Innovative and sustainable packaging solutions for food

aktive packaging with CO$_2$ emitter solutions to increase shelf life and reduce waste

*Packaged – the 6th global summit, Amsterdam 2017*

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**Nofima:**
National food research institute, established on January 1, 2008.

Target market:
Food industry, aquaculture and fisheries industry

360 employees
580 mill NOK (2016)
NOFIMA infrastructure at Ås

**Expertise**
- Raw materials
- Ingredients
- Processes

**Processing hall**
- Packing of Meat
- Fish
- Vegetables
- Cereals

**Packaging hall**
- Packaging machines
  - Thermoformer
  - Tray sealing machine
  - Vacuum chamber machine
- Packaging tests
  - Gas and light transmission
  - Gas atmosphere in packaging
  - Density/leakage
  - Migration analyses
  - Safe food contact materials (The Packaging Convention)
- Packaging methods
  - Gas (MAP)
  - Skin pack
  - Vacuum
  - CO₂ emitter

**Packaged product**
- Shelf-life studies in climate rooms

**Product quality**
- Sensory
  - (smell, taste, color, and texture)
- Microbiological
  - (traditional and DNA-based methods)
- Chemical
  - (taste and rancidity components)
- Physical
  - (fluid loss/water holding capacity, pH, and texture)
Unique processing facility in Norway: **Pathogen pilot plant**

Facility of Biosafety level 3 for testing survival and growth of pathogenic microorganisms in foods and production environments

- **UV-C treatment of eggs**
- **Pulse UV treatment of chicken filets**

- **Sausage production with entereohemmoragric E.coli**

- **Equipment for decontamination of poultry carcasses currently being installed**
Packaging – why and how?
CO$_2$ emissions for various foods

Treehugger, 2011
EU: Reduce Food Waste to 50% in 2030
Packaging in the bioeconomy

- Ensure product quality and safety
- Reduce waste
- Better transportation solutions
- Biobased packaging material
- Recycling
What is sustainable? Minimize packaging? NOT Always!!

We have to explain the importance of packaging!!
Food without packaging

Original Unverpackt, Berlin
Packaging of food - Holistic thinking!

Interaction product/packaging!

Product
- Raw material
- Process
- Hygiene.

Distribution
- Handling
- Storage:
  - Time
  - Temperature
  - Light
  - Mechanical impact
  - Logistics
  - Environment
  - Consumer

Packaging- material and -machine
- Barrier
- Runability
- Sealability
- Design
- Hygiene

Optimization along the entire value chain - the best quality preservation to ensure low amount of food waste
Facts about food waste in Norway

- Food Industry: 17%
- Retail stores: 21%
- Consumers: 61%

68 kg
Facts about food waste in Norway

Food waste in households – at consumers (2015)

Consumers: **42.1 kg** food pr. year

value **625 Euros** annual

13% of the consumption

1 of 8 shopping bags = WASTED

Source: Østfoldforskning/ForMat-Report
Reasons for Food waste by consumers

- Expired
- Improper product quality
- Parts of the product is damaged
- Incorrect/not optimal storage of the product at home or during transportation
- Too much of the product is left in the packaging
- The product is damage or lost its quality due to poor packaging

2015
Alternatives for packaging of ground beef

Estimated shelf life, days

<table>
<thead>
<tr>
<th>Oxygen permeable wrapping</th>
<th>High oxygen package ca. 70% O₂/ 30% CO₂</th>
<th>Low oxygen package ca. 60% CO₂/ 40% N₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 4</td>
<td>8 - 10</td>
<td>16 - 18</td>
</tr>
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</table>

Velzen & Linnemann, 2008
Packaging using high oxygen - Norway

- The retailer NorgesGruppen started in 2012 the packaging center Norfersk at Hærland for private label fresh meat, in collaboration with Nortura.

- Up to November 2014 was using high oxygen for many types of meat.

- Thereafter, changing to gas mixture with 60 % CO₂/ 40 % N₂
Waste of ground meat in stores in NorgesGruppen under/after use of high oxygen

Source: NorgesGruppen/ Østfoldforskning
Traditional/optimal MAP for fish

Modified atmosphere packaging (MAP) have been applied for several years:

Reason for using CO$_2$ in the packaging gas

✓ CO$_2$ is solved in the product and the growth of some bacteria (Gram-negative bacteria) is reduced

✓ Better product quality and increases the shelf life of fresh fish

**BUT** - Standard MAP require high gas volume to product volume (gas/Product volume ratio) 3 times as much gas as product for optimal effect
Increased product quality and shelf life with CO$_2$-emitter

EXAMPLE – SALMON MAP and Vacuum

This figure shows the total viable counts of bacteria (non specific bacteria) in Salmon stored in MAP consisting of 60%CO$_2$/40% N$_2$, and stored at 1°C.
Why CO$_2$-emitter

- Increased product quality and shelf life
- Reduction of package volume and gas volume in the packages
  - Reduces transportation costs
  - Reduced gas consumption
  - Reduction of packaging material
- Economically and environmentally better solution
Total counts on chicken breast fillets with different level of CO$_2$, stored for up to 26 days at 4 °C

Different cons. of CO$_2$ in the packages

Holck et al. 2014
Drip loss apparently increased with increasing CO$_2$ content.

- Significant increase in drip loss between 60 and 100% CO$_2$.
- The CO$_2$ emitter significantly reduces the drip loss from 7.3 to 2.5 % when 100% CO$_2$ is applied.
- This reduction is due to less collapse of the packages.
«I’m always looking for unpacked vegetable»

«I do not understand why each individual broccoli should be wrapped.»

«Really, why not have all the vegetable presented just in bulk?»
Quality of Broccoli – colour head

Broccoli yellowing scale
score of 3 or higher=unmarketable

Photo Credit: Marita Cantwell, UC Davis
Assessed by: Dr. Hanne Larsen, Nofima
Quality of broccoli

Weight Loss of Broccoli

- Reduced weight loss
- Preserve Texture - firmer head

4°C and dark for 16 days
4°C (dark) 4 days + 20°C (light) 3 days + 4°C (dark) 9 days

Assessed by: Dr Hanne Larsen, Nofima

Large weight loss for unpackaged broccoli
EU Platform on Food Losses and Food Waste

http://ec.europa.eu/food/safety/food_waste/eu_actions/eu-platform/index_en.htm

List of Members: private sector organisations

30. OSTFOLD RESEARCH, Nofima and Matvet Consortium

– Academia, research institutes and think tanks
Focus on food waste

Packaging Saves Food Research Group
– new international collaborations
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