacyanins which are based on chemical structures of gomphrenins present at high quantities in fruits and leaves in some spinach-like Asian species. The studies will be performed in the extracts and in model foods as well as for pure pigments which, based on preliminary investigations, inhibit formation of diverse reactive oxygen and nitrogen species responsible for chronic inflammation in human body but also exhibit chemopreventive properties. Gomphrenins enable a unique possibility to observe their alternative reaction pathways in comparison to betanin derived from red beet roots. They presumably have other pro-health activities and chemical properties than betanin.

Description of the research to be carried out

The cultivation of spinach-like species will be performed in a greenhouse. The fruits and leaves will be extracted in order to concentrate the special pigments for research. Determination of influence of physicochemical conditions on directions of gomphrenins chemical changes in solutions, extracts and preparations will be performed. Directions of gomphrenins transformations will be analysed depending on the main following factors: the temperature, conditions of irradiation, the kind and the concentration of metal cations, presence of selected stabilizing organic compounds, acidity of solution, kind of solvent, access of oxygen, and initial concentration of the pigments in the samples. Determination of antioxidant activities as well as bioactivity (toxicity and anti-inflammatory activity) of isolated gomphrenin-based betacyanins as well as natural extracts and processed extracts (submitted to various physicochemical factors influencing the reactions of the pigments) will be performed by selected standard analytical protocols.

Reasons for choosing the research topic

Recent surveys are pointing at particularly advantageous action of betalains as antioxidants being found in different cases of the human organism anomalies associated with the oxidative stress. A growing interest is also being registered in betalains as potential chemopreventive measures able to stop the development of neoplasms. This indicates that new sources of betalains deserve more and more attention in development of anticarcinogenic preparations. Therefore, we see a need for performing of systematic studies leading for determination of transformation directions for specific gomphrenin-based betacyanins as well as their composed mixtures in selected matrices imitating real colorizing preparations as well as coloured food products at different physicochemical conditions.

Our Project expands this subject matter much for the identification of the reaction products generated in extracts of spinach-like species as well as sets the directions of chemical reactions depending on conditions in which processing of preparations is being conducted. One should underline, that not only in Poland but also in the world, the studies on the structures of gomphrenin derivatives are planned for the first time by the author of the presented Project. Original consequences of these studies will result from the appropriately conducted research on the stability and the application of betacyanins in the industry, as well as with their biochemistry and chemopreventive properties. The results of the Project will have importance in pharmaceutical and biochemical sciences.

Cultivation of the Asian species in our climate in greenhouses will be an attractive option for commercially justified production of spinach-like leaves with interesting flavour on one side and for the preliminarily known pro-health activities of the leaves and fruits on the other side. Therefore, we plan to initiate exploration of the phytochemical characteristics of the betacyanin-bearing parts of the plants as well as the important stability and activity aspects related to the specially structured gomphrenin-based betacyanin pigments in various extracts and model preparations.