Experimental validation of the TTI based chill chain management system SMAS for meat products

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Temperature conditions during transportation, distribution and storage often deviate from specifications. Application of an optimised quality and safety assurance system for the chilled distribution of fresh meat products requires continuous monitoring and control of storage conditions, from production to consumption. Time Temperature Integrators (TTI) allow such control down to product unit level. A novel chill chain management system, coded SMAS, based on the real quality and risk profile of products, was developed. SMAS uses the information from the TTI response at designated points of the chill chain, ensuring that the temperature-burdened products reach consumption at acceptable quality level.

The objective was to design a field test experiment to demonstrate the effectiveness of the TTI based SMAS system and quantify the improvement at the time of consumption in comparison to the conventional First In First Out (FIFO) approach.

One hundred and twenty products of fresh pork cuts, MA packed (60%CO_2), were used in the chill chain simulation. On half, enzymatic TTI were attached at the time of packing. All products entered the regular transportation route to the central distribution center of the manufacturer and then were stored in the research food laboratory, in programmable cabinets simulating the conditions of the real chill chain to the point of consumption. Products were split at the designated decision time and followed a simulated path to a “local” and a “distant” market. Microbiological measurements of all products at “consumption time” were conducted.

Kinetic models of growth of Lactic acid bacteria (LAB) and TTI color response in the range of 0 to 15ºC were developed by separate initial experiments. At the decision point, at 72h from packing, the products were split in half and were stored for 3 different short times (local market scenario) and 3 longer times (distant market scenario). The products without TTI were split randomly. The information from the ones with TTI was translated into the integrated temperature history and quality status of each product and their further handling was based on this data.

According to the final microbiological measurements the spoilage profile of the TTI bearing products was significantly improved. 21% of samples that were handled

randomly were spoiled at the time of consumption (LAB>log7) compared to less than 10% handled with the SMAS approach.

The conducted field test demonstrates the applicability and usefulness of TTI monitoring of the meat chill chain. Applying SMAS approach leads to significant decrease of the number of spoiled products at the time of consumption.