WEB2.0 based Software Solution to support a practical implementation of Time Temperature Indicators

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Outline of the presentation

- Motivation to develop a software to use TTIs in cold chains
- Short description of Time Temperature Indicators
- Development of a TTI kinetic model that also describes the spoilage of food and what is the basic algorithm for the software
- Field trial to validate the TTI kinetic model and the usability of Time Temperature Indicators within cold chains
- Presentation of an Internet based software to improve the cold chain management with the use of TTIs
Face the facts of food chains

- Continuous increase of the consumption of chilled and frozen foods
  (BVE 2009, Deutsches Tiefkühlinstitut 2009)

- Our Industry faces 30% waste from harvest to the consumer while real
  food prices rose by 64% between 2002 and 2008
  (Helms 2010)

- Much remains to be done to eradicate the scandal of malnutrition in the
  context of the globalization of the world
  (Helms 2010)

- Also inefficient cold chain management leads to these facts!

Face the facts of cold chains

- There are huge temperature variations in transport vehicles which are
  often not detected

- Cold chain interruptions take often place at handover points which are
  mostly not monitored

- Monitored temperature data often differ from the products temperature,
  since the environmental temperature is measured

- Random measurement of the products temperature at the incoming
  inspection is not always sufficient

- The exchange of temperature data over the whole chain is missing, in
  general no integrated and sufficient systems are implemented

- Misinterpretation and lacks of information lead to inefficient
  management- and operational decisions in various steps of the cold
  chain
Challenges in the Supply Chain

Motivation

Food Chain → Supply Chain → Cold Chain

Processing → Trans. → Storage

Temperature monitoring devices

- Plunge Thermometers
- RFID data logger
- Electronic data logger
- Real-time monitoring via GPS
- Smart Active Labels
- TTIs

Challenges: data handling and interpretation, information management

→ find cost effective decisions and decision-support tools

A Short Description of a Time Temperature Indicator

Description of a TTI

Principle of Time Temperature Indicators (TTIs):
chemical, physical or enzymatic reactions provide information in dependency of Time and Temperature

Example:
Response in form of a discoloration (modern TTI) or melting (an ice-cube, glaciers)

- TTIs provide generally the option to continuously monitor the temperature history along the entire cold chain
- TTIs are able to provide indirectly an indication of the freshness of specific products
Requirements to use TTIs for an effective decision-making

- Knowledge about the TTI-kinetic in dependency of Time and Temperature
- Possibility to adjust the TTI-kinetic to the spoilage of your products
- Cost-Efficiency
- Electronic readable and storable TTI-information
- Fast way to correlate the information of the TTI with product-information

Aim of the study

The objective of this study was the development of an Internet based software solution integrating a TTI kinetic model as a reliable and easy-to-use tool to support the decision-making within cold supply chains.
Steps to develop a Software

- Development of a TTI kinetic model to describe spoilage of food
- Validation of the TTI kinetic model within Field Trials
- Development of the Software
- Evaluation of the Software with gathered data from field trials

Development of a TTI kinetic model

- SV0: 59
  Exemplary initial value
- SV: 71
  End of shelf life

Kreyenschmidt et al. 2010
Several studies have been conducted during the last years under isothermal and non-isothermal temperature conditions. Development of a TTI kinetic model: Kreyenschmidt et al. (2010) and Raab et al. (not published yet).

Validation of the TTI kinetic model

Field trial to validate the TTI kinetic model

Integration & measuring points:
- OnVu TTI
- Microbiological sample
- Temperature logger
- Step in the chain
- Information flow
- Product flow
- Transport step
- Sojourn time

Cold chain management
Features of the software-solution:

- The software allows user-friendly simulations of shelf-lives for dedicated products depending on dynamical and adjustable time-temperature-rows.
- It is possible to simulate time and temperature scenarios for real or assumed supply chains.
- When the software is used with TTIs, it allows to monitor the cold chain, to estimate remaining shelf life and so e.g. a storage optimization or to rate prices.
- Software can be adjusted to different products, to different supply-chains and gives automated action alternatives.
- Since the software is programmed with the widely known scripting language php and a mysql-database it is compatible with most servers of commercial internet providers and it can be easily updated and administrated.

How to use? – Simulate Shelf Life

- Choose a product and time-temperature scenario.
- Apply the simulation and calculate shelf life.
Simulate Shelf Life - Result

Check a very good cold chain ;-)

Your food probably will be spoiled when T reaches 7:
Cold chain management

Check a good cold chain

Presentation of the Software

Just Check a cold chain

Presentation of the Software
Estimate remaining shelf life

How to use? Remaining shelf life

The images show software interfaces for estimating the remaining shelf life of products. The software likely calculates the shelf life based on temperature and other environmental factors, ensuring that products meet safety and quality standards.

The presentations emphasize the importance of cold chain management, particularly the accurate estimation of shelf life, to maintain the integrity and safety of perishable goods.
Conclusions

Application in real cold supply chains

- The field tests showed the applicability and usefulness of the internet based software solution
- Allows an economical integration of the TTIs into temperature monitoring systems
- Enhances the possible spectrum of applications by using TTIs together combined with software
- Flexible integration according to the structure of international food chains

Thank you for your attention!

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