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Development of intelligent Packaging solutions to increase resource efficiency in cold supply chains (#557)

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Introduction

Alongside supply chains of perishable food products, rejections and food waste occur due to a lack of information at different chain levels. The implementation of intelligent packaging solutions, such as Time-Temperature-Indicators (TTIs), enables the estimation of the remaining shelf life at all steps of the supply chain by providing additional information on the actual product status. Although intelligent labels have already been investigated in the last years, specific requirements for different supply chains, a digital readout and data exchange via traceability systems as parts of an entire system do still not exist. The aim of the project "Intelli-Pack" (2018 – 2021) is the development and implementation of an innovative intelligent packaging system for B2B, B2C and online trading, considering specific requirements of industry, trade and consumers to increase the quality, safety and resource efficiency of perishable products in the long term.

Methods

In the initial stage of the project, the different cold supply chains of B2B, B2C and online trade and their requirements for intelligent labels are analyzed through close collaboration between scientific and entrepreneurial experts. Different issues accompanied by the implementation of intelligent packaging are investigated. In parallel, laboratory studies for the modeling of spoilage kinetics of selected food products are conducted. Therefore, perishable products on the different categories meat and sausage, fish and vegetables are chosen to include a wide variety of spoilage kinetics. Simultaneously, established intelligent systems are improved by developing a smartphone application for the digital readout of the TTI color change and the integration of information as a decision guidance for stakeholders. The overall optimization of processes along supply chains by the use of intelligent systems is identified including legal aspects accompanied by the implementation of intelligent packaging and a flexible shelf life. Pilot studies are conducted to validate the advanced packaging systems adjusted to B2B, B2C and online supply chains. Based on the project results, an online support tool is developed to provide information about various intelligent packaging solutions for all participants – industry, logistics and trade – of supply chains. The tool contributes to the optimization of cold chain management. Additionally, an assessment tool for sustainability and resource efficiency of intelligent packaging is integrated into the online platform.

Results

The first results of the supply chain analysis reveal the specific and different procedures and requirements on the B2B, B2C and online supply chains. Furthermore, the interviews show that for every surveyed supply chain, costs are the main factor in the decision-making process for the implementation of an intelligent packaging concept.

First results of laboratory shelf life studies with sausage products and the modeling of the spoilage kinetics will be presented. The results of microbiological investigations and the analysis of freshness parameters dependent on different temperatures will be shown. The development of a first smartphone application for the digital readout of the TTI colour change will be presented. An experimental setup to customize the parameters to predict the remaining shelf life on the base of measured TTI values will be discussed.

Conclusion

The overall concept for the implementation of intelligent packaging solutions in different supply chains is shown in Figure 1. Intelligent packaging solutions will be adapted to the specific process steps and requirements of B2B, B2C and online supply chains. A digital readout of the remaining product shelf life in real-time based on temperature data will be realized. The implementation enables the optimization of logistic processes and their efficacy and as a result, the reduction of food waste. The project provides an innovative integral system, including the requirements of all stakeholders along the cold supply chain, combined with a digital implementation of intelligent packaging solutions under the aspects of logistics, traceability and sustainability.
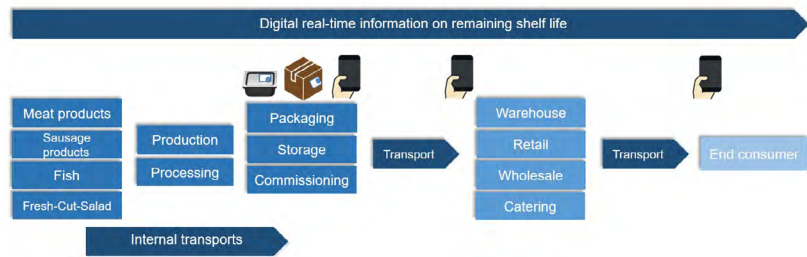
Figure 1: Implementation of intelligent packaging solutions and its digital readout in different sup