

In recent years, growing scientist and industry interest in the use of unconventional treatment processes, including ultrasound treatment (sonication) or pulsed electric field treatment on food in order to change its properties. High-power and low-frequency ultrasonic waves produce interesting effects for industrial applications regarding the possibility of using them for food processing and supporting technological processes, decontamination and inactivation of microorganisms, activation or inactivation of enzymes and acceleration of mass and / or heat exchange processes, such as drying, freezing, osmotic dehydration or extraction. On the other hand, the pulsed electric field causes the rupture of the cell membrane and leads to its structural changes, which is used to accelerate the extraction process, modifying enzyme activity, preserve solid and semi-solid food, disinfect liquid waste, modify the functional properties of food ingredients and accelerate water removal.

Due to the not fully known impact of these unconventional techniques on food, comprehensive studies have been planned to determine the impact of non-thermal treatments such as sonication (US) and pulsed electric field (PEF) and their combinations (US + PEF and PEF + US) on the properties of plant tissue on the example of red bell pepper. The aim of this project is an deep analysis of various properties of plant tissue in order to thoroughly explain the mechanism of the interaction of ultrasound and pulsed electric field and their combinations. Furthermore, various relationships between the properties studied will be explored in order to better understand the mechanisms of these innovative treatments and the changes taking place during them.

The research will include the determination of the impact of the application of preliminary operations using sonication and pulsed electric field as well as their combinations on a number of physical properties (dry substance content, water activity proving the microbiological safety of food, color, texture), chemical properties, including the content of biologically active compounds, which are beneficial for the human body (vitamin C, polyphenols, carotenoids, antioxidant activity determined by DPPH, ABTS and FRAP methods) and sugar content. The analysis of the mechanism of the impact of non-thermal technologies on bioactive compounds will be assessed for plant tissue and compared with model bioactive substances to demonstrate the effect of enzymatic changes in plant tissue on bioactive ingredients contained in food. What's more, bioavailability analysis of active ingredients will be carried out, which will allow to determine whether the treatment with ultrasound and/or pulsed electric field does not adversely affect the use of these ingredients by the body. Additionally, the influence of particular non-thermal technologies and their combinations on metabolic changes, enzymes activity and odour changes as well as microbiological changes in red bell peppers and model liquids will be determined.

The PEF and US treatment parameters will be selected on the basis of preliminary research. On this basis, 3 different parameters of US and PEF treatments for combined methods (US + PEF and PEF + US) will be selected for further research. For this purpose, an experiment will be designed using the response surface methodology (RSM) to model the processes, as a result of which it is possible to design food with specific parameters. The above will allow the optimization of the innovative treatments in relation to selected food properties.

Realization of the project will allow gaining deep knowledge of no-thermal, modern treatments used in food processing. There will be known their mechanism, as well as the various relationships between the tested properties of red bell peppers. The potential practical application of the project results is high. The obtained results may be used in the future in the design of food with specific features, e.g. an increased content of biologically active ingredients and a lower sugar content, which is beneficial due to the reduced calorific value of the final product.