## Description for the general public

Despite considerable research achievements in the description of heat transfer processes, there are still issues where the amount of available knowledge is insufficient and there are considerable difficulties in carrying out experimental research. Such issues should be addressed in the project the problem of heat exchange in packed bed vegetables and fruits. Knowledge of heat transfer for such a case is essential when designing modern storage facilities where vegetables or fruits are stored at reduced temperature for a period of a few months or more. Providing the desired high quality vegetables or fruits requires very stable thermal and humidity conditions (temperature fluctuations should not exceed 0.25 K and relative humidity is 1%). Even for today's cooling technology, this is a challenge and therefore, when designing refrigeration systems for modern storage facilities - precise information is needed about the heat exchange between the circulating air and the vegetable or fruit bed.

The issue of heat exchange and flow resistance in packed beds made of regular geometry (balls, rolls, cuboid) has been repeatedly made in the literature, a number of measurement methods have been developed and criteria have been developed to describe the heat exchange and flow resistance that can be applied in the technique. However, many vegetables or fruits do not have regular shapes, and the heat exchange is accompanied by a change in mass (associated with the transport of moisture) and heat released in the metabolic processes. So far, methods of measuring heat exchange in packed beds have been invasive and generally long-term. They are therefore not suitable for vegetable and fruit applications, which, at each invasion induced by the measuring elements, will be damaged and, in the course of long-term measurement, their physical condition and will undergo significant changes. Hence, the proposal to apply a completely different approach to the case of vegetables and fruits, namely a completely non-invasive method, which requires a very short measurement time. The applicant proposes, for the first time, the use of the average heat transfer coefficient in the vegetable and fruit bed - the blowing method.

The blowing method that is planned to be used in the project consists in measuring the temperature and the value of the static pressure difference before and after the test bed. The measured value, the static pressure difference, is used to determine the airflow resistance of the test bed. Conversely, the temperature measurement is performed to determine the value of the heat transfer coefficient of the bed components. This is done by comparing the temperature profile behind the bed that was obtained during the experiment to the temperature profile obtained analytically using a suitable mathematical model describing the heat exchange in the bed. The temperature profile obtained analytically is obtained by selecting the appropriate value of the heat penetration coefficient.

The project will also measure the determination of air velocity fields flowing around a bed of vegetables. In order to determine the speed fields, will be used the PIV (Particle Image Velocimetry) method. The results obtained can be presented in the form of longitudinal sectional planes of the tunnel showing velocity vectors or velocity distribution fields of the flowing air.

During the project, numerical modeling (CFD) is also planned. The results obtained during the numerical modeling will be used to compare the results obtained during the blow experiment and the results obtained by PIV. The tasks that will be done here will allow you to fit a suitable turbulence model for flowing through a bed of vegetables or fruits.

The results obtained in the project will not only allow you to obtain much more accurate and reliable generalized criterion relationships that describe heat transfer and flow resistance in vegetable and fruit beds but will also provide the possibility of a wider application of non-invasive methods for measuring heat transfer for other complex cases in research and technology.