POPULAR SCIENTIFIC SUMMARY

Coacervation of double emulsions with anthocyanins using plant proteins

Among consumers, people who do not eat meat or animal products are becoming more and more important. Even if they are not vegetarians or vegans, many people describe themselves as flexitarians because of greater awareness of food production with less environmental impact. Therefore, the science of food and nutrition is looking for new sources of protein that can be an alternative to meat protein. While soy or pea protein is quite widely used, and its properties are thoroughly described in the literature, the desire to expand the range prompts scientists and technologists to look for new sources of proteins. Such proteins may be proteins that are by-products of food processing. Another trend that is observed is the increase in conscious consumers looking for food with bioactive substances that have a particular impact on human health. One of the groups of such substances are antioxidants, among which anthocyanins play a significant role. These are chemical compounds found in plants with anti-inflammatory, anti-cancer and blood vessel protection properties. In addition, they are an important dye in food technology, ranging in color from pink to purple. A characteristic feature of anthocyanins is the change in color under the influence of pH. Unfortunately, these compounds are quite easily degraded as a result of oxygen access or changes in pH, hence the need to protect them from environmental conditions.

One such method is the separation of hydrophilic (i.e. water-soluble) anthocyanins from the environment by emulsification. It consists in the fact that anthocyanins dissolved in a drop of water are covered with a layer of oil. However, in order to increase the stability of such emulsions, they should be reduced to a solid form, i.e. a powder. This can be done by coating the emulsion droplets with polymers such as proteins and polysaccharides. When external conditions (such as pH) change, the electrical charge of these polymers can change and they will become bonded together, resulting in the emulsion droplets being trapped inside. It is this last stage that is called coacervation.

This project aims to gain new knowledge in the area of possible uses of proteins consumed by humans (broad bean and rice proteins) and a group of proteins that are by-products that so far have not been widely used in human consumption (lupine protein, potato protein and sunflower protein). The project will be divided into four stages. The first will be devoted to the extraction of anthocyanins from plant sources, which will come from the group of vegetables (red cabbage), fruit (black chokeberry) and cereals (purple corn). The next step will be to obtain and test the properties of isolates and hydrolysates of plant proteins. We expect that the use of native proteins will not be successful, therefore there is a need to isolate and hydrolyze proteins. After this stage, we will start testing the properties of double emulsions based on anthocyanins and vegetable oils. The formation of double emulsions based on anthocyanins and vegetable oils will be combined with the measurement of their properties such as stability, particle size distribution, cream index and rheology. The next step will be to make coacervates, where the polysaccharide material will be gum arabic (the most common source of plant origin), chitosan (as a source of animal origin) and xanthan gum (source of microbial origin). Following detailed studies of the coacervates obtained by the freeze-drying and spray-drying process, the project will enter the phase of biological research involving the measurement of the release of core particles (i.e. anthocyanins) in the *in vitro* digestion system.

In the Project, we intend to indicate that changing protein structures through hydrolysis may be important for the final functionality. To the best of our knowledge, the proteins which will be the main research material were not used for coacervation purposes and also for anthocyanin coacervation. There are even fewer scientific reports on the modification of proteins by hydrolysis and their influence on the ability to form coacervates.

There is still a gap in the use of plant proteins due to their low solubility and poor emulsifying properties. Thanks to research on proteins that have been treated marginally so far in the literature, it will be possible to accumulate new knowledge in order to focus research on improving the functionality of proteins in terms of solubility, emulsifying properties or molecular structure.