

## Ensis Papro

# Functional Packaging for the Meat Industry

1. FRST Functional Packaging research programme
2. Development of antimicrobial films

<https://www.ensisjv.com/>

- Objectives

- ▶ Bioactivity Control → antimicrobials, microencapsulation
- ▶ Moisture Control → barrier coatings
- ▶ Responsive Thermal Control → biofoams (BPN); phase change materials (VUW)
- ▶ Quality Assurance Devices → SAW devices (AgResearch)



## Controlled release applications

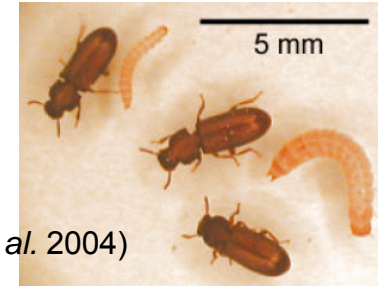
- Past work on insect repellents

## Horticulture (EP, MU)

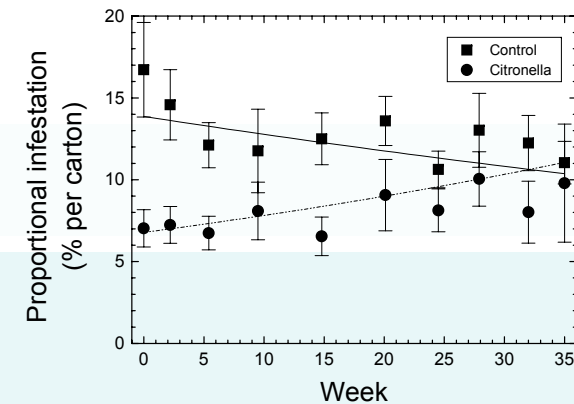
- Antimicrobials, physiologically active agents
- Modelling of controlled release

## Seafood (CFR, EP)

- Antimicrobial materials
- Peroxide release materials



(Wong *et al.* 2004)

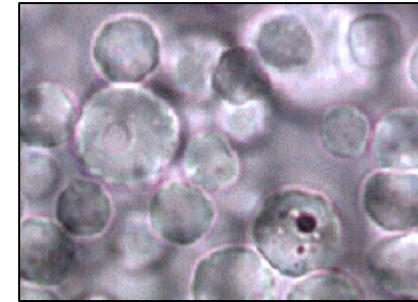


(Wong *et al.* 2005)



Lloyd *et al.* (unpublished)

- Adsorption
  - ▶ Modification of inorganic particles
- Microencapsulation
  - ▶ Biopolymers such as fats, polysaccharides, proteins
- Bioactive agents
  - ▶ Essential oils, plant elicitors
  - ▶ Lactoperoxidase enzyme
- Ongoing work to:
  - ▶ Optimise loadings
  - ▶ Control release properties
  - ▶ Methods of application



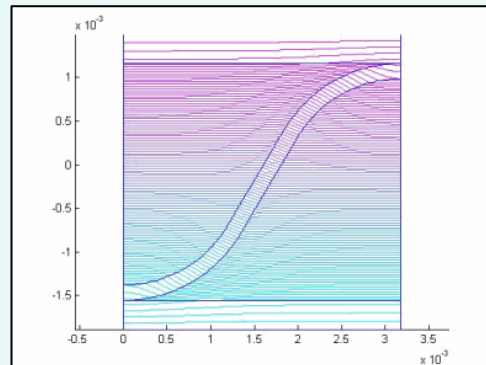
Motion (unpublished)



Yamato Pulvis Mini Spray

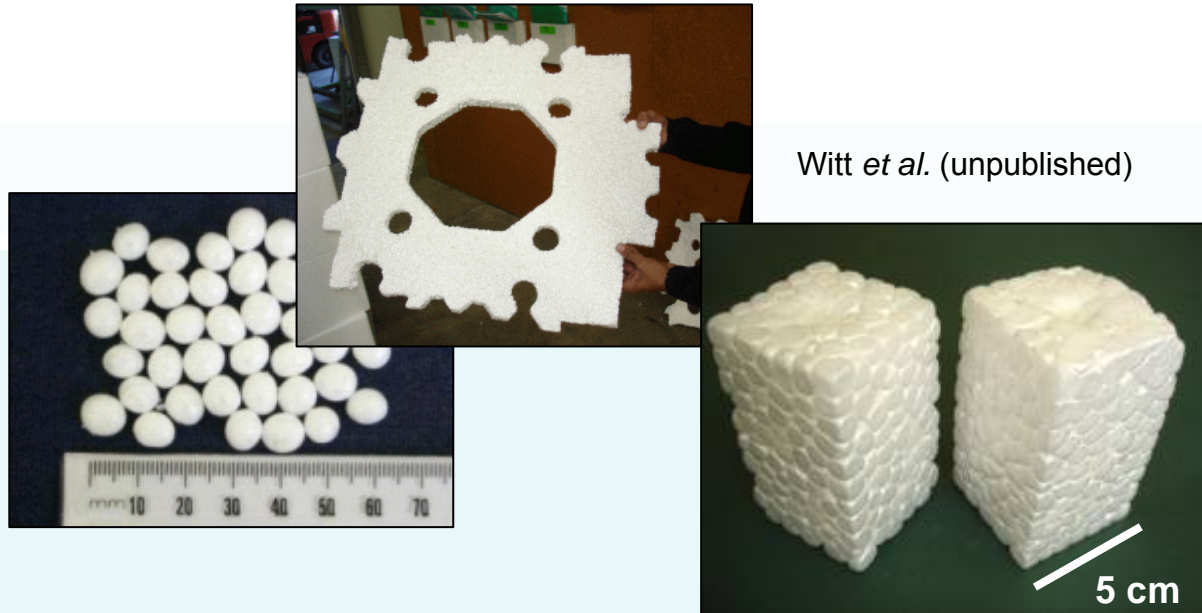
- Properties of the coatings
  - ▶ WVTR barrier (WVTR < 20 gsm/day), liquid water & grease barrier (Kugge & Johnson 2006)
  - ▶ Creep resistance, down-weighting possible
  - ▶ Printable, recyclable, glueable, relatively cheap

Bronlund (unpublished)



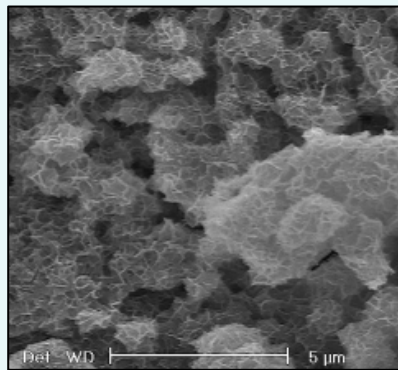
Pilot trials on  
Dow Lab coater





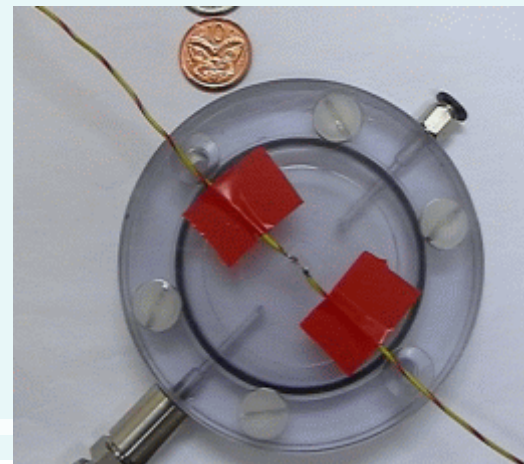
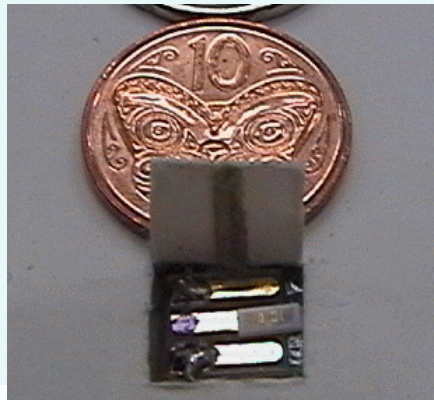
Witt *et al.* (unpublished)

- New composite material for thermal buffering
  - ▶ Comprising nano-structured calcium silicate embedded with alkane phase change materials
  - ▶ Maintains food at pre-defined temperature range



Johnston *et al.* (2007)

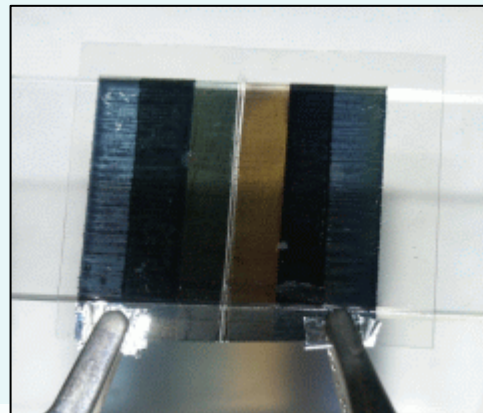
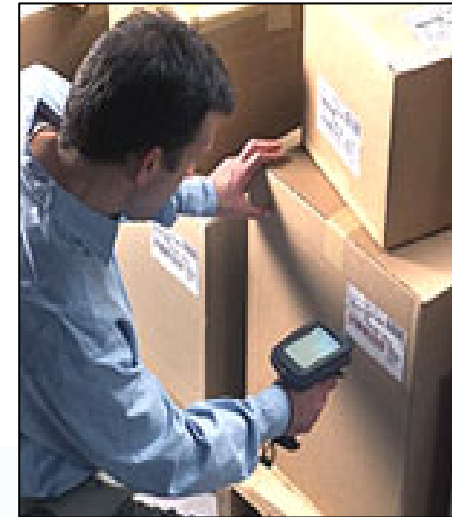
- Work done at AgResearch
- Devices to monitor environmental conditions and metabolic gases
- Current focus: surface acoustic wave devices



Ranford *et al.* (unpublished)



- Work involving CSIRO personnel
  - ▶ Active barcodes
  - ▶ Inkjet printed electrochromic device
  - ▶ Inkjet printing of conductive polymers on biofibre sheets



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Inkjet printed  
electrochromic device

Clark *et al.* (unpublished)

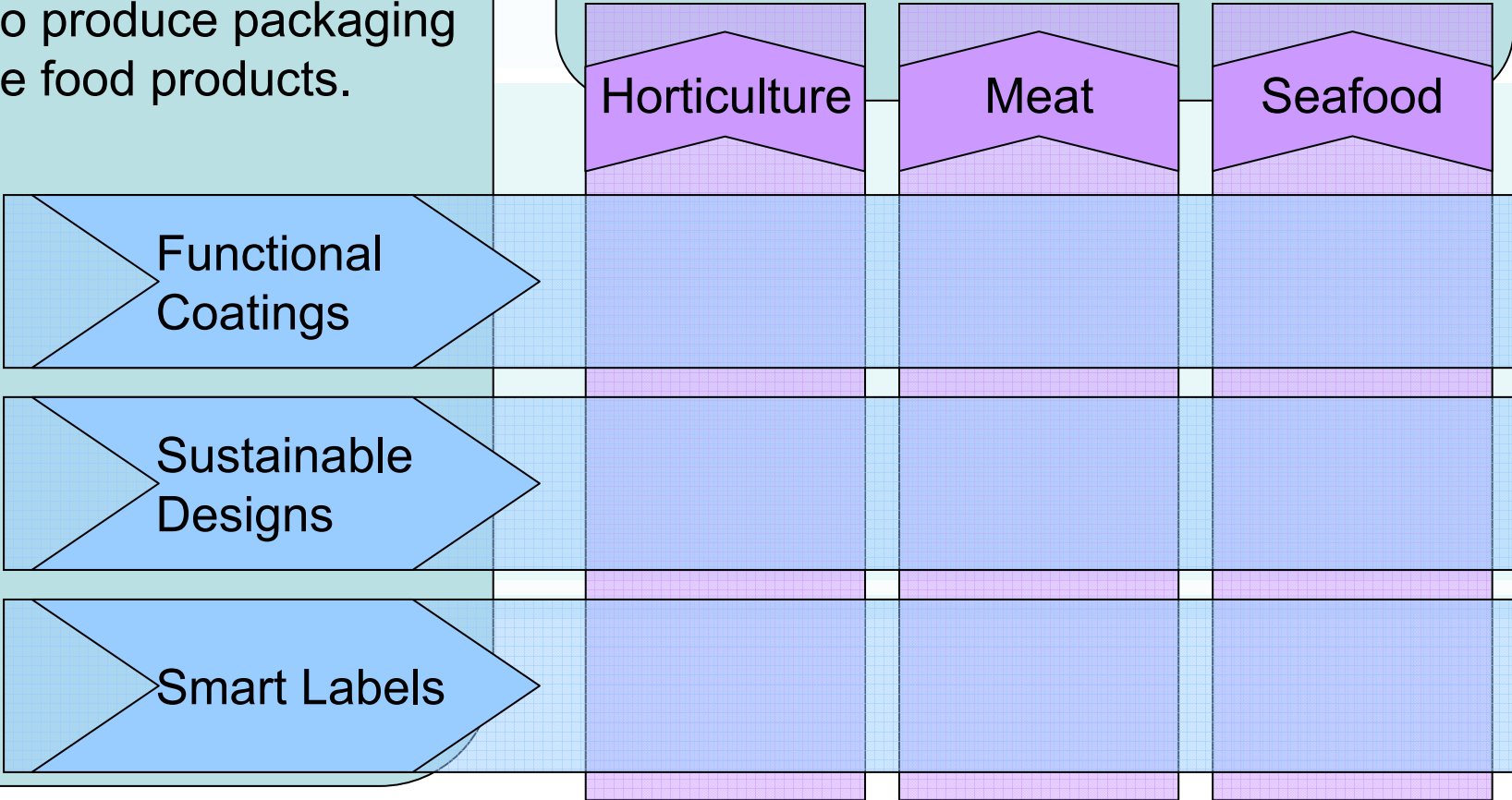
# Vision for New Programme

# Advanced Manufacturing

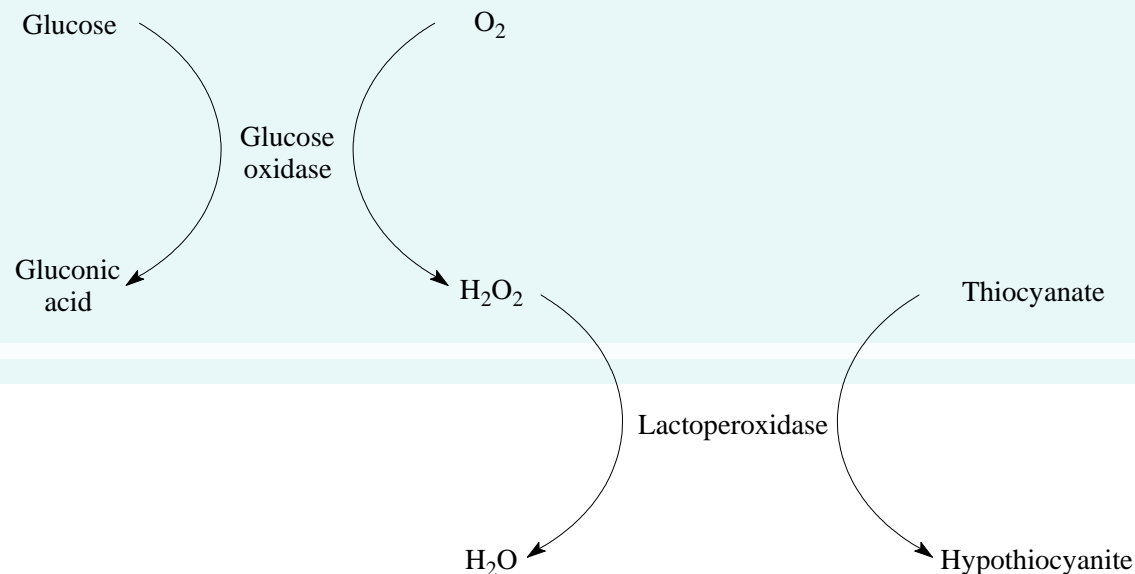
New capabilities for New Zealand's manufacturing sector to produce packaging for niche food products.

# High Value Food Exports

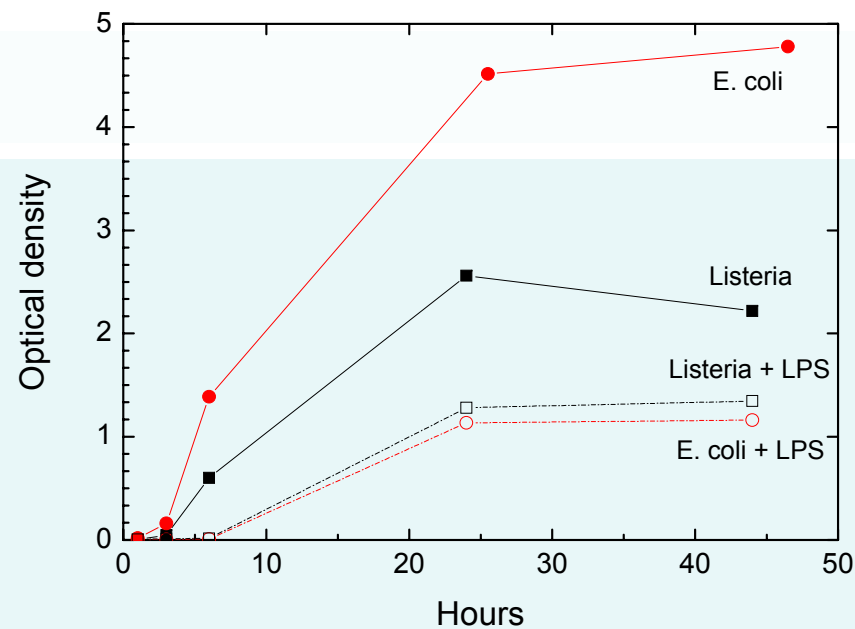
Increase NZ food exports using advanced packaging that ensures food arrives to distant markets at premium quality.



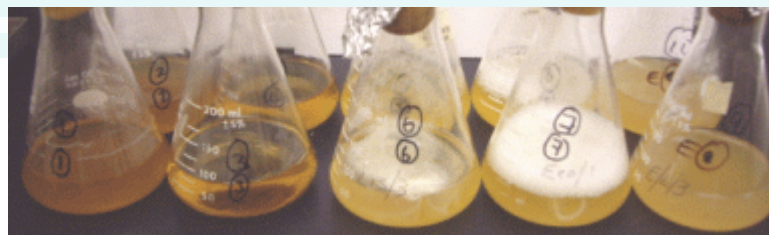
- Work of Evan T.Y. Sim and John A. Lloyd
  - ▶ Collaboration with Crop & Food Research
  - ▶ Recent collaboration with Prof J.H. Han at University of Manitoba (Canada)
- Based on lactoperoxidase enzyme
  - ▶ Natural antimicrobial system found in milk, etc



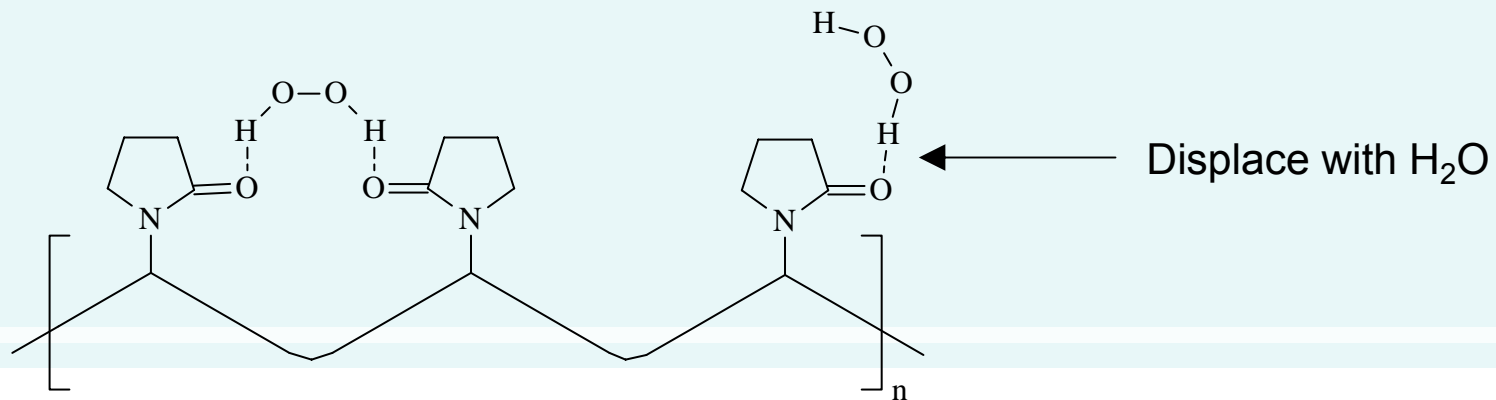
- Inhibition of growth in *E. coli* K12 and *Listeria monocytogenes*



Sim *et al.* (unpublished)

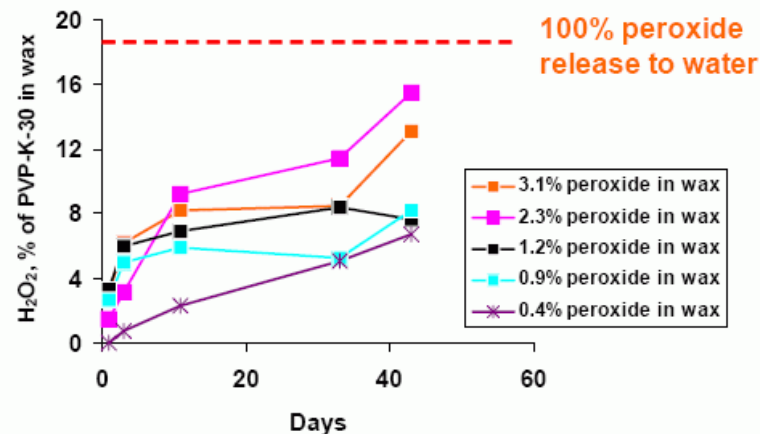
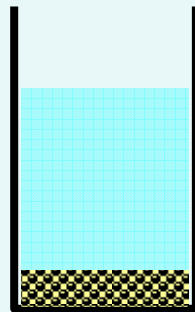


- Alternatives to glucose oxidase
  - ▶ Magnesium dihydroperoxide –  $\text{Mg}(\text{OOH})_2$
  - ▶ Polyvinylpyrrolidone- $\text{H}_2\text{O}_2$  complex (ISP, U.S.A.)
    - Peroxydome K30, 40 kD, water and ethanol soluble
    - Peroxydome K90, 360 kD, water and ethanol soluble
    - Peroxydome XL10, cross-linked, insoluble

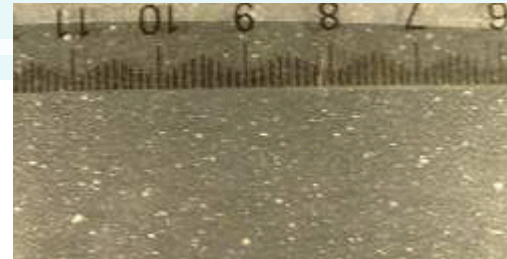




- Some success with wax
- Not compatible with extrusion in polyolefins
- Film casted with PVOH and acrylates not stable



Lloyd *et al.* (2007)

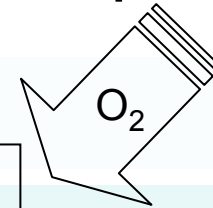


Film extruded by  
Julian Steer  
(Scion)

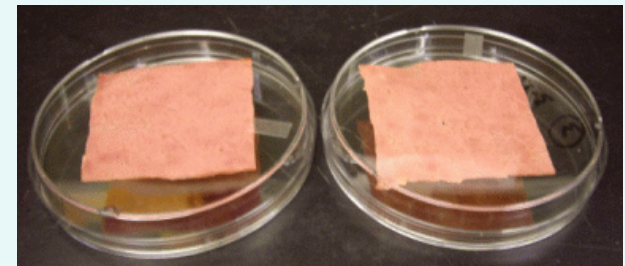
- Trials with alginate, gelatin and starch
- Most success with bilayer film in pea starch

Starch + etc... + Glucose + thiocyanate
Starch + etc...+ Lactoperoxidase + Glucose oxidase

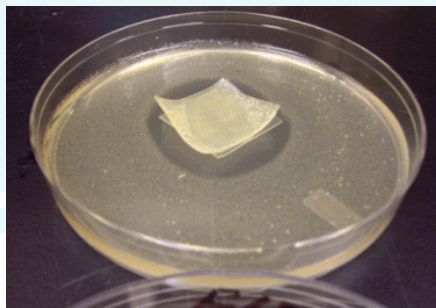
Meat



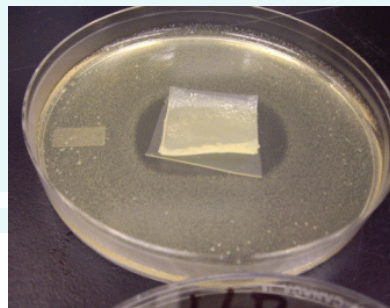
Sim *et al.* (unpublished)



- Successful experiments with pastrami beef
- Quantitative experiment started with salmon



*E. coli* K12



*L. monocytogenes*

- FRST funded research programme
  - ▶ Functional coatings
  - ▶ Sustainable designs
  - ▶ Smart devices
- Antimicrobial materials
  - ▶ Films from starch
  - ▶ Lactoperoxidase system to inhibit bacterial growth

