



Lactic acid bacteria as fresh meat bio-preservation agents

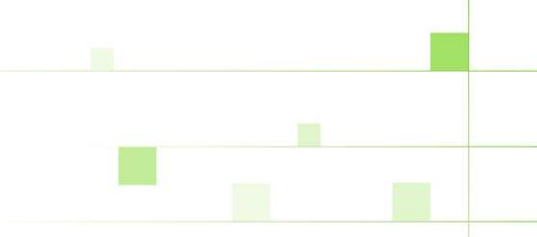
agresearch

Rhys Jones

Food, Metabolism and Microbiology

Agresearch, Ruakura

Hamilton



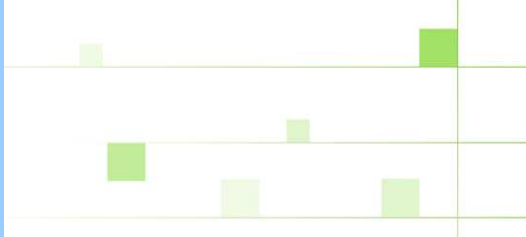
Lactic acid bacteria (LAB) are a loose grouping of bacterial species

- Gram positive
- non-spore forming
- catalase negative
- oxidase negative

- *Lactobacillus*
- *Lactococcus*
- *Pediococcus*
- *Streptococcus*
- *Carnobacterium*
- *Enterococcus*
- *Leuconostoc*
- *Weisella*

- generate molecules such as organic acids as metabolic end-products

- **lactic acid**
- acetic acid, ethanol....

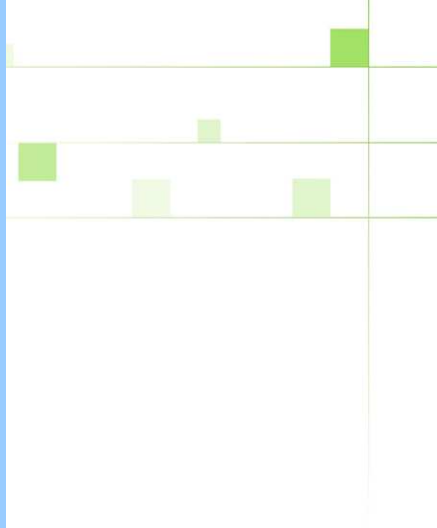


LAB can modify their environment to favour their own growth

- acid production from sugars > lower pH
- scavenge nutrients for energy production
- aciduric
- repair mechanisms

Many LAB are neither pathogenic or food spoilers

- LAB have found uses in food preservation





LAB use in food manufacture

dairy

lactococci

Lc. lactis - cheese making

fruit/cereals/vegetables

lactobacilli

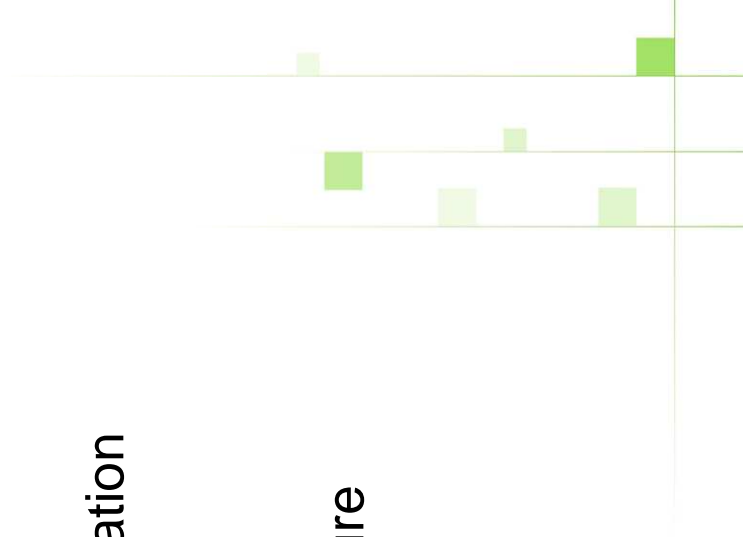
L. plantarum - olive preservation

meat

lactobacilli

L. sakei – salami manufacture

pediococci

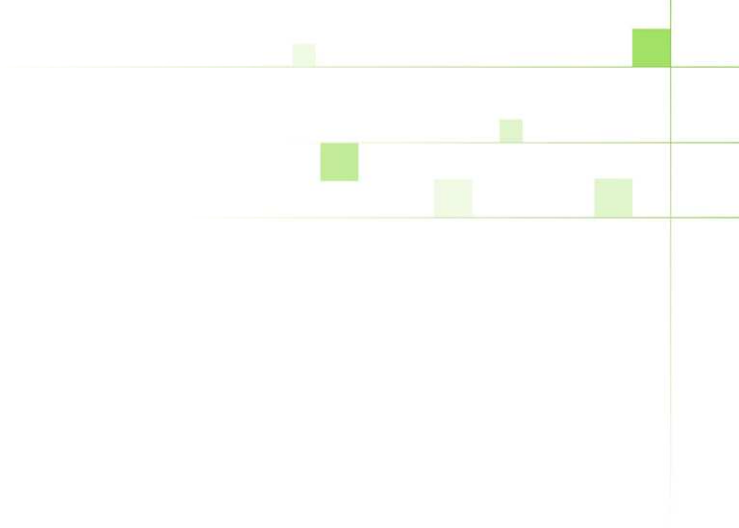


Growing interest in LAB for fresh meat bio-preservation

Some products available overseas for specific purposes

Chr. Hansen: SafePro™ range

- **SafePro B-SF-43**
 - *Leu carnosum*
 - anti- listerial in vac-packs meat cuts
 - no sensory changes
- **SafePro B-2**
 - *L. sakei*
 - anti- *B. thermosphacta* in vac-packs stored at +3°C
 - no sensory changes

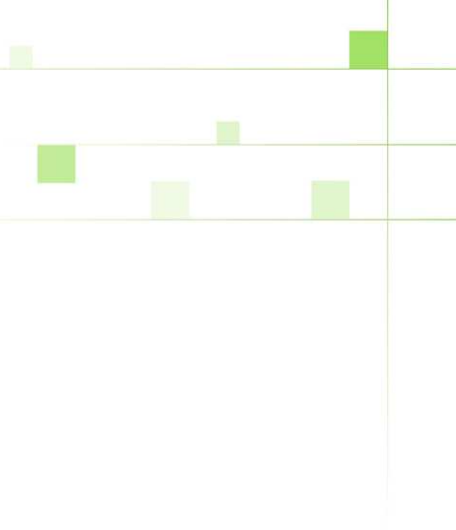


Growing interest in LAB for fresh meat bio-preservation

Some products available overseas for specific purposes

Nutrition Physiology Corporation (NPC)

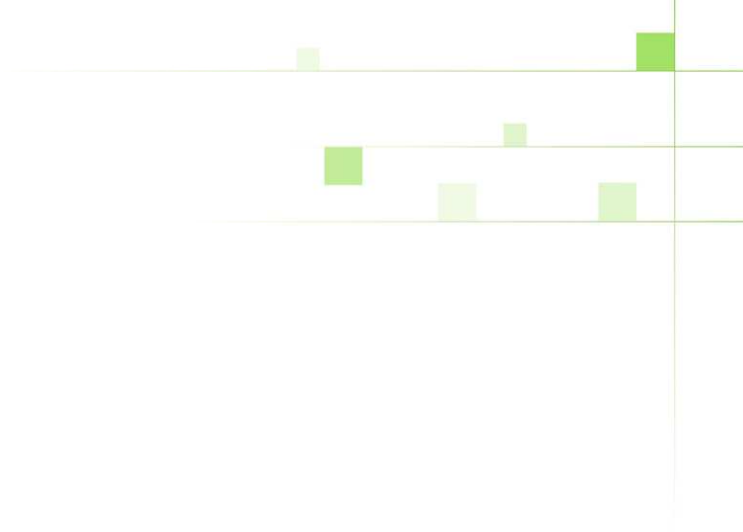
- **Bovamine Meat Culture™**
 - *L. acidophilus*+3
 - anti- *E. coli* O157 and *Salmonella* in refrigerated (+5°C) ground beef
 - FDA GRAS, pending final USDA approval



NZ has unique microbial control needs

\$4.5 billion (15%) export earnings from meat

- lamb: 426Kt (97% total prod.)
- mutton: 98Kt (98%)
- beef: 539Kt (87%)



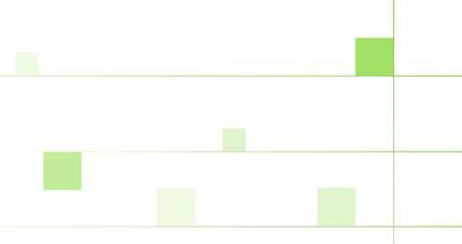
NZ has unique microbial control needs

1. Chilled product spends a long time at sea

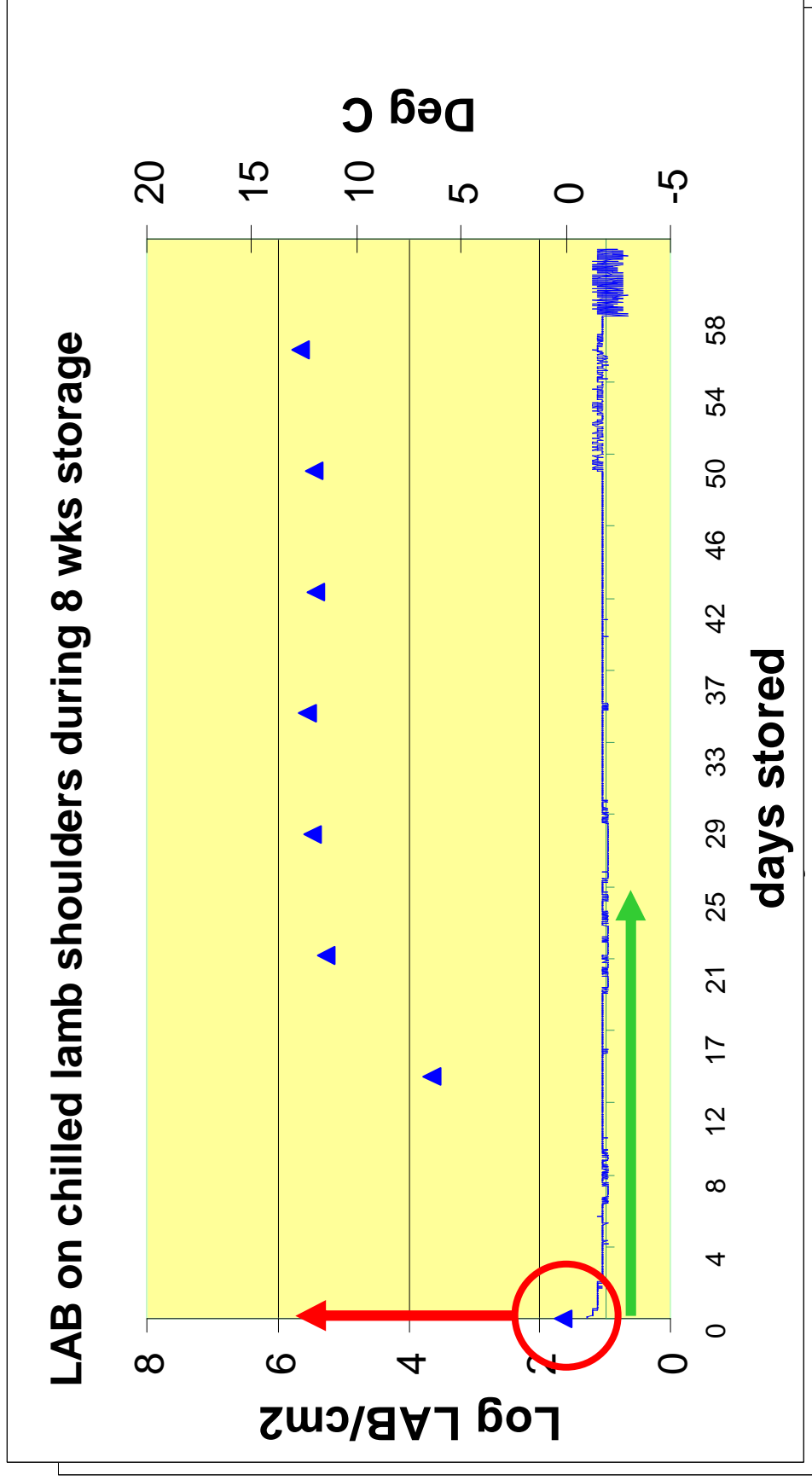
- 6-7 weeks to Europe
- 3-4 weeks to North America

During transport bacteria can grow

- cold-tolerant bacteria surviving process hurdles
 - LAB
 - spoilers (e.g. *Brochothrix*, *Serratia*)
 - pathogens (e.g. *L. monocytogenes*)



Some contaminant strains grow during LAB fermentation, others are not





NZ has unique microbial control needs

2. Other bacteria can survive

- mesophilic pathogens detectable at market
 - *E. coli* O157, *Campylobacter*



NZ has unique microbial control needs

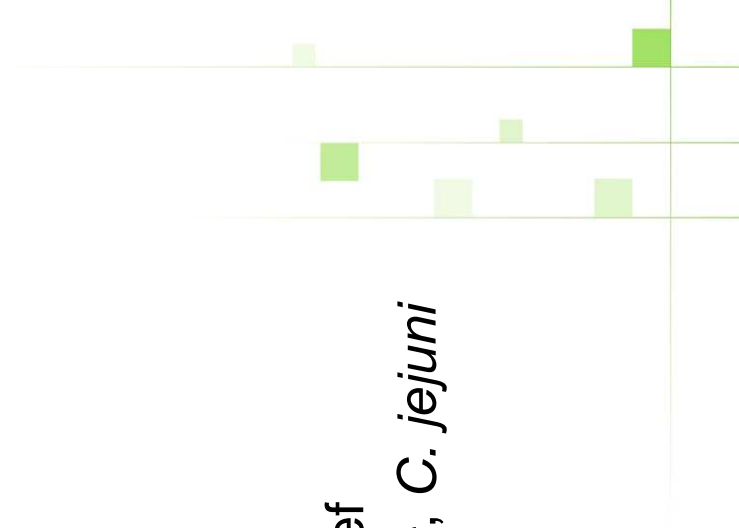
3. Market demands

consumers want products that are increasingly :

- safer
- longer lasting
- minimally processed
- ‘greener’

regulators getting tougher

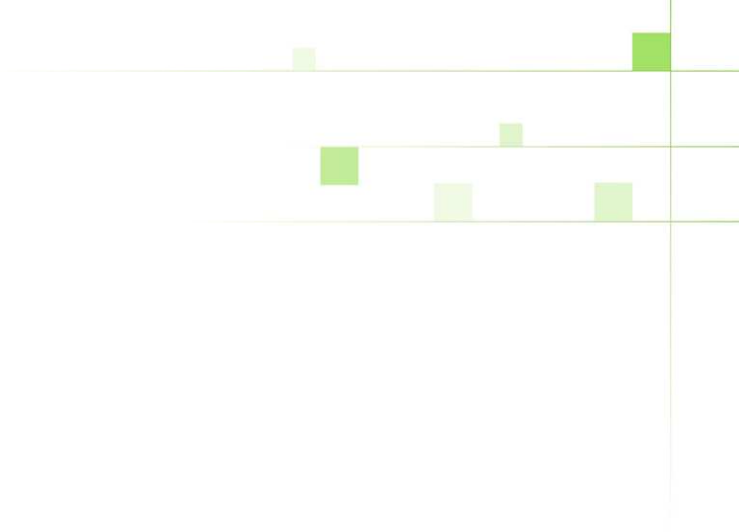
- *E. coli* O157 – already an adulterant in beef
- others may follow? e.g. *L. monocytogenes*, *C. jejuni*



NZ has unique microbial control needs

How can seeding meat with LAB help 'bio-preserve' NZ product?

- restrict unwanted bacteria
- improve consistency of flora



Improving product consistency

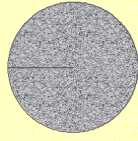
VP boned
lamb shoulders

0

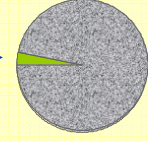
weeks stored

~100 cfu/cm²

- mixed strains
- small numbers



Add 3 cfu/cm²
L. sakei 706



1x10⁵ cfu/cm²



• Improving product consistency

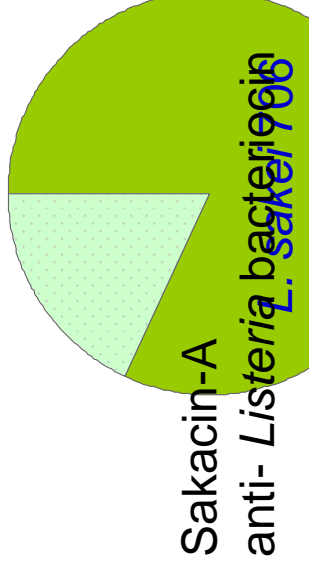
agresearch

LAB compete with other bacteria

- lower pH
 - sugars > acid + ATP
- acid tolerant

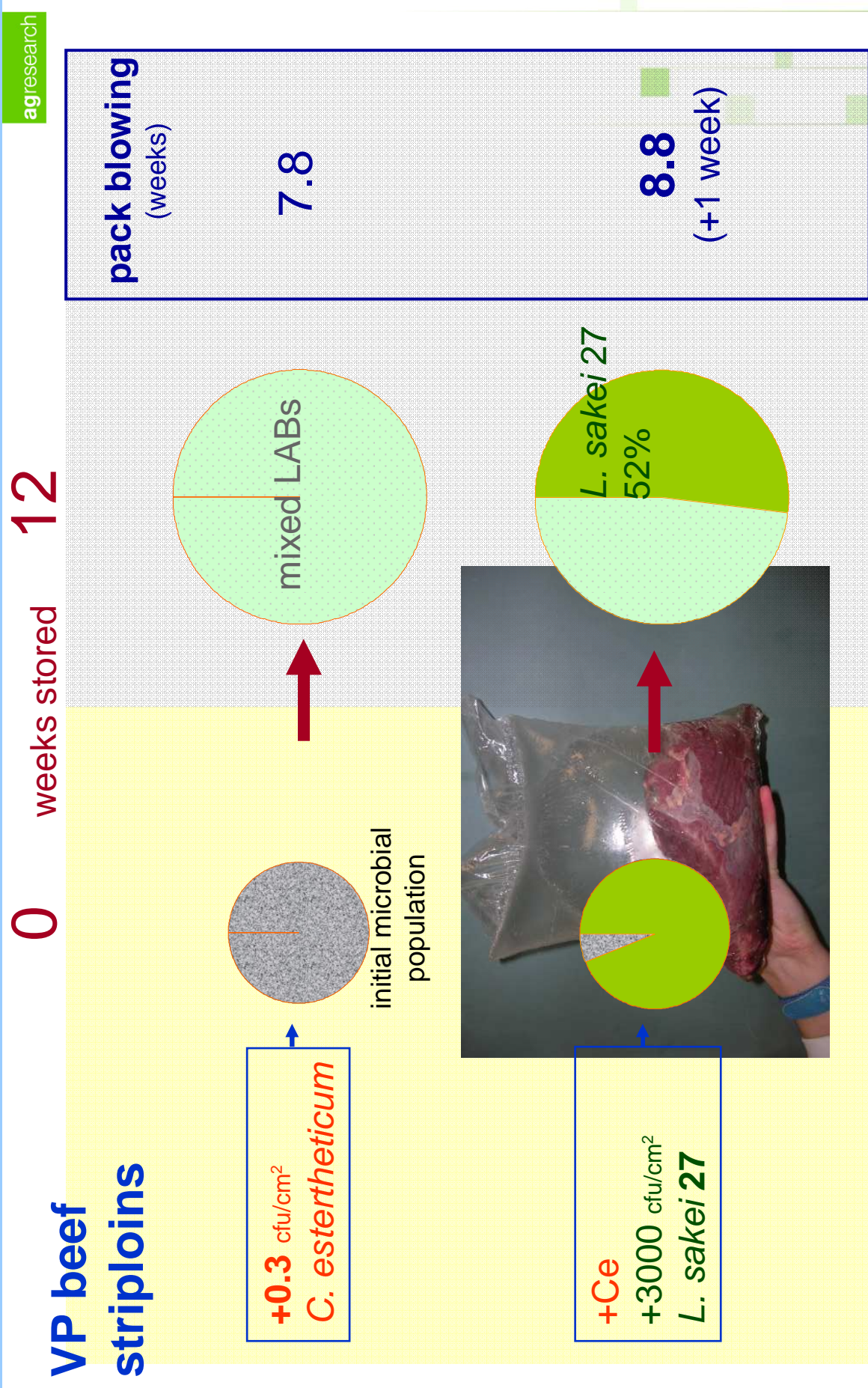
L. sakei

- high acid tolerance
- stress resistant
- scavenge nutrients
- **antimicrobial molecules**



• restrict unwanted bacteria

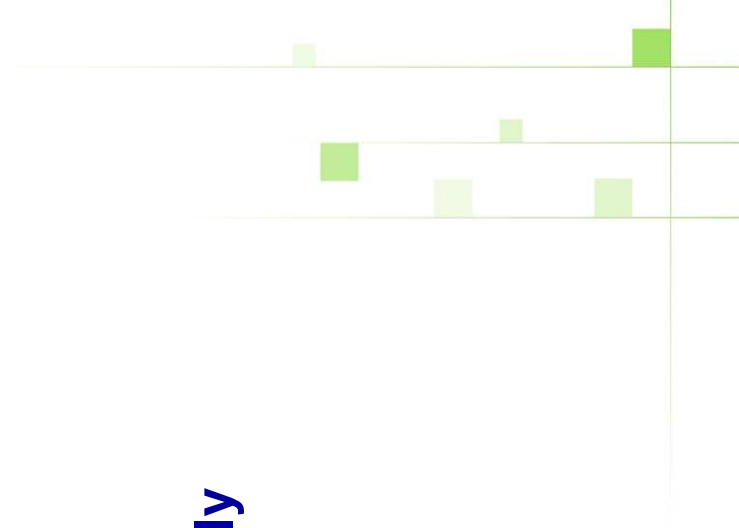
• restrict unwanted bacteria



Restriction of activity by a specific organism

Scope for shelf-life extension?

- **LAB can restrict specific organisms**
 - lactobacilli (*L. sakei*, *L. plantarum* etc), carnobacteria, lactococci, pediococci etc.....)
 - pathogens (e.g. *L. monocytogenes*)
 - spoilers (e.g. *Brochothrix*, *C. estertheticum*)
- **LAB can also restrict background flora generally**
 - competitive mechanisms
 - NZ strains of *L. sakei* ?

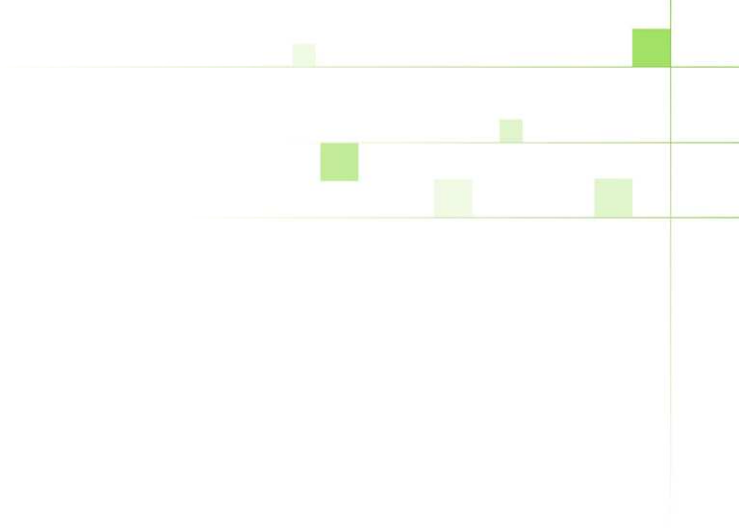


Scope for shelf-life extension?

• Upcoming Project (08-09)

- determine extension of sensory qualities in lamb 'bio-preserved' using a cocktail of inhibitory NZ *L. sakei* strains.
 - microbiology
 - visual (colour acceptability)
 - smell
 - texture and taste

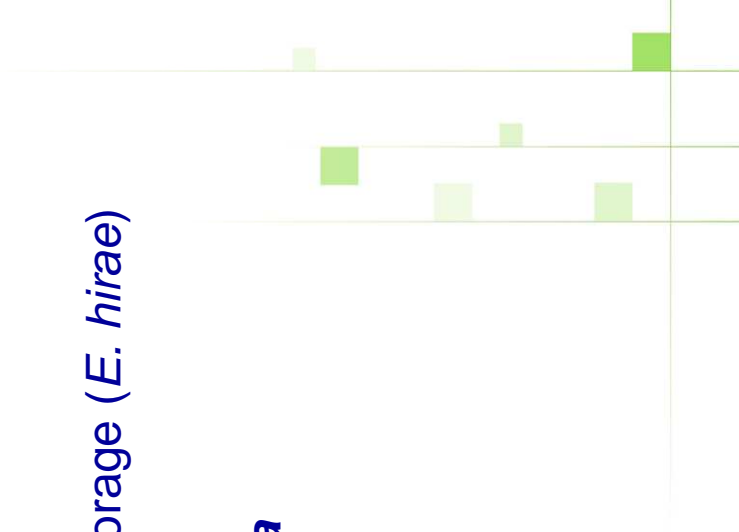
- Success → Product Development



Some Potential Products (3-5yrs)

1. *L. sakei* cocktail for slowing development of **spoilage flora**.
2. *L. sakei* product for delaying **gas production** due to ***C. estertheticum***
3. *L. sakei* product to reduce survival of ***C. jejuni*** during storage (*E. hirae*)
4. *Carnobacterium* – based inhibition of ***B. thermosphacta***

Seeking answers for *E. coli* O157



Commercial Application

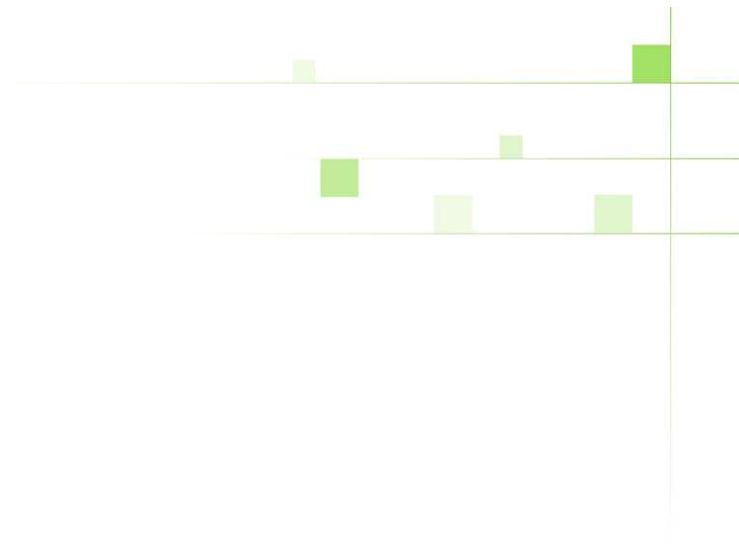
Discovery



Application



Approval



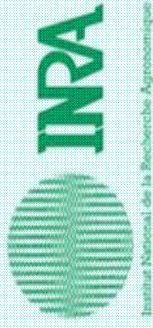
Collaborators

- Food, Metabolism and Microbiology



Agresearch, Ruakura

- Monique Zagorec



lactic-acid bacterial research unit
(FLEC), INRA, France

- John Tagg



Dept. Microbiology and Immunology,
Otago University



Current Funders



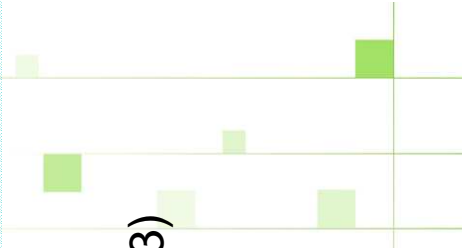
- **ARC Fund** (Agresearch Research Capability 2006-09)



- **MIRINZ Inc.** (LAB to Increase Shelf-life 2007-09)



- **ForST** (Value from Quality programme 2007-2013)





Lactic acid bacteria as fresh meat bio-preservation agents

agresearch

Questions?

