Tracking the temperature of super-chilled meat products via RFID

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Agenda

• About SINTEF Fisheries and Aquaculture (SFH)
• Electronic traceability and EPCIS
• Objective of the study
• Materials and Methods
• Results and Discussion
• Questions
SINTEF Fisheries and Aquaculture

SINTEF is the largest independent research organization in Scandinavia. SINTEF is a broadly based, multidisciplinary research concern that possesses international top-level expertise in technology, medicine and the social sciences.

SINTEF Fisheries and Aquaculture located in Trondheim, Norway represents the technological expertise in the utilization of renewable marine resources. Under the vision "Technology for a better society" we are working for a knowledge-based bio marine industry.
Traceability Drivers in the Food Sector

- Certification (BRC, IFS, ISO 22000, ..)
  - HACCP
  - Common Food Law
- Food safety
  - $18, §19$
  - Labeling laws
  - Non-IUU fish
- Legislation
  - Traceability requirements
  - Environmental load, food miles, emissions, resource use, animal treatment
- Traceability
  - Trace contamination, Enable recall
  - Documenting ethics, welfare, sustainability
- Labour/cost reduction
  - Avoid re-punching
  - Optimal production
  - Industrial statistics
  - Make or buy
  - Profiling feedback-loops
- Chain communication
  - Integration of systems
- Competitive advantage
  - Consumer preference
EPCIS - Electronic Product Code Information Services

- Electronic Product Code (EPC) is a universal identifier that provides a unique identity for every physical object anywhere in the world. It was designed to establish a global unique object identifier which was made possible through the use of RFID – Radio Frequency Identification.

- EPC Information Services (EPCIS) is an EPCglobal standard designed to enable EPC-related data sharing within and across enterprises.
EPCIS

• Event based approach

EPC Events answer 4 questions –*What, Where, When, and Why*

| What          | • EPC number (can leverage master data - GTIN)  
|               | • Manufacturing Data (lot, batch, expiration date)  
|               | • Transactional Data (PO, Shipment, Invoice) |
| Where         | • Location (can be fixed or moving – leverage master data - GLN) |
| When          | • Event Time  
|               | • Record Time |
| Why           | • Business Process Step – e.g.: Receiving, Shipping  
|               | • Product State – e.g.: Saleable, Active, In Transit  
|               | • Current Conditions – e.g.: Temperature |
EPCIS and Food Traceability

- Identify states and events in food production
- Mapping of these events to the EPCIS standard
Cold Chain Time-Temperature Monitoring

- **Objective:** To test an online system for temperature monitoring and traceability in a cold meat chain
- The EPCIS based system and RFID technology for online temperature monitoring and traceability was tested during the transportation of chilled lamb products
Materials and Method

- **Product:** Chilled legs of lamb – transported from the processing plant to the distribution terminal (800 km distance)
- **RFID tags:** EPCglobal UHF Class 1 Gen 2 RFID tags with integrated temperature sensors
- **Communication system:**
  - RFID (read zone: 6 m X 1.5 m) and GPS antennas
  - GSM/GPRS based communication unit to read the temperature data and transmit it to the EPCIS based online temperature monitoring system
Set-Up

- **Product receiving**
  - Slaughter
    - Packing boxes
      - **Packing**
        - RFID tags placed inside the product
      - **Storage**
        - RFID tags and communication unit placed inside the truck
    - **Shipping**
      - **Transit out**

Temperature read at 10 minute intervals during transportation.

**Temperature sensors - placement**
- MEAT:
  - 4 tags with external sensors
    1. Inside meat: 2 in each, 5-6 cm inside
    2. Under meat surface: 2 in each, 1-2 mm inside
- TRUCK:
  - 9 sensors:
    1. Left wall: Upper front, lower middle, upper back parts
    2. Right wall: Lower front, upper middle, lower back parts
    3. Middle ceiling
    4. 2 Inside boxes with meat

**RFID tags with internal temperature sensor**
Results

• During transport, online geo-location and real-time temperature data captured by the RFID tags was accessible through the web interface.
Results

Cold chain temperature history

Loading

Unloading

Temperature °C

Time

Ambient
Product
Results – EPCIS temperature events

- For each RFIS tag, an EPCIS event was created every 10 minutes when temperature data was read.
- Definitions:
  - Business step: **temptracking**
  - Disposition: **in-transit**

```xml
<EPCISBody>
<EventList>
<ObjectEvent>
<eventTime>2011-11-23T12:21</eventTime>
<epcList>
<epc>urn:epc:id:giai:0000000.121</epc>
</epcList>
<action>OBSERVE</action>
<bizStep>urn:hrfn:temperature:bizstep:temptracking</bizStep>
<Disposition urn:epcglobal:cbv:Disposition:in_transit</Disposition>
<readPoint>
?id>urn:hrfn:readpoint:licenceplate:SINTEF</id>
</readPoint>
<bizLocation>
?id>urn:hrfn:readpoint:licenceplate:SINTEF</id>
</bizLocation>
<temp1>0.3</temp1>
</ObjectEvent>
</EventList>
</EPCISBody>
```
Discussion

• Decision making in logistics of fresh food is characterized by product quality deterioration

• Significant amount of food is wasted during transportation

• Online time-temperature monitoring can potentially reduce the amount of food wasted during transportation without increasing human resources for maintaining temperature control and for transfer of information

• Hardware prototype used in this study was premature for industrial implementation but the functionality of EPCIS for linking temperature information to traceable units and events was successful
More Information

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Thank You