Monitoring of temperature and management of the food distribution chain including the retail and domestic stages

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Temperature conditions in the chill distribution often deviate from the recommended ones, making continuous monitoring of perishable foods, such as meat products, crucial for their quality at consumption. Miniature electronic data loggers and Time Temperature Indicators (TTI) are useful tools for an effective chill chain management, allowing for the estimation of the actual quality status of the food.
TTI applicability is studied in a novel chill chain management policy, coded SMAS: "Safety Monitoring and Assurance System" (EC RTD project QLK1-CT-2002-02545, http://smas.chemeng.ntua.gr) that allows for the optimisation of the stock rotation system. SMAS gives priority to products in such a way that, compared to the First In First Out (FIFO) current approach, risk at consumption time is minimized and quality optimised. The main cornerstones of the system include (a) validated models of microbial growth of pathogens and Specific Spoilage Organisms (SSO) for each different meat product, (b) information on the initial prevalence and distribution of the SSO, N_o (c) continuous temperature monitoring of the chill chain with Time Temperature Indicators and (d) correlation of sensory acceptability to a specific level of microbial load, N_S, that signals the end of the product shelf life. These elements are integrated in the SMAS algorithm, allowing for the estimation of the actual remaining shelf life and the risk assessment of each product unit, at selected points of the chill chain.
Within the SMAS project, temperature distributions were measured in a large number of home and retail refrigerators. Computer downloadable, self-contained, temperature loggers were used to measure temperature in the upper, middle and bottom tray as well as in the door of the refrigerator. Temperature appeared to vary significantly versus time in typical retail and domestic refrigerators. Highest temperatures, as it was expected, (typically about 10ºC) were recorded in the door of the refrigerator. In all cases though there was a difference of more that 5ºC between different positions inside the refrigerator. The effect of storage and cooking conditions on the safety of meat products has been included in risk assessment simulations. In order to demonstrate the effectiveness of SMAS, the Monte Carlo method was applied. Two decision points were selected, namely the product split at the distribution center, and the stocking of the retail cabinets. Products with the higher microbial load and risk were promoted first, instead of the FIFO criterion. The results indicate that SMAS management approach of the food distribution chain substantially reduced risk probability and minimized products of high risk, optimizing, at the same time, quality distribution.