Biological and technological application of kefiran, an EPS from kefir grains

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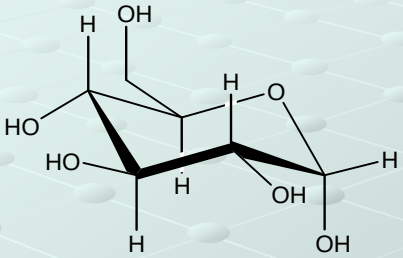
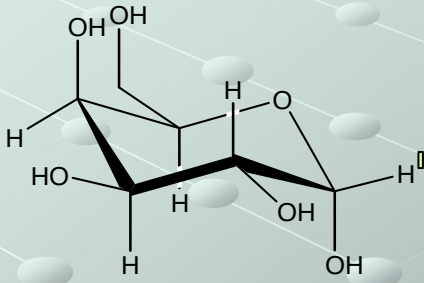
Kefiran

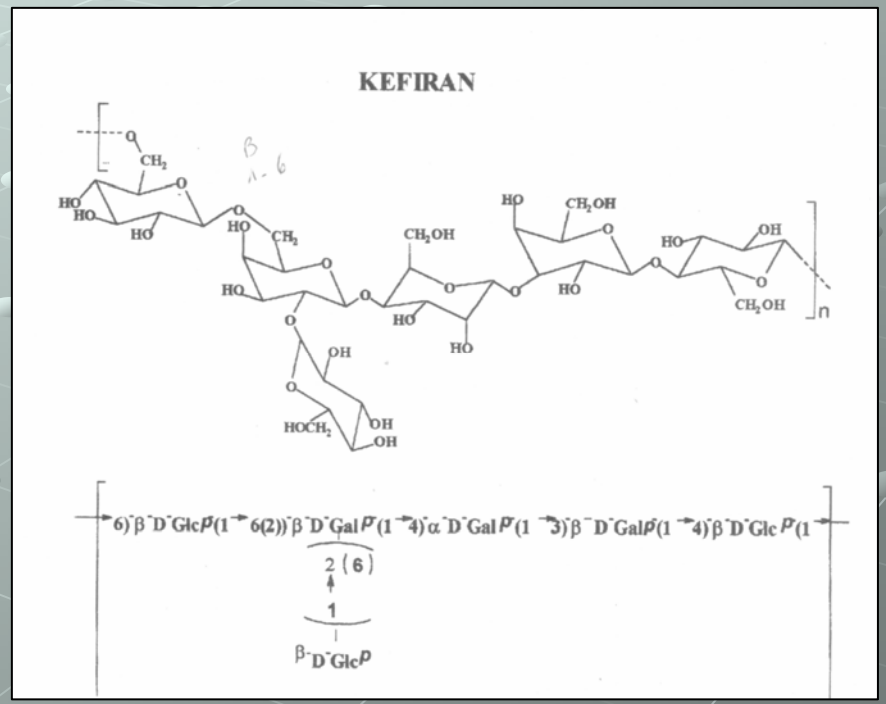
Non-digerible polysaccharide composed of glucose and galactose



glucose



galactose

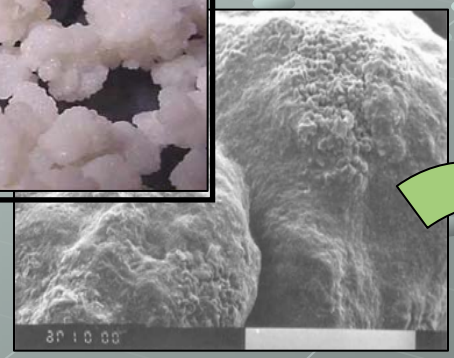


Kooiman 1968, Micheli et al 1999

Produced by lactic acid bacteria (GRAS) included into kefir grains

Kefir grains

Kefir grains are natural immobilized starter consisting of a complex association of microorganisms



Microorganisms are embedded in a proteins and polysaccharide matrix.

- Lactic acid bacteria (lactococcus, homo y hetero fermentatives lactobacillus)
- Yeast
- Acetic acid bacteria

Kefir grains

Milk or whey

Incubation at 20 °C

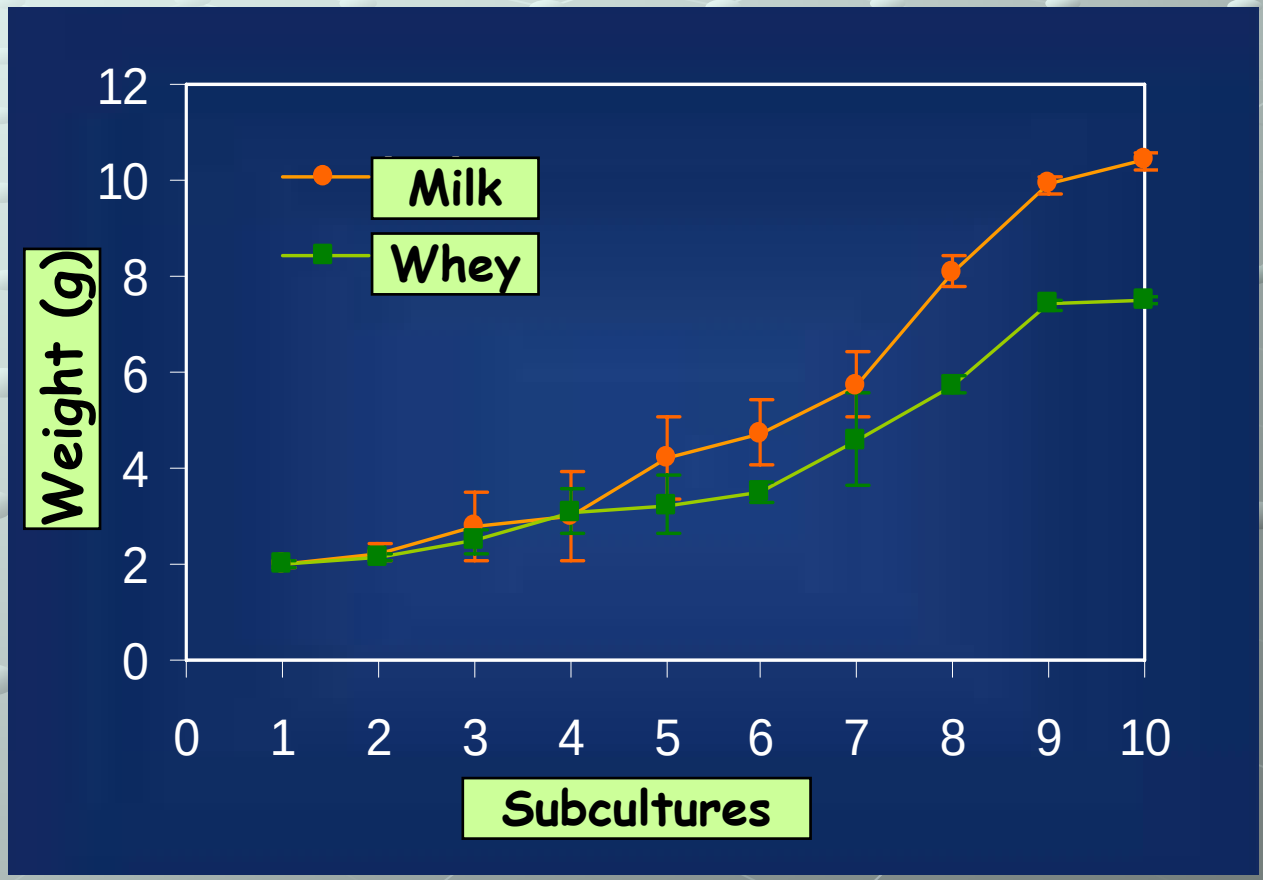
Filtration
plastic sieve

grains

Fermented
product

Kefir grains

Grain weight increases a function of subcultures



Kefir grain composition

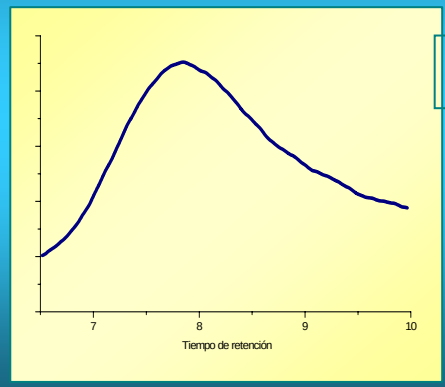
	Milk	Whey
Protein	5-6%	6-8%
Polysaccharide	8-9%	8-9%
water	86-87%	83-84%
LAB	$1.8\ 10^8$ cfu/g	
Yeast	$2.1\ 10^7$ cfu/g	
AAB	$2.5\ 10^5$ cfu/g	

Kefiran: Physicochemical properties

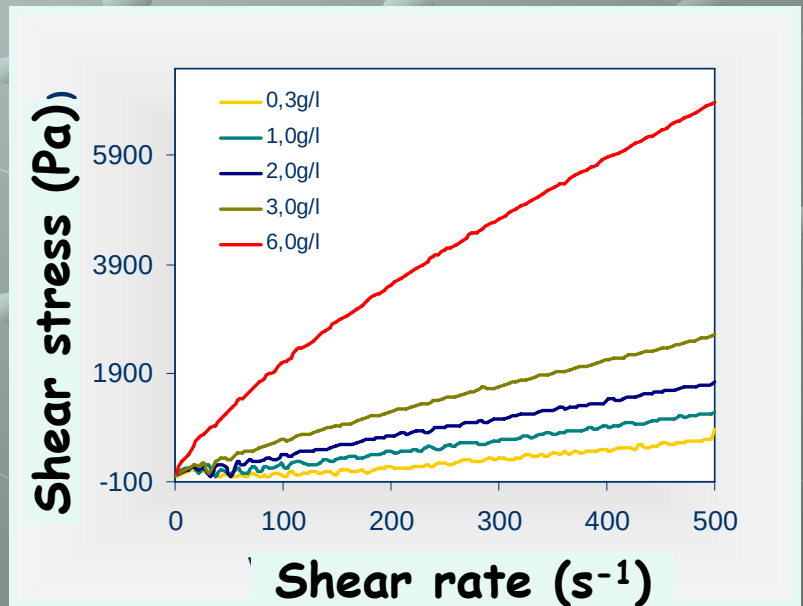
Intrinsic Viscosity

6.0 ± 0.05 **dL/g**

Molecular mass by gel permeation chromatography

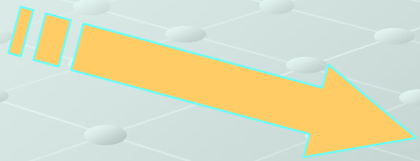


MW> 4 10^6



Polysaccharide and biological function

Polysaccharides and oligosaccharides



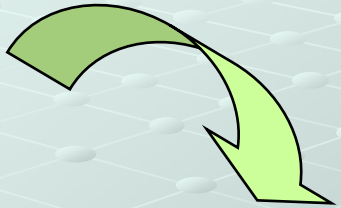
Dietary fibers
FOSs
GOSs
inuline
lactulose

Functional Aspects

- Prebiotic
- Non-digerible fibers
- Immune system stimulation
- Antiulcer
- Antitumoral

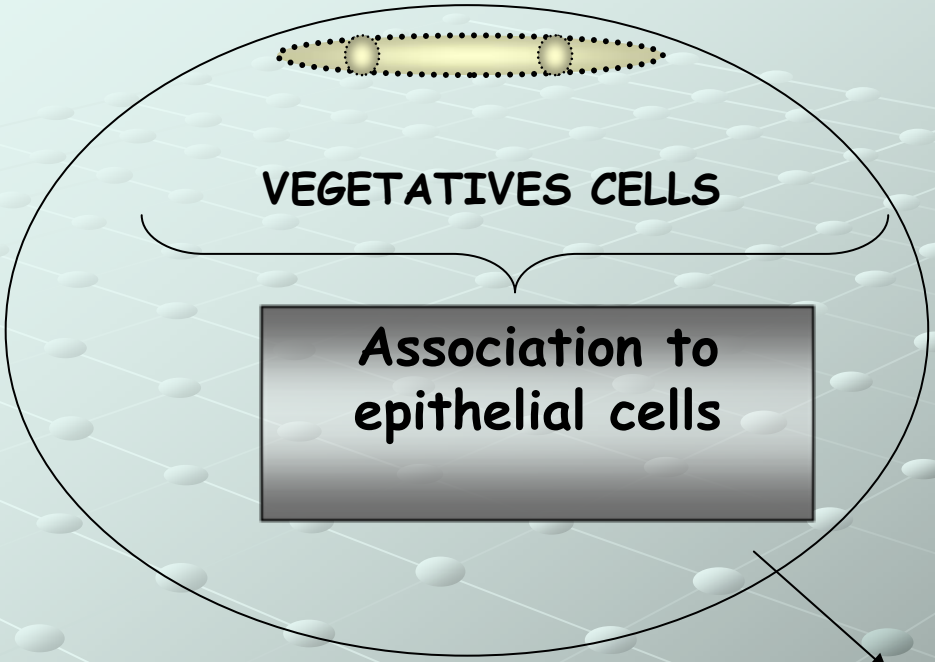
Polysaccharide and biological function

Kefiran



Effect of kefiran on cytopathic events triggered by Bacillus cereus on Caco 2 cells (In vitro study)

B. cereus: virulence factors

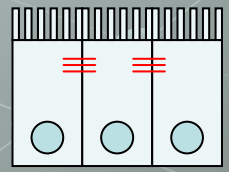


VEGETATIVES CELLS

Association to epithelial cells

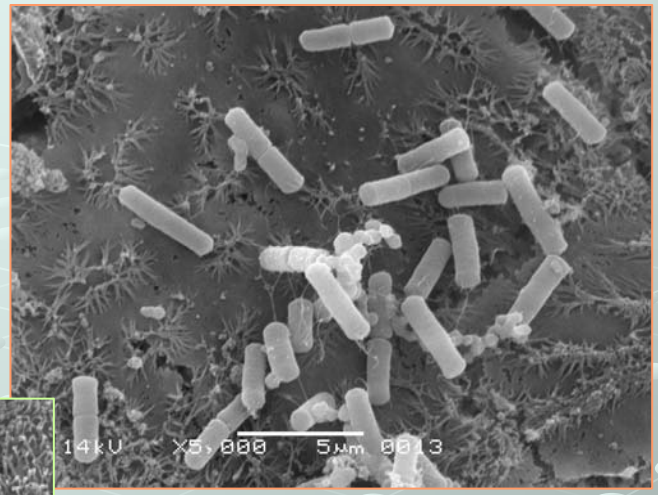
EXTRACELLULAR FACTORS

High haemolytic and citotoxic activity

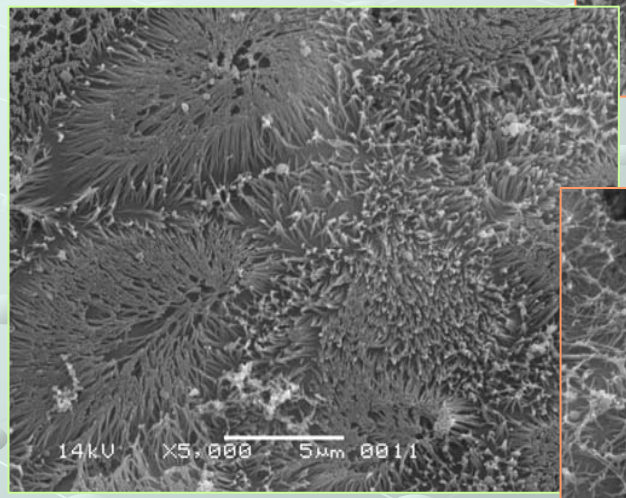


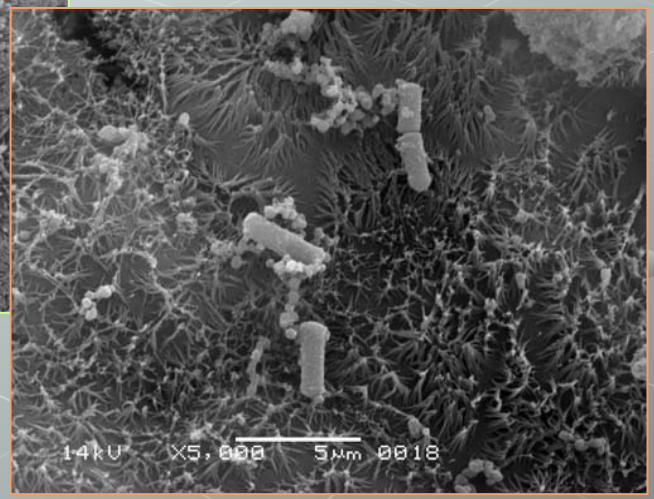
Damages in enterocytes

Bacillus cereus on Caco 2 cells



Bacillus cereus on Caco 2:





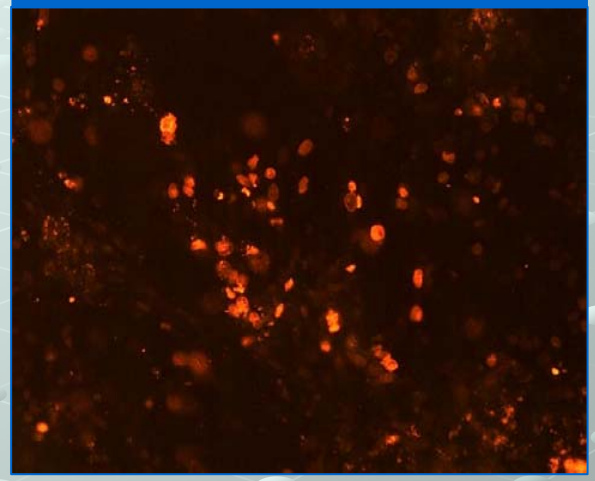
Caco 2 preincubated with kefiran

Scanning electron microscopy

Labelling of necrotic cells with Propidium iodide

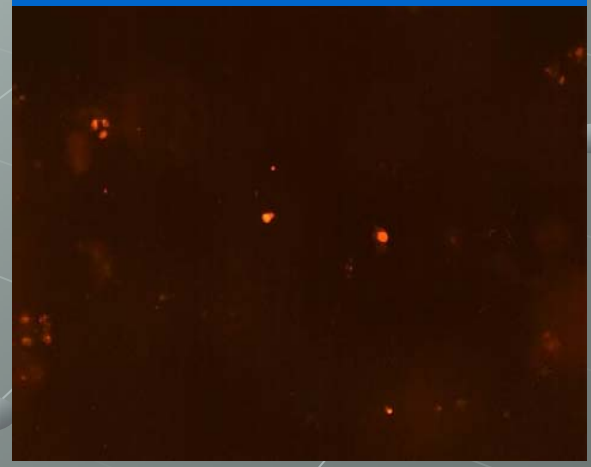
Control

B. cereus



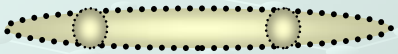
B. cereus + kefiran

preincubation



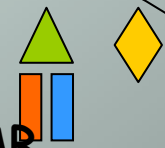
Kefiran antagonize cell death events triggered by *B. cereus*

B. cereus: virulence factors



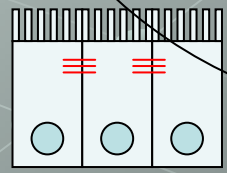
VEGETATIVES CELLS

Association to epithelial cells



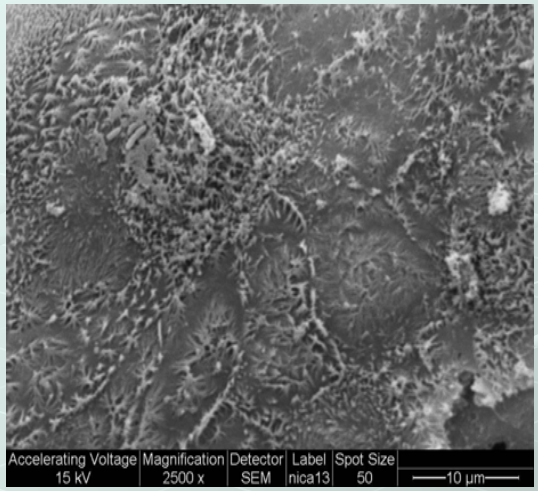
EXTRACELLULAR FACTORS

High haemolytic and citotoxic activity

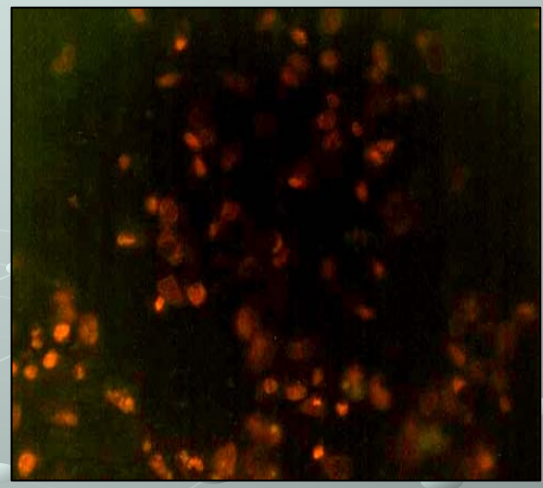


Damages in enterocytes

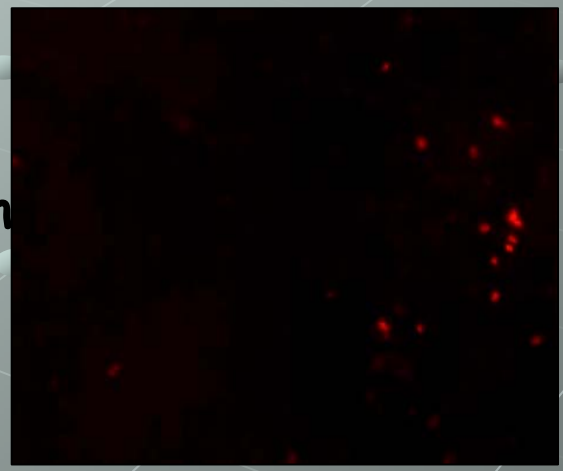
Effect of Supernatant of Bacillus cereus on Caco 2 cells



Without kefiran



with kefiran



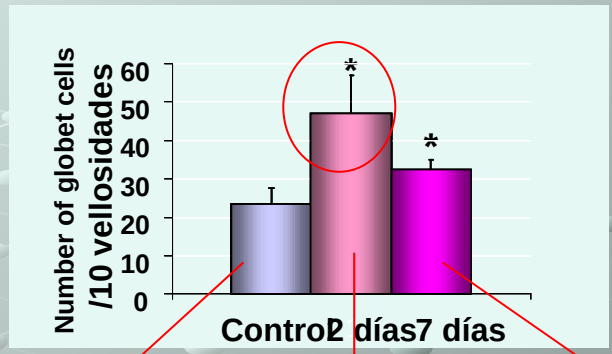
Scanning electron microscopy

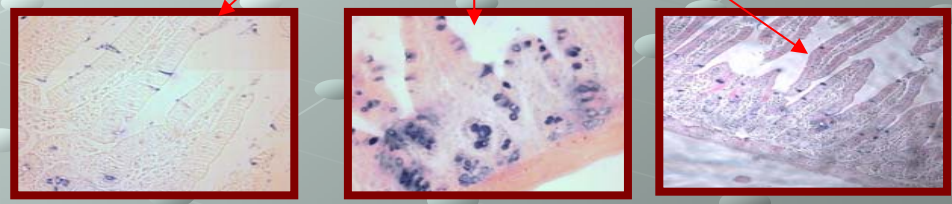
Propidium iodide labelling

In vivo studies: Balb C mice

Increment in mucus producing cells in small gut

oral administration of kefiran



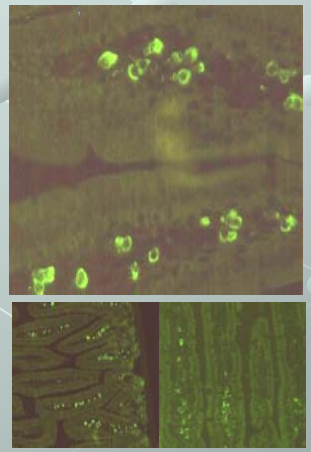


Control 2 days 7 days

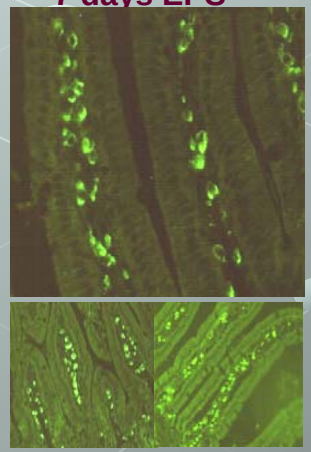
*

Increment in number of IgA producing cells in *lamina propria*

Control



7 days EPS



Kefiran

Fermented

Grain

250mg/L

8g%

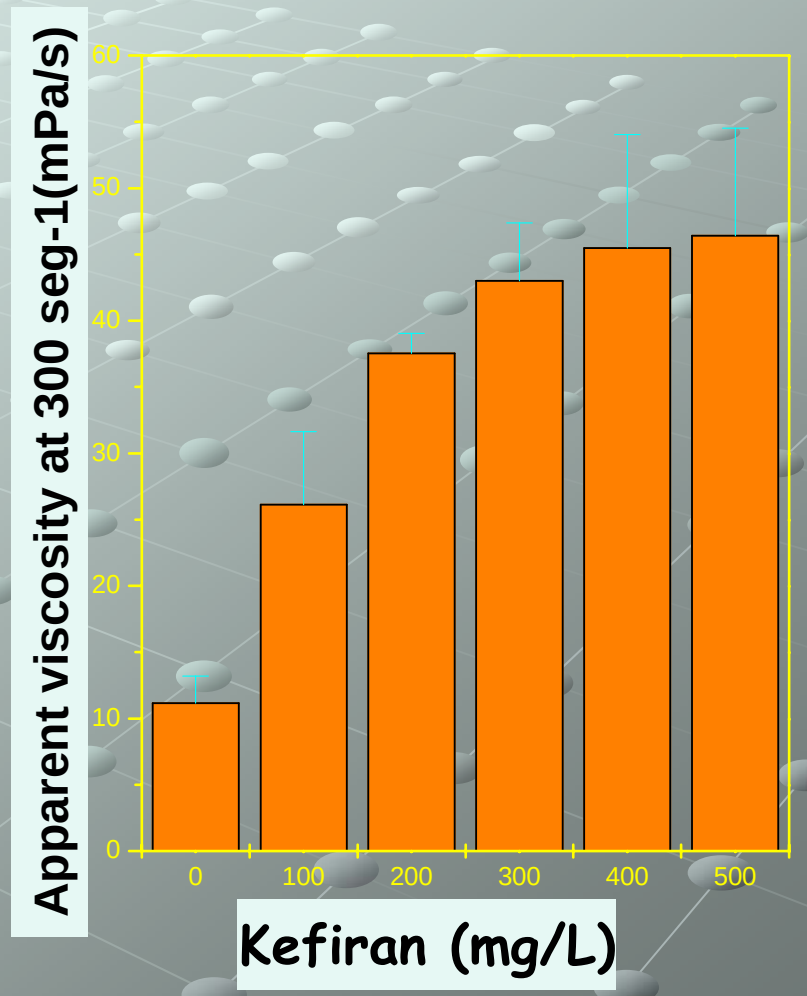
Technological application of kefiran

Kefiran as food additive

Does Kefiran improve texture of fermented food?

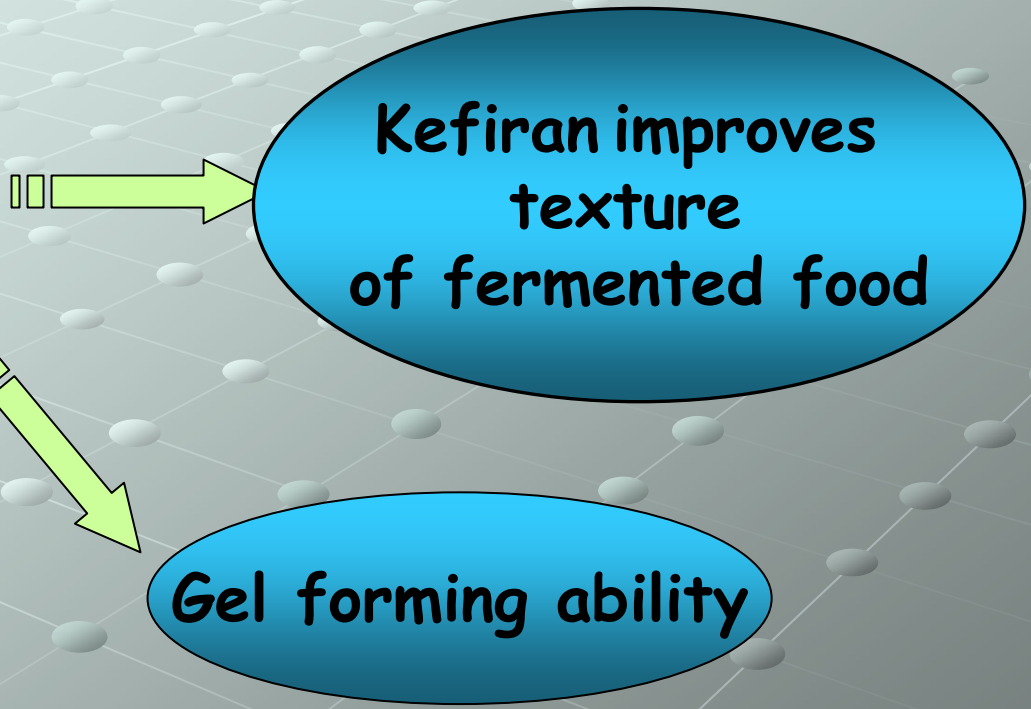
Rheological properties of glucono- δ-lactone induced skim milk gels

Kefiran improves texture of acid milk gels

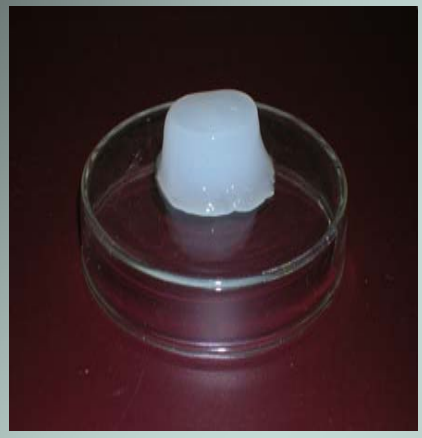


Technological application of kefiran : functional properties

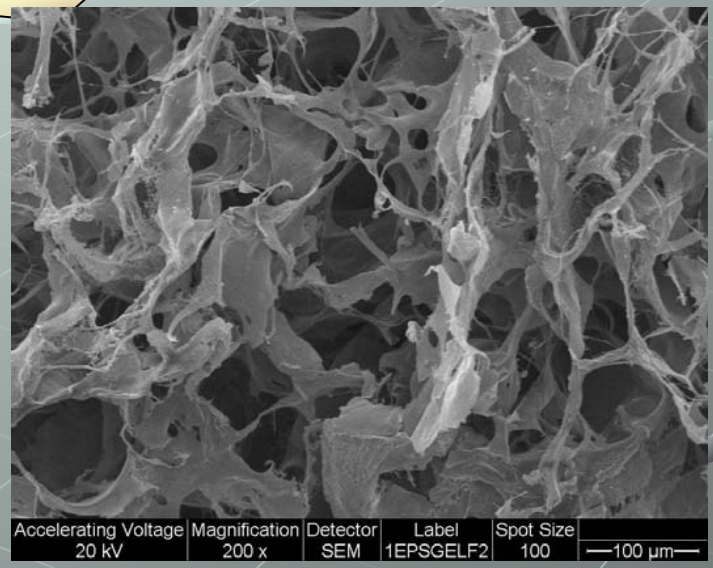
Kefiran as food additive



Kefiran cryogels :

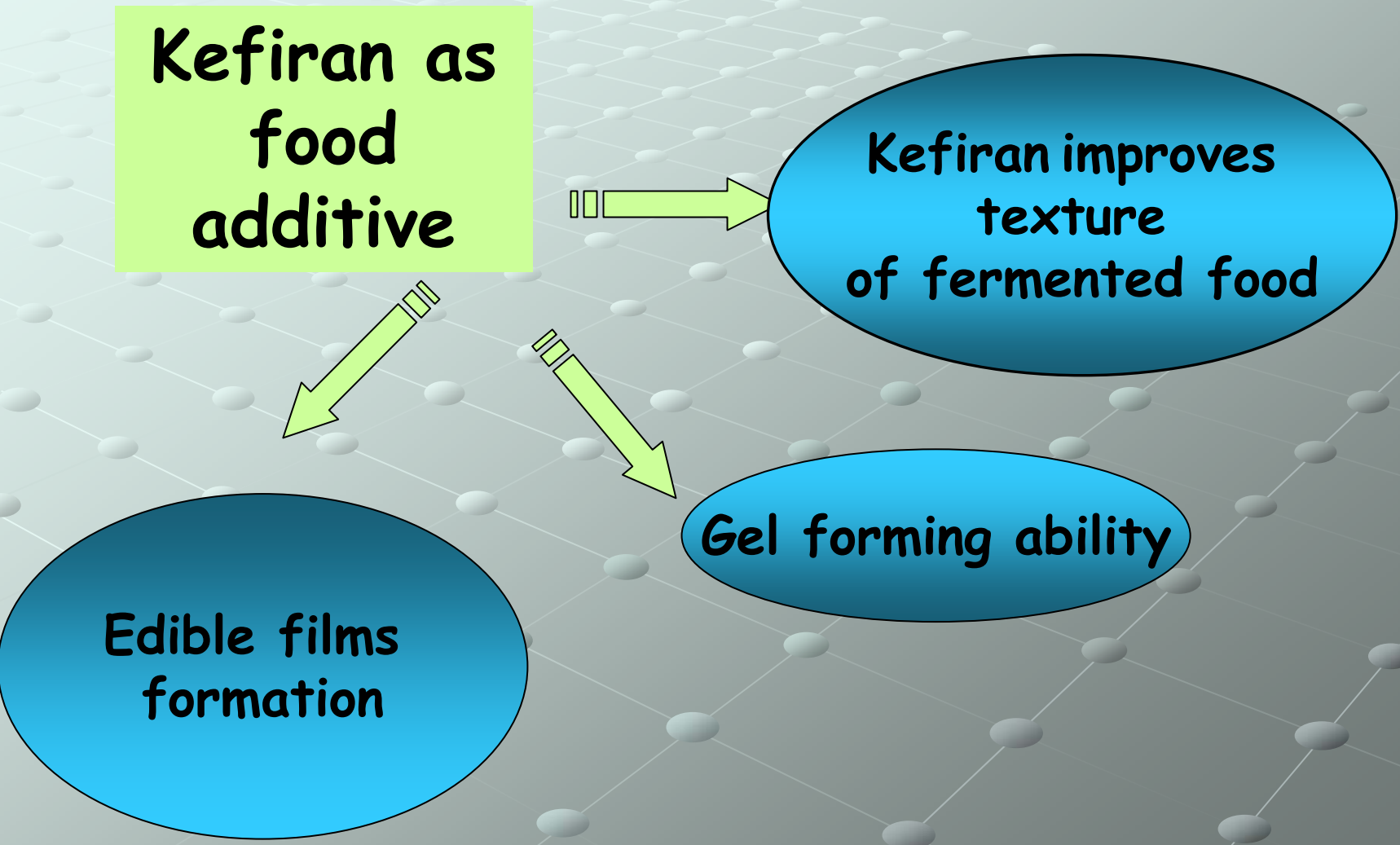


Water holding capacity (WHC)
90.43 ± 1.51%



Microscopic aspect of cryogels (magnification 200X)

Technological application of kefiran : functional properties



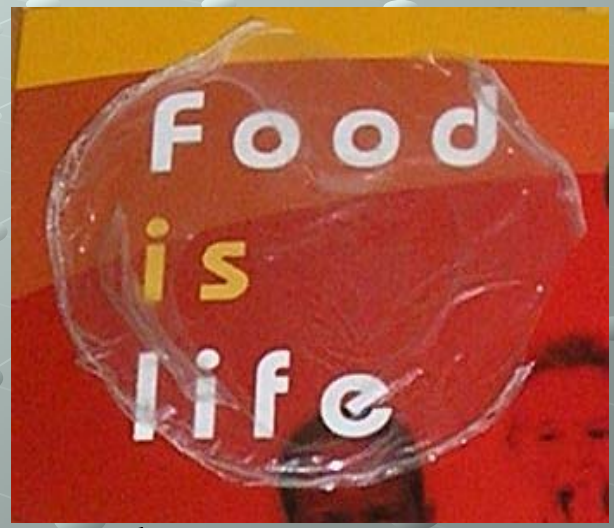
Edible films formation

kefiran

- 5g/l
- 7,5g/l
- 10g/l

57 cm2

Dry in oven at 50°C



Films: Water vapour barrier properties

Films	Water vapour permeability (WVP)
Kefiran (10 g/L)	5.43×10^{-11}
Chitosan (10g/L)	9.03×10^{-11}
Cellophane	8.4×10^{-11}
LDPE	9.14×10^{-13}

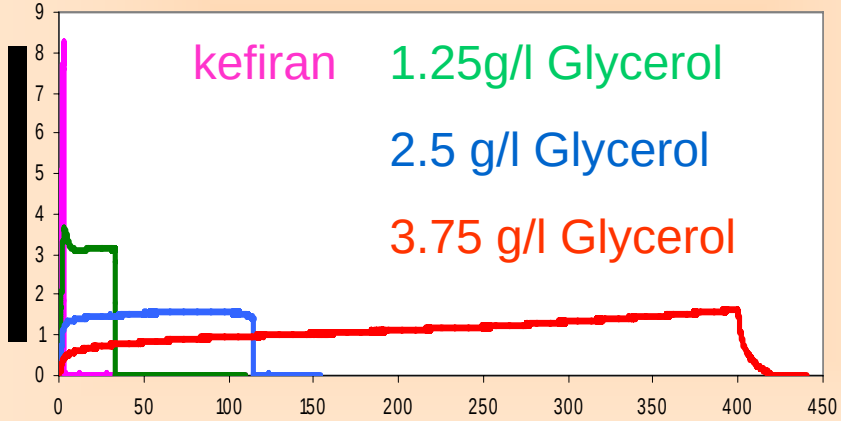
LDPE: low density polyethylene.

Films: mechanical properties

Tensile tests of films plasticized with glycerol

Texturometer Ta xT2i (TA.XT2i- Stable Micro Systems).

Traction profiles



Elongation (%)

Kefiran

Fermented product

Grains

250mg/L

8g%

Fermented milk

- ✓Microorganisms with probiotic properties
- ✓High inhibitory capacity of pathogens and contaminant microorganisms.
- ✓Low lactose concentration (3.2%)
- ✓Functional components **Kefiran**

Frozen Kefir

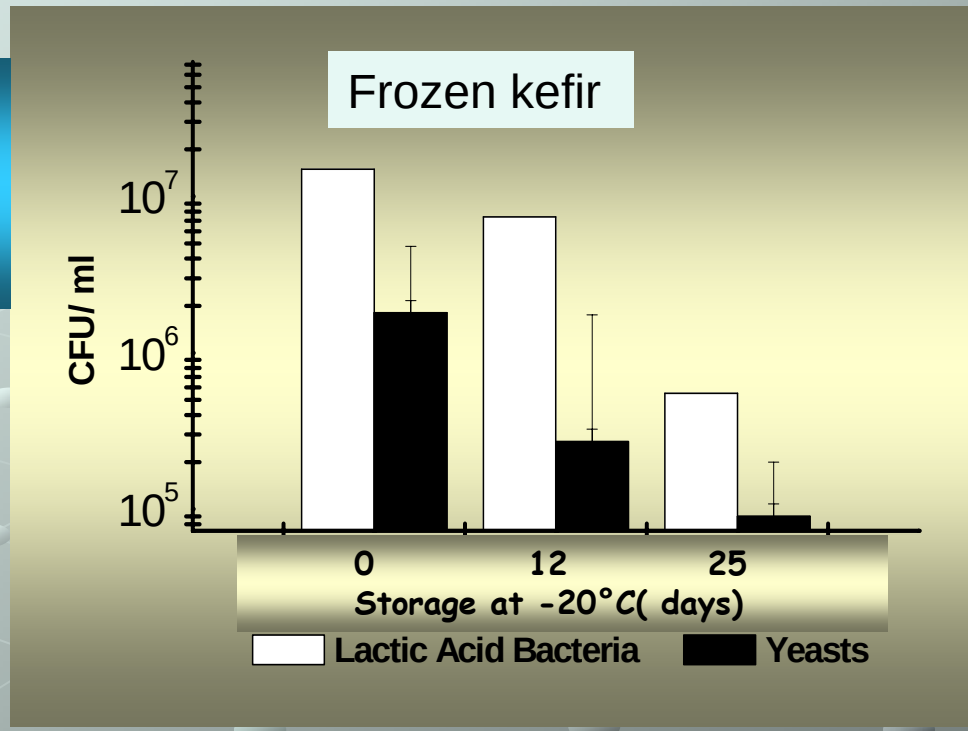
	Stability	Crystal size
Frozen kefir	30.3±1.8	99±41
Frozen kefir with cream	36.8±0.6	98±40
Frozen yogurt	18.8±1.1	87±28
Commercial ice cream	27.7±1.6	81±32

Frozen kefir without cream has higher stability than frozen yogurt and similar to commercial formulation

Kefiran

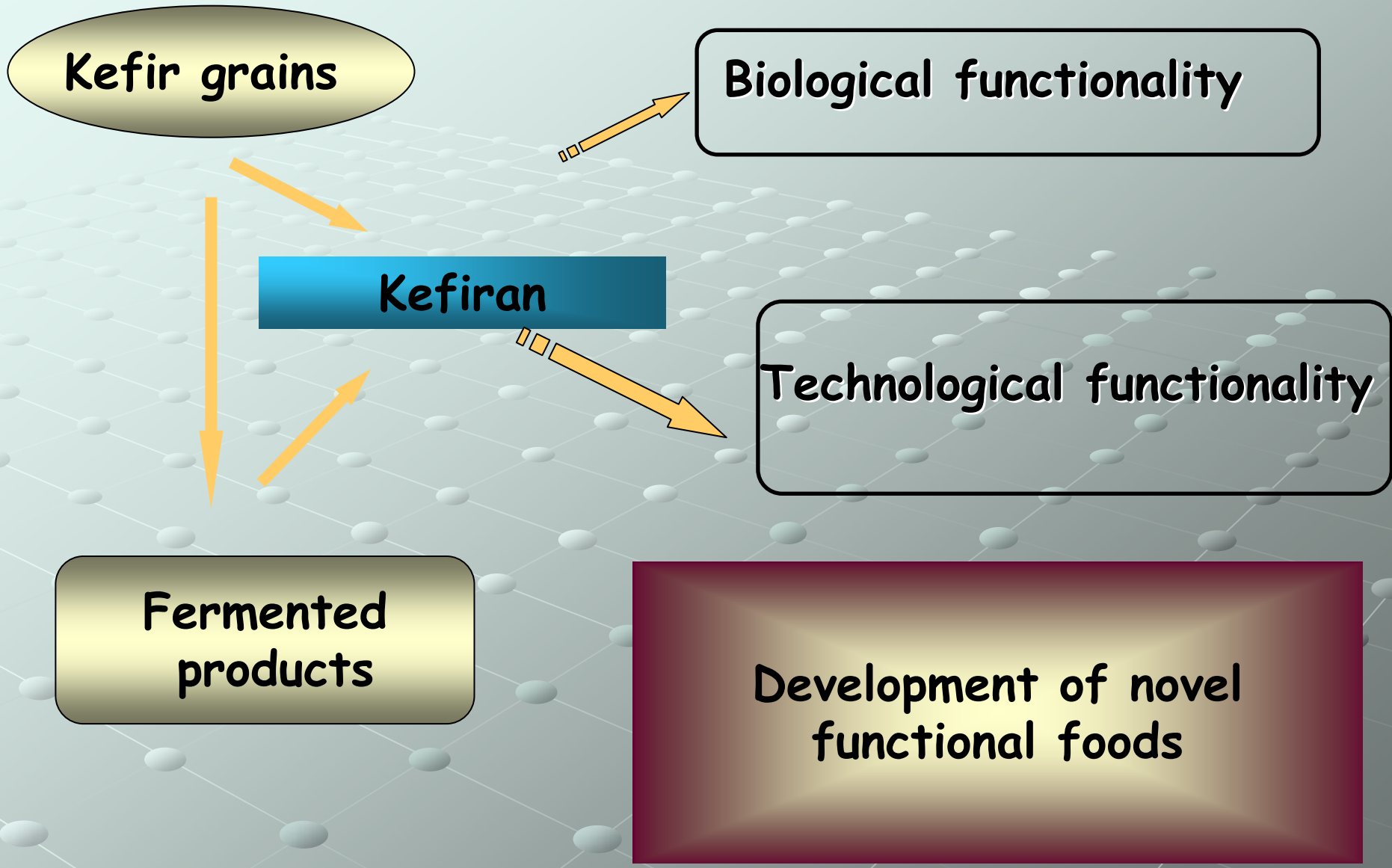
Frozen Kefir

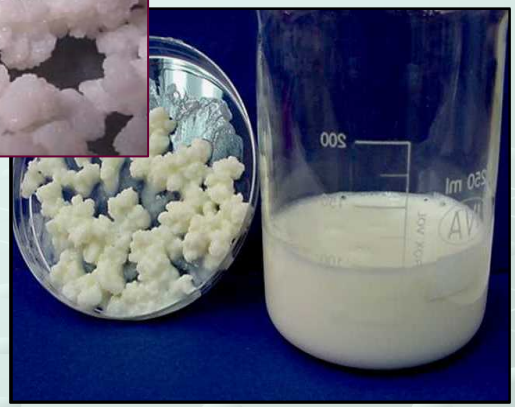
Kefir microflora maintains viable at least 12 days at -20°C

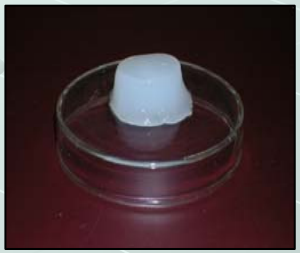


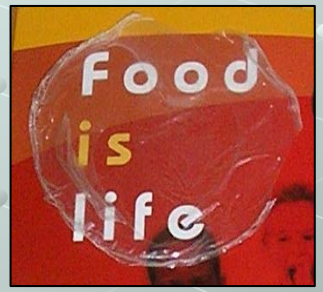
Non-trained sensorial panel

High acceptability


Kefir grains
Biological functionality
Kefiran
Technological functionality
Fermented products
Development of novel functional foods







Judith Piermaria
Micaela Medrano
Fernanda Hamet
Pablo Rimada
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Pablo Pérez
Graciela Garrote
Analia G Abraham

Alejandra Londero
Marina Golowczyc
Pablo Mobili
Emiliano Kakisu
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