Safety and Quality Management of chilled meat products with Time Temperature Indicators

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Summary:

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. 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 [1,2]. However, for optimizing the effectiveness of TTI application, all possible sources of error in their response should be considered and systematically studied. Otherwise, the error in the evaluation of the integrated impact of time-temperature history may lead to substantial error in quality estimation. TTI applicability is studied in a novel chill chain management policy, coded "Safety Monitoring and Assurance System" (SMAS, EC RTD project QLK1-CT-2002-02545) that allows for the optimisation of the stock rotation system.

Methods:

Color change of enzymatic TTI (VITSAB AB, Malmö, Sweden), measured by a Minolta Chromameter, was kinetically studied in the range between 0 and 15°C, in isothermal incubators. For the validation of the established models, experiments under non-isothermal conditions were also performed. Reproducibility of the response of each TTI was assessed based on experiments of a large number of TTI units. An algorithm was developed that allows the correlation of the TTI response to a characteristic quality or safety index A of the food, based on validated TTI and food kinetics. The key point of this correlation scheme, i.e. the reliable estimation of the integrated time-temperature history of the product, assumes that the temperature dependence of the TTI response and the food quality loss rates should be identical. To overcome this requirement, the potential to use multicomponent systems with different kinetic characteristics, instead of single tags, is studied and the error reduction accomplished is calculated.

Results & Discussion:

The results showed that TTI can be reliably used as shelf-life monitors of chilled meat products, either by a single TTI with a similar kinetic pattern as the food, or by a multiple system, bearing TTI of different kinetics. In the latter case, a correction factor was estimated, based on the response and the kinetic features of the two TTIs. The alternative of using a multiple system reduced the maximum error in effective temperature (T_{eff}) estimation from ±2°C to ±0.05°C, minimizing the error in food quality estimation from ±19 to ±1%, allowing for TTI application in an "intelligent" chill chain management system (SMAS).

References:

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