

**The main objective of this project is to carry out research on novel sensors and sensing systems along with data processing techniques allowing for detection of poisonous substances and quality analysis as well as processes monitoring of food products.**

Food safety have greatly attracted much attention from both academic research and industry communities due to its close relation to people's lives and ecological environments. Food quality and food composition are key parameters at all stages of food production chain. Therefore, control of food and monitoring of food compounds play an important role for food producers, retailers as well as consumers themselves. Traditional methods of food quality assessment rely on chemical analysis, which features certain disadvantages, as they are: time-consuming, costly, some require high-tech molecular tools and thus, experienced, and specialized personnel and commonly they are destructive to test products, limiting their potential to be used on-, in- or at-line.

The currently observed rapid development of agriculture including food industry requires new solutions, which allow for continuous measurement and nondestructive quality control of food products. To meet these demands magneto-dielectric spectroscopy methods utilizing microwave sensors have become an attractive choice in characterizing the quality of food, since electromagnetic waves penetrate the measured material, what allows for obtaining information about the food sample in a noninvasive way and more accurately than in the case of optical sensors. The most important quality related changes are chemical reaction, microbial reaction, biochemical reaction, and physical reaction. Quality indicators are not constant and the quality of food changes over time. Therefore, the food quality measurement is essential to food industry including the stages of production, storage, and transport and there is a strong need for development of novel sensors and sensors systems allowing for real-time an inexpensive monitoring of food products quality and control of food production processes.

The main objective of this project is to investigate broadband magneto-dielectric spectroscopy with the design specific sensors incorporated systems coupled with model-based analysis and machine learning algorithms for the accurate determination of quality of food products in a nondestructive, and real-time way. The results obtained using broadband magneto-dielectric spectroscopy methods can be utilized for realization of application-specific low-cost narrow-band or resonant sensors. Three classes of sensing systems are planning to be developed i.e., broadband microwave sensors allowing for detection of mold and heavy metals in food as well as methanol in alcohol beverages, broadband and multi-resonant microwave sensing circuits allowing for nutrient content analysis and detection of adulteration of food products and broadband together with narrowband sensors allowing for fermentation processes monitoring. The performed investigations will allow for development of a single stand-alone non-invasive measurement system equipped with a set of replicable application-specific sensors providing functionality of monitoring, characterization, estimation, or composition analysis. The obtained results will be interesting for many research groups and industry as well as in the future for consumers itself, for whom quality of food plays an important role.