



# Functional Cultures in Production

- protective media, symbiotic composition

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## What is fermented milk?

It's a milk product prepared from milk using cultures.

The microflora is kept alive until the product is consumed.

## What is fermented milk with functional cultures?

It's a fermented milk product beneficial to health.



## Lifecycle of functional fermented milks

- Our food for thousands of years
- Preserving valuable milk
- Improving digestion
- Uncontrolled microfloras
- Unknown health effects
- Not standardized products



# Lifecycle of functional fermented milks

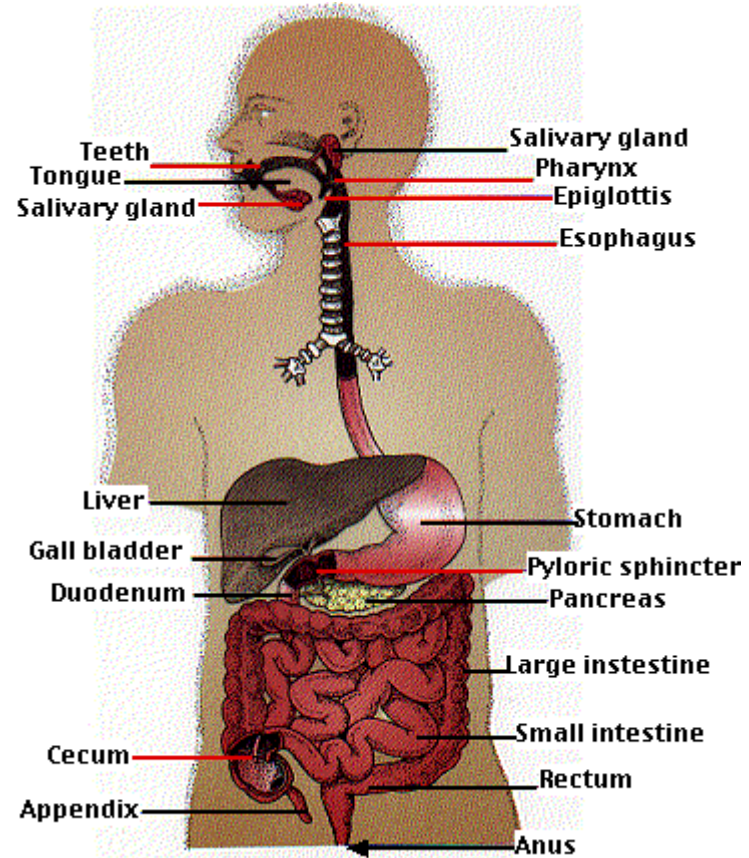
Now:

- Revolution happened 100 years ago thanks to Élie Metchnikoff
- Special lactic acid bacteria in fermented milk has health effects in the large intestine
- Specific microfloras = dairy cultures
- Standardised products and production



# Probiotics

Probiotics are bacterial cultures or living microorganisms which upon ingestion in certain numbers exert health benefits beyond inherent general nutrition and support a good and healthy intestinal bacterial flora.



Gorbach SL. Probiotics in the third millennium. *Dig Liver Dis* 2002;34(suppl 2):S2-7



## Requirements for the production of functional dairy milks

1. Probiotic bacteria survive in the product in sufficient amounts
2. Probiotics should not cause any bad taste or structure



# Probiotic bacteria survive in the product in sufficient amounts

- Milk acts as a dominant and good carrier of standard starter cultures, but not always of functional cultures.



## Because

- They grow slowly in milk; such as *Lb. acidophilus* and *Bifidobacterium* spp.
- High numbers (min  $10^6$  cfu/g) are needed in the product to compensate losses in the gut.



# To improve viability in the product through ingredients



- Casein
- Whey protein
- Yeast extract
- Glucose or other sugars
- Vitamins
- Lactulose
- etc.

**May promote the growth of probiotics**



## To improve viability in the product via other starters

In most cases, probiotics are not the only microbes used in the product.

Because:

- Other cultures, such as yoghurt cultures, shorten the fermentation time and so avoid the risk of contaminant bacteria growing.
  - Interaction between probiotics and other starters may cause synergistic effects which accelerate the growth of all organisms.
- >also has a positive effect on the taste and structure of the final product!



## To improve viability in the product via technical solutions

- **Microencapsulation**
  - To encapsulate the bacteria using e.g. gelatin or gums to reduce cell losses in product.
  - Works in a challenging matrix
  - Capsules open in the gut
  - Commercially available



## Synbiotic Microcapsules That Enhance Microbial Viability during Nonrefrigerated Storage and Gastrointestinal Transit

Ross Crittenden,\* Rangika Weerakkody, Luz Sanguansri, and MaryAnn Augustin

Preventative Health National Research Flagship, Food Science Australia, Werribee, Victoria 3030, Australia

Received 19 July 2005/Accepted 31 December 2005

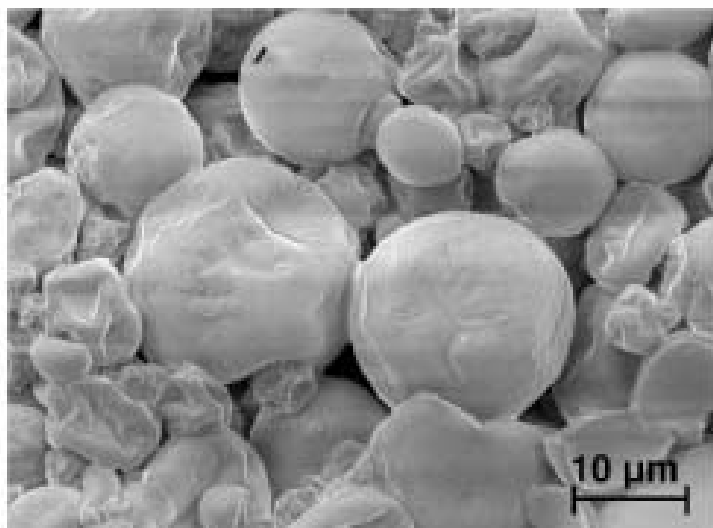


FIG. 1. Scanning electron micrograph (magnification,  $\times 1,000$ ) of spray-dried encapsulated *Bifidobacterium infantis*.

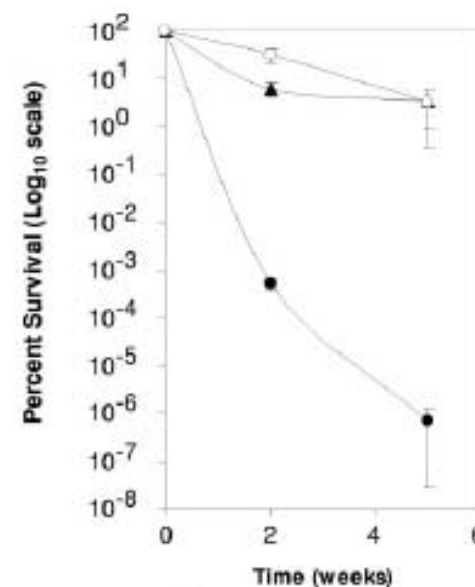


FIG. 2. Survival of *Bifidobacterium infantis* Bb-02 during storage for 5 weeks at 25°C and 50% relative humidity. ●, nonencapsulated bacteria; ▲, bacteria encapsulated in caseinate-FOS-oil-DGS emulsion; ○, bacteria encapsulated in caseinate-FOS-oil-RS emulsion. The

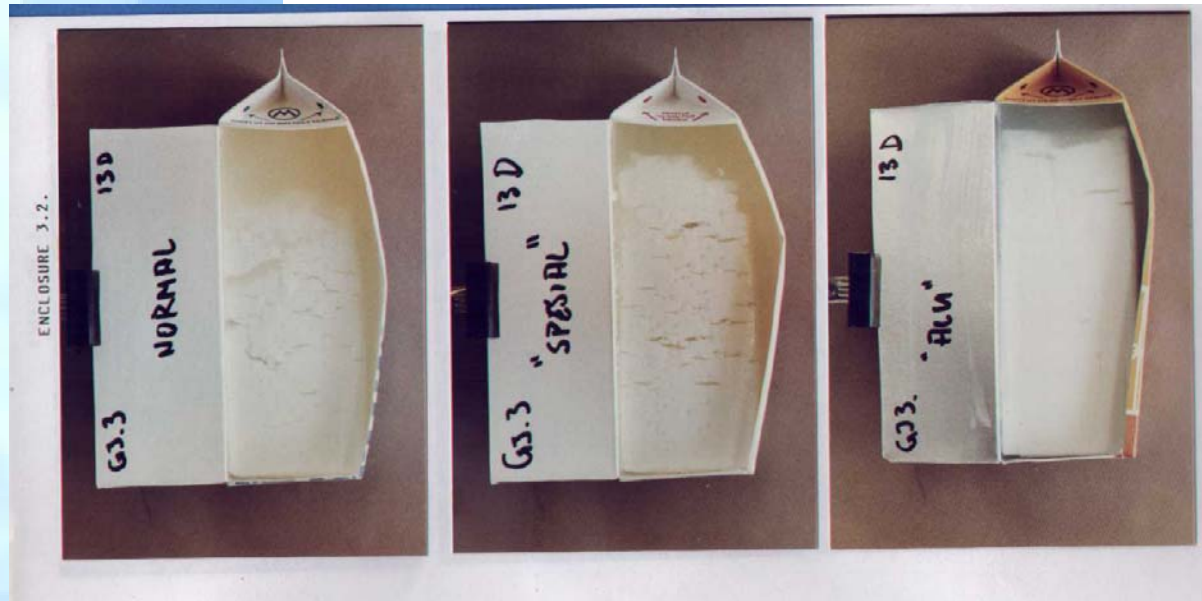


## To improve viability in the product via technical solutions

- Oxygen is toxic to anaerobic bacteria such as bifidobacteria
  - Vacuum processing of milk prior to fermentation
  - Choosing optimised filling materials
- Good hygienic practice
  - From milking to consumer



# Packaging



Normal

Special

Aluminium

Skimmed cultured milk after 13 days storage at 4 °C





## Inhibitory effects on functional cultures

- In many cases, functional cultures are even more sensitive to inhibitors than standard cultures
  - Disinfectants
  - Antibiotics
  - Bacteriophages



## Different types of functional fermented milk products

- A. Traditional fermented milks with possible probiotic effect
- B. Modern functional cultured milks
- C. Advanced functional cultured “dairy” products

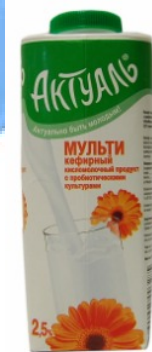


## A. Traditional fermented milks with possible probiotic effect

- Kefir is a good example
- Almost ideal probiotic dairy product
- If further studies are conducted, more health benefits for humans will appear



y



IDF Moscow May2007 silfverberg



## B. Modern functional cultured milks

- Based on traditional fermented milks but with added functional cultures
- Optimised to survive with other micro-organisms during fermentation and storage (alone may cause bad structure or taste to the final product )

Examples:

- *Lb. asidophilus* (La-5)
- *B.animalis ssp.lactis* (Bb-12)
- *Lb.rhamnosus* (Lgg)
- *Lb.reuteri*
- *Lb.plantarum* 299v
- 
-





## C. Advanced functional cultured “dairy” products

- Specially developed for functionality
- Probiotics in straw = long life probiotic products
- No milk matrix = juices with cultures
- Sweet acidophilus milk
- Lb. helveticus strain, which forms bioactive peptides (lowers blood pressure)
- “Protective” cultures, which have antimicrobial activity



No milk in product:



Lowers blood pressure:



# Bioactive peptides of milk protein

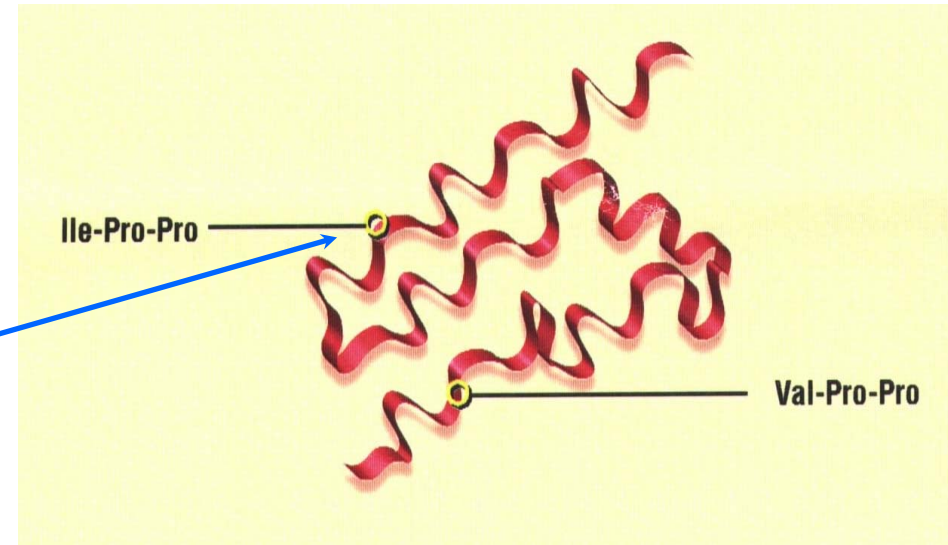


Fig. 1

*L. helveticus* LBK-16H  
degrades  $\beta$ -casein of milk

Fig. 2

Bioactive, blood pressure lowering tripeptides  
fractions from milk protein  
(Val = valine, Pro = proline, Ile = isoleucine)

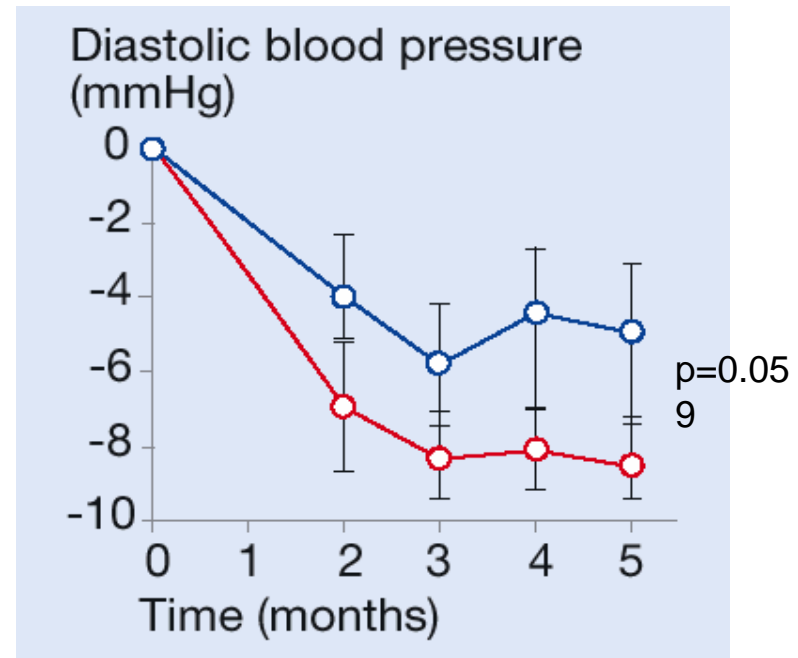
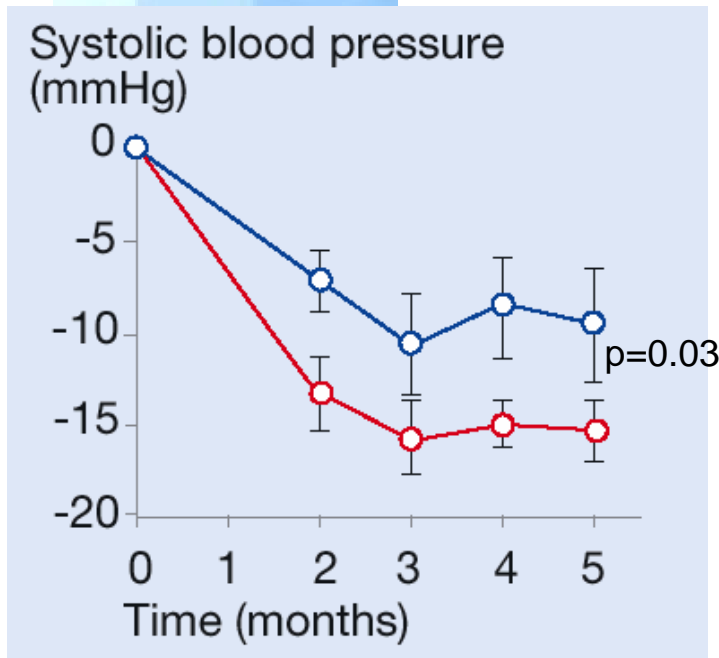


# Long-term study on Evolus<sup>®</sup>

## Changes in systolic and diastolic blood pressure

○ Control group  
○ Test group

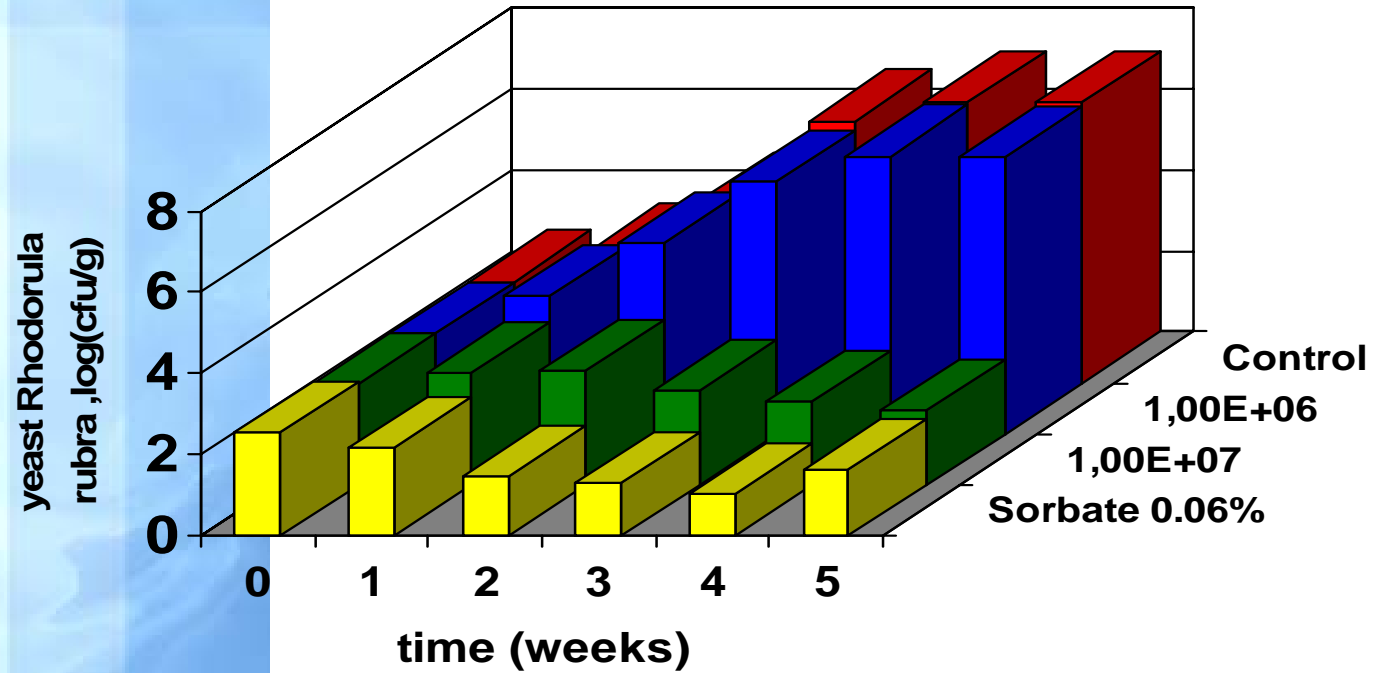
- 1.5 dl/day/person
- n = 39





# “Protective” cultures\*, which have antimicrobial activity

\**Propionipacterium freudenreichii* ssp. *shermanii*  
& *Lactobacillus rhamnosus* Ic705

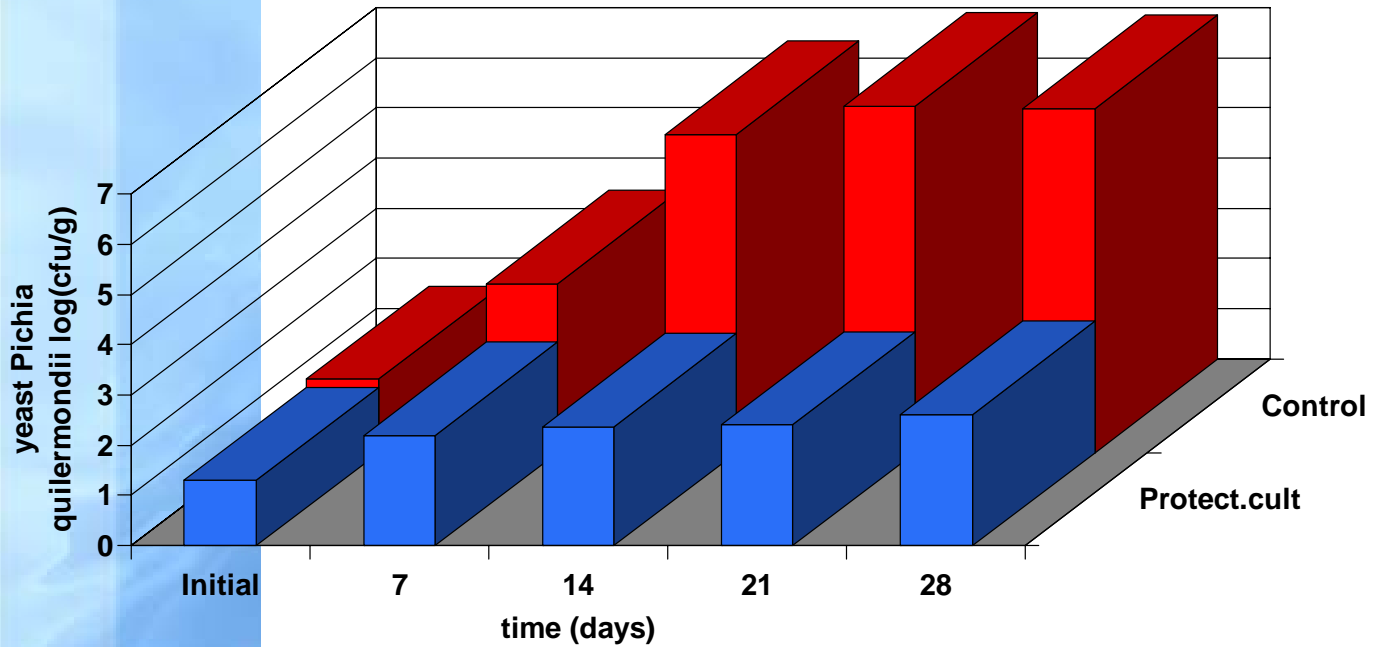


**FIG 1: Influence of the Protective Culture (Holdbac™ by Danisco) on the Quark quality during the self-life. Ref. Valio R&D**



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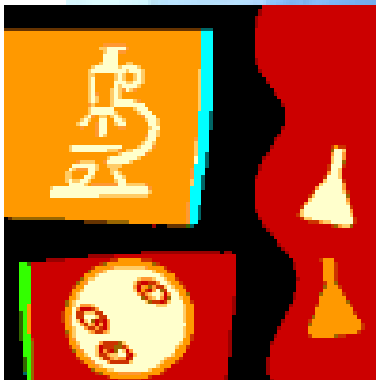
**FIG 2: Influence of the Protective Culture (Holdbac™ by Danisco) on the yoghurt quality during the self-life. Ref. Valio R&D**



# Future



Knowledge about functional cultures will definitely improve via new technologies to maximise the stability of functional organisms (both traditional and new) during manufacture, formulation, storage and in the GI tract.





## Further information

### References:

- IDF Bulletin Fermented milks - science and tech. no. 227/1988
- IDF Seminar on Aroma and Texture of Ferm. Milk 2002
- Probiotic Dairy Products, edited by A.Y. Tamime. 2005
- Dairy Processing. Improving quality. Edited by Gerrit Smit. 2003
- Fermented Milks. Edited by A.Y. Tamime. 2006



**Thank you for your attention!**