A very important issue determining the suitability of a method for food preservation, especially fruit and vegetable products, is possibility to inactivate/ reduce microbial counts and inactivation of tissue enzymes.

The aim of this project is to prove the hypothesis that there is a possibility to inactivate plant enzymes such as polyphenol oxidases and peroxidases with application of High Pressure Carbon Dioxide (HPCD) as well as High Pressure Processing (HPP).

The project will include the examination of changes in the structure of key enzymes present in plant tissue, both in model solutions as well as in the fruit juice. These studies will help to understand the mechanism of enzymes inactivation influenced by inactivating factor. The inactivating factor used in this project will be carbon dioxide at high pressure and high hydrostatic pressure.

Daily consumption of food produced from raw materials occurring seasonally, mainly fruit and vegetables, is associated with the necessity of preservation. Over the last century thermal pasteurization, the use of chemicals or radiation has become almost a requirement of civilization in food preservation industry. From the viewpoint of modern consumer this phenomenon has significant disadvantages. Very often the product preserved in this way irretrievably loses the desirable features of unprocessed product. In case of fruit and vegetable products the most frequently used technique is high temperature treatment, the so- called pasteurization, which exerts negative effect on sensorial quality and other important nutritious compounds like vitamins and other biologically active substances. Aware consumers would like to consume minimally processed food throughout the whole year, so the most recent research focus on non- thermal methods, i.e. those where the effect of preservation can be achieved even at room temperature. Lack of heat treatment makes this food almost unchanged compared to fresh unprocessed food. In recent years a basic, non-thermal food preservation method has emerged, with application potential in significant number of countries, namely: preservation/ processing of food using high hydrostatic pressure (High Pressure Processing/ Preservation- HPP). This technique is based on treating the food product with very high pressure (about 600 MPa) to inactivate microorganisms present in raw material. Research shows that this technique is effective in the inactivation of microorganisms which significantly extends the shelf-life of processed food. Unfortunately, many studies also indicate that this technique is not fully effective in the inactivation of tissue enzymes that cause large losses of biologically active components and deterioration of sensory characteristics of product during storage, mainly so-called enzymatic browning. It is worth to emphasize that fruit and vegetable products represent approximately 50 % of the food preserved by HPP produced in the world, therefore searching for the new methods offering both microbiological safety and the ability to inactivate tissue enzymes is now a very important direction in food processing.

A relatively new method with high application potential is a High Pressure Carbon Dioxide (HPCD) technique, including supercritical state (Supercritical Carbon Dioxide- SCCD). Carbon dioxide is a safe substance and does not react with food components. It can occur in different states of matter: gas, liquid and solid. Moreover, under certain pressure and temperature conditions (pressure above 72.9 atm and temperature above 31.1°C), it can occur in supercritical state, i.e. it has features of liquid and gas. Supercritical carbon dioxide has a very low density and viscosity, and in combination with high pressure can easily penetrate food. It has microbiocidal properties, because it is able to dissolve cell membranes of microorganisms, also has a destructive influence on enzymes by increasing the acidity inside the cell. In contrast to the HPP technique, HPCD has not yet found industrial application in food preservation.

The project will result be better understanding of the mechanisms which decide on the inactivation of plant tissue enzymes and gained knowledge will be the basis for designing innovative technological processes, enabling the production of low-processed foods, rich in nutrients and with high sensory quality.