



Algunas soluciones biotecnológicas para los retos de formulaciones actuales

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Improving food & health



Agenda

San José. Costa Rica; 15 noviembre 2016

- **Introduction: Market Trends**
- **Enzyme solutions: More functionality less additives :**
 - **Acid Lactase** : New Lactase Enhancing the sweetness of yoghurt through new enzyme.
 - Fosfolipase :More functionality in pasta filata segment.
- **New cultures new solutions:**
 - More texture in fermented milk through EPS production.
 - BioP: Natural protection. Success case (FreshQ)

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Key Trends: Food and Beverages



10 Key Trends in Food, Nutrition & Health 2016

1
BEVERAGES REDEFINED

A circular graphic with a blue banner at the bottom containing the text "BEVERAGES REDEFINED". The circle is filled with various beverage products like cans and bottles.

2
SNACKIFICATION

A circular graphic with an orange banner at the bottom containing the text "SNACKIFICATION". The circle is filled with various snack products like bags and boxes.

3
DAIRY 2.0

A circular graphic with a yellow banner at the bottom containing the text "DAIRY 2.0". The circle is filled with various dairy products like milk cartons and cheese.

4
REDEFINING SWEETNESS

A circular graphic with a pink banner at the bottom containing the text "REDEFINING SWEETNESS". The circle is filled with various sweetener products like bottles and packets.

5
THE GREAT FRAGMENTATION

A circular graphic with a teal banner at the bottom containing the text "THE GREAT FRAGMENTATION". The circle is filled with various food products like boxes and bags.

6
NATURALLY FUNCTIONAL

A circular graphic with a dark green banner at the bottom containing the text "NATURALLY FUNCTIONAL". The circle is filled with various food products like boxes and bags.

7
PLANT-BASED FOODS

A circular graphic with a green banner at the bottom containing the text "PLANT-BASED FOODS". The circle is filled with various plant-based food products like boxes and bags.

8
DIRECT-TO-CONSUMER

A circular graphic with a light blue banner at the bottom containing the text "DIRECT-TO-CONSUMER". The circle is filled with various food products like boxes and bags.

9
PROTEIN

A circular graphic with a red banner at the bottom containing the text "PROTEIN". The circle is filled with various protein products like cans and bottles.

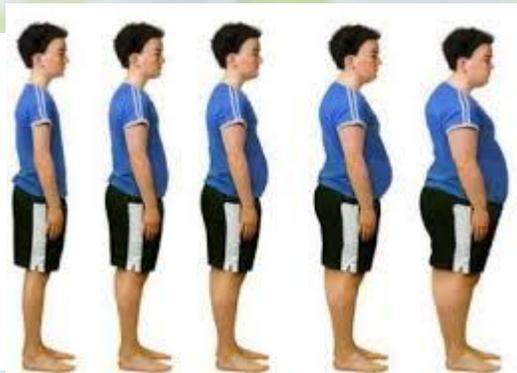
10
FREE-FROM

A circular graphic with a dark blue banner at the bottom containing the text "FREE-FROM". The circle is filled with various food products like boxes and bags.

Key Trends:

“Change is more organic. Ideas emerge from a variety of sources-often in response to the EVENTS OF THE MOMENT, SOMETIMES AS A PART OF NATURAL EVOLUTIONARY PROCESS. Ideas get thrown out(one can think of them as intellectual mutations), and some find fertile ground”

Joseph Stiglitz,
Nobel prize laureate in economics(2001).



Key Trends: Food and Beverages

1 The strongest foundation for success

NATURALLY FUNCTIONAL

KEY TREND 1

NATURALLY FUNCTIONAL

The strongest foundation for success

POWERFUL DRIVER
for ingredients and brands



Naturally functional is behind the success of almonds, Greek yogurt, coconut water, pistachios, olive oil, blueberries

Nature's **1**
Reaffirmed **no. 1**

Tendencias de Mercado: Alimentos y Bebidas



- Costa Rica emerging market.
- Tourism, Costa Rica international perception = love and respect for the nature.
- Millennials y seniors demand healthy, natural and convenience food in fruits and veggies markets and supermarkets

Chr. Hansen taps into strong global megatrends



Growing world population and rapid urbanization



Resource scarcity



Increasing health care costs



Demand for cleaner, healthier and more natural products



Technology breakthroughs

The implication*

By 2030, almost 2/3 of world population will reside in cities, and the middle class will have increased by 2.5 billion people

Global food production will have to increase with 70% by 2050 to support growing world population

Global health spend is estimated at USD 6.5 trillion, with an expected growth rate of 5.3% until 2018

67% of US consumers prefer groceries with fewer and simpler ingredients

Big data and speed of DNA sequencing allow for much faster strain screening and knowledge sharing

The opportunity

Need for more industrialized production of food & beverages

Need for innovation to improve productivity

Need for cheaper and preventive solutions

Need for better, safer products based on natural ingredients.

Opens up for faster innovation and new areas such as human microbiome

*EIU, WHO, The World Bank, IDA, IBRD, Food & Agriculture Organization of the United Nations, ReD, OECD, PwC, E&Y

NOLA FIT: Lactose free is a category where you can create value...

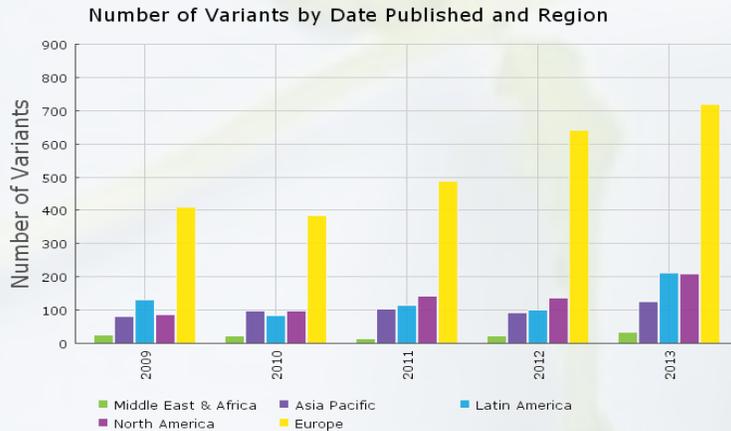
Intolerance in over 50% of global population!*



It often takes only one lactose intolerant person in a family to move an entire household



Increasing launch activity in lactose free segment



Premium positioning, price up escaping commoditization

Regular:
€0.39 / 500g



Private Label
Price: €0.39 / \$0.50
Pack Size: 500.00 g

Lactose free:
€0.99 / 500g



Private Label
Price: €0.99 / \$1.28
Pack Size: 500.00 g

Solve the consumer dilemma: how to get lactose free yet tasty yogurt



New enzyme solution that easily removes lactose from milk and secures the authentic taste of fermented milk products

New generation of lactase

- Acid Lactase is a standardize liquid; an enzyme that hydrolyses lactose (disaccharide) into two monosaccharides: glucose and galactose
- This process makes dairy sweeter and digestible for wider range of consumers



Make a difference - the new generation of lactase

Chr. Hansen introduces the new **lactase** that:

- 1) Easily removes lactose from milk and secures authentic taste of dairy products for:
 - Lactose Free/Reduced **Milk** products (esp. for UHT, ESL and sterile application)
 - Lactose Free/Reduced **Fermented Milk** products
- 2) Increases sweetness / allows to **reduce added sugar** in dairy products

New lactase - what is so different?

1. High activity across **broader pH range**

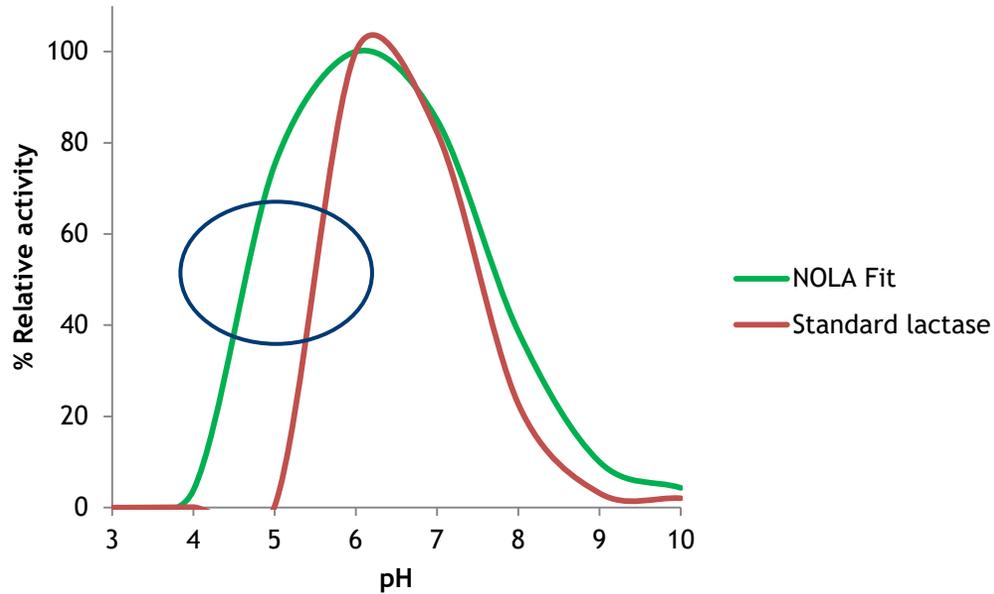
It unlocks the growing need for lactose free yogurt.

Because NOLA™ Fit works also in low pH values, it can be added together with the culture at a lower dose

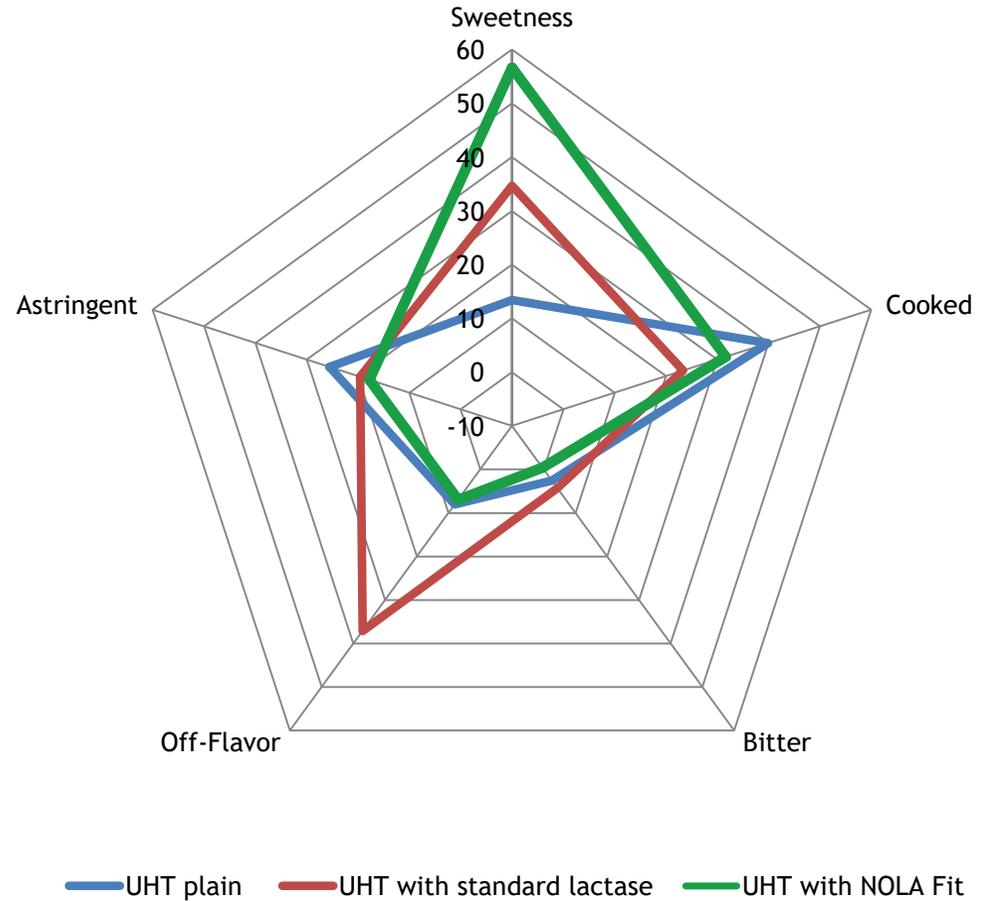
2. **High purity** - arylsulfatase and invertase free and very low in protease

It is so pure that it yields a much cleaner taste in a lactose free milk (including sterile application for UHT and ESL) and it also supports the sweetness enhancement

Authentic tasting dairy products free from lactose



High **activity** across a broad pH range - perfect for fermented milk



High **sweetness** formation if applied with the complementary culture**

*BDL=below the detection limit

**Combinations with some cultures will work better than with the others.

New lactase shows very low or no side activities

Arylsulfatase

Potentially causing fff- flavors

Absent in NOLA™ Fit (<0.03 A410/mL) and

Invertase

Supposed to have a flavor effect

Absent in NOLA™ Fit (<0.01 U/mL) and

Protease

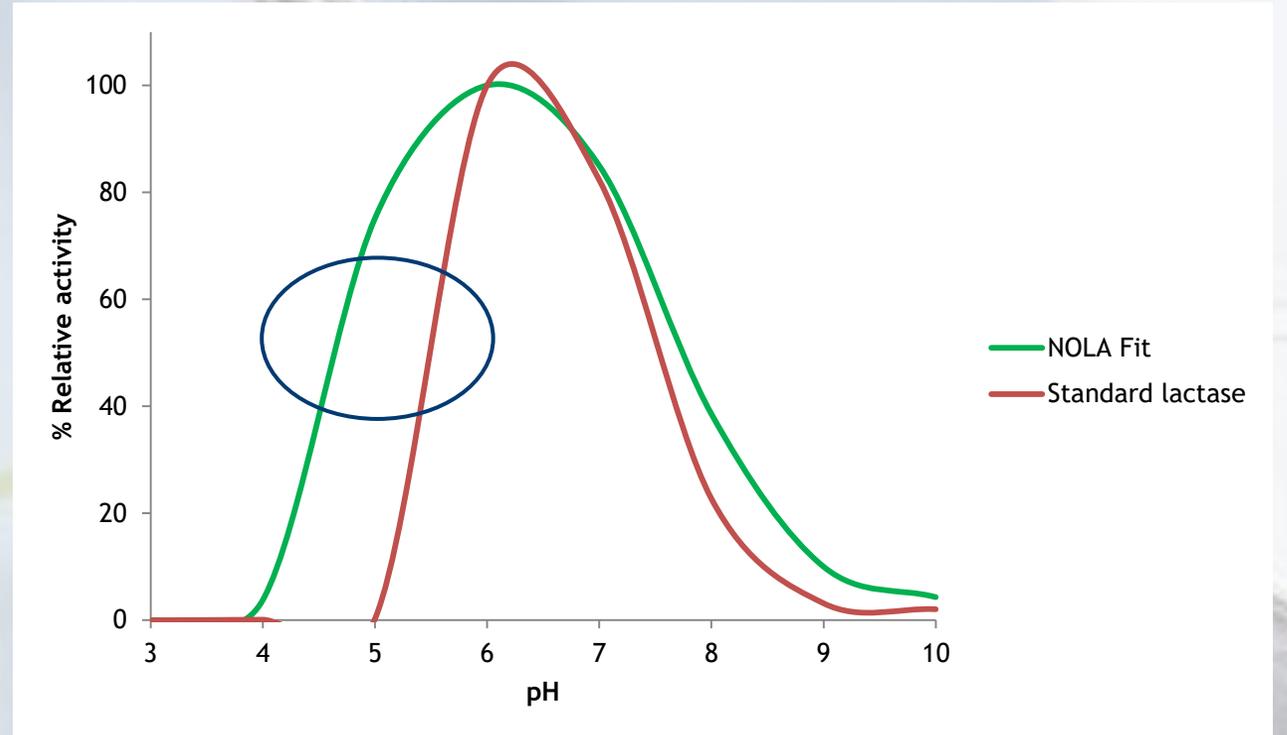
May cause off-flavor (bitterness)
and give clotting of the milk (only if very high)

Extremely low in NOLA™ Fit (<10 U/mL) and
low for Ha-Lactase (<35 U/mL)

NEW LACTASE retains high activity at a broad pH range

Influence of pH on relative activity for NEW LACTASE & standard lactase

Standard lactase rapidly loses activity below pH 5.5



New generation of lactase (β -galactosidase)

NEW LACTASE has a different origin than most of the lactases (yeast lactases)

Donor: *Bifidobacterium bifidum*

Producer: *Bacillus licheniformis**

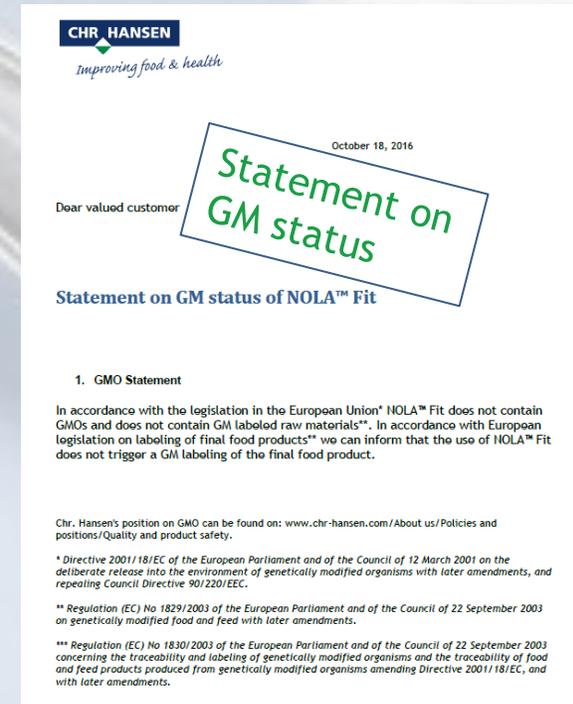
NOLA™ Fit is a processing aid (just like Ha-lactase) and therefore does not require labeling**

The producer of NOLA is a GMO organism but it is completely removed from the enzyme (enzyme is produced in the contained conditions).

Therefore **NOLA™ Fit is GMO free**. Yet due to the way it is produced - GMM technology, GMO producer, it is not suitable for organic purpose (or Ohne Gentechnik). Instead, Ha-lactase can be used.

*The producer is a GMO organism.

** However, certain specific food standards mandate the labeling of enzymes, even if they are processing aids. The manufacturer can decide to label if they conclude that the enzyme is not exempted as a processing aid.





LACTOSE FREE

Enzyme solutions

Lactose free yogurt - concept demo samples

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Lactose free (<0.01% lactose) yogurt concept demo samples

	Sample	Purpose of the sample
#1	Plain F-DVS Premium 4.0 3000 BLU/L	Effect of LACTASE to make premium quality lactose free yogurt with slight sweetness thanks to the lactase.
#2	Coffee F-DVS Premium 4.0 3000 BLU/L	Effect of LACTASE Delicious coffee flavor lactose free yogurt*



Recipe

Skimmed milk
Semi low fat milk
F-DVS Premium 4.0 (500U/2500L)
NOLA™ Fit (3000 BLU)
Coffee Prep

Process:

Fermentation temperature: 43°C
Cutting pH: 4.55
Post-treatment: 25°C/2 bar

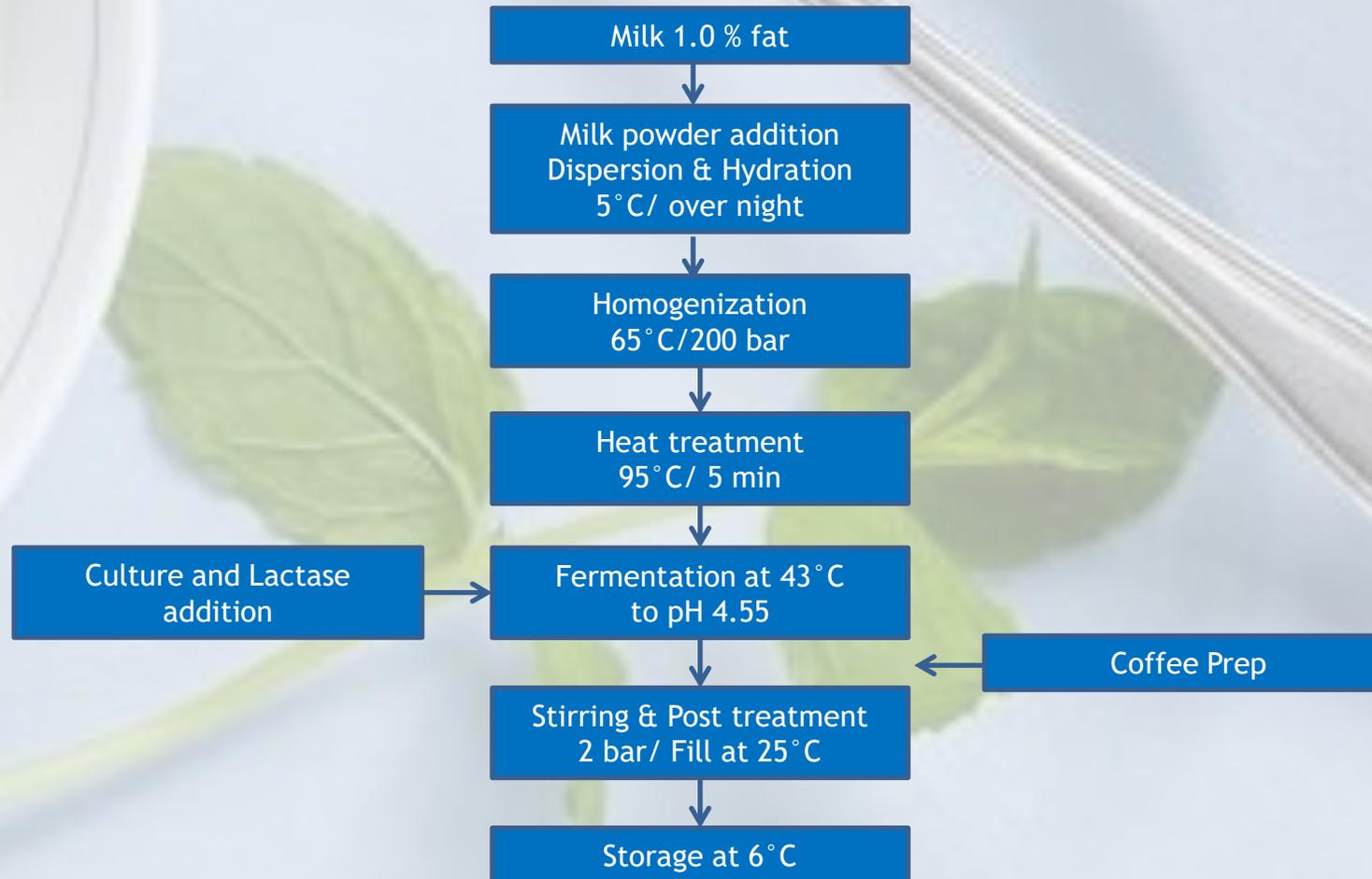
Nutritional Facts:	Plain	Coffee
Fat:	1.0%	1.2%
Protein:	4.7%	4.1%
Carbohydrates:	4.7%	12.1%



*Lactose free desert

Production of LACTASE Coffee concept samples

- Formulation & Process





Enzyme solutions

Sugar reduction in yogurt (fermented milk)

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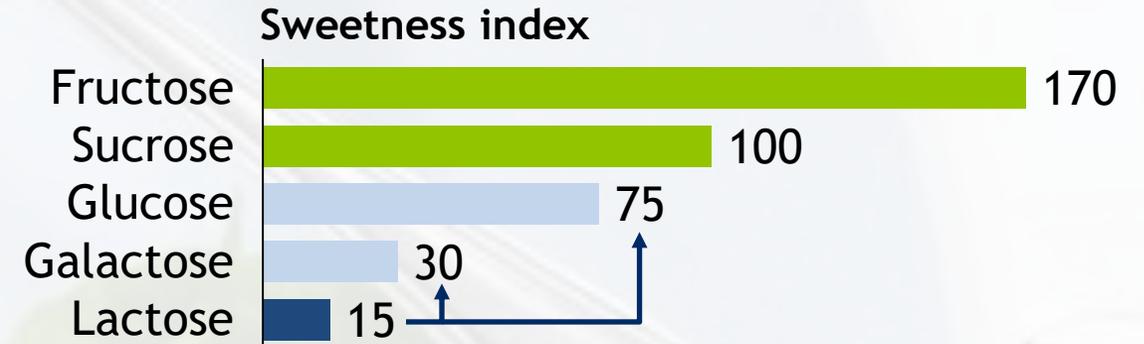
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New natural strategy for reducing sugar in yogurt - without losing sweetness

Milk contains the natural sugar lactose...

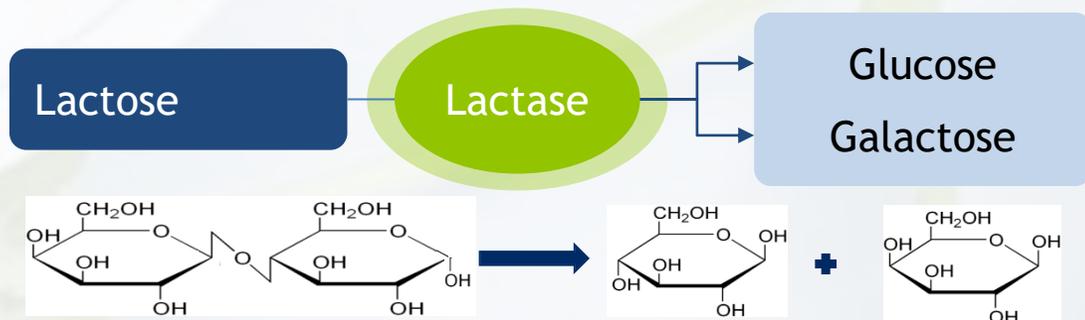


Lactose is not as sweet as other sugar molecules...



Source: www.sugar-and-sweetener-guide.com

LACTASE enzyme breaks lactose down to glucose and galactose...



Yogurt with LACTASE has a higher sweetness

Composition of 100g yogurt made with the NOLA™ Fit complementary culture	NEW LACTASE +6.5% sugar	Reference +8% sugar
% Protein	4.0	4.0
% Fat	1.7	1.7
% Carbs.:	10.9	12.4
KJ/Kcal	182/44	208/50

Sugar reduction - concept demo sample

Recipe

Skimmed milk
Semi low fat milk
F-DVS YF-L812(500U/2500L)
ACID LACTASE (1200 BLU)
Sugar

Process:

Fermentation temperature: 43°C
Cutting pH: 4.55
Post-treatment: 25°C/2 bar

Nutritional Facts:	Reference a)	NOLA Fit Plain b)
Fat:	1.0%	1.0%
Protein:	4.7%	4.7%
Carbohydrates:	4.7%	4.7%
Calories (kcal/100 g)	47.1	47.1

Nutritional Facts:	Reference c) + 8% sugar	NOLA Fit Plain d) + 6.5% sugar
Fat:	0.9%	0.9%
Protein:	4.1%	4.3%
Carbohydrates:	12.4%	10.6%
Calories (kcal/100 g)	75.0	68.7



Sugar reduction



1. **Dosage** recommended for sweetness enhancement for all the cultures is **1.200 BLU/L***
2. It is possible to reduce added sugar from 8% to 6.5% sugar, in other words to **reduce added sugar by 1.5 grams** per 100 grams yogurt without affecting sweetness.
3. **Acidification activity** (=fermentation time) is culture-dose-milk base dependent.
 - a) **Recommended** combinations:
 - i. Premium 4.0, YC-X 11, regardless of the milk base
 - ii. YF-812 and Mild 2.0 with milk bases containing $\leq 4.7\%$ protein (SMP and WPC)
 - iii. Creamy 1.0, Premium 1.0, BY Premium, Mild 1.0, YF-L950 with milk bases containing $\leq 4\%$ protein (most likely a bit higher e.g. $\leq 4.5\%$ protein. However, milk bases with protein levels 4-4.7% have not been studied)
 - b) **Longer fermentation** time combinations:
 - i. High protein milk base 4-7% and WPC.
 - c) **Not recommended** combinations:
 - i. High protein milk base $\geq 7\%$ (unless with Premium 4 and YC-X 11)
4. Generally, LACTASE may contribute to the pH stability over the shelf life (less post acidification compared to non lactase treated yogurt).
5. Effect on **texture** is culture-dose dependent.
 - a) Positive effect was observed for some cultures - further investigation ongoing
 - b) Texture was not affected with YF-812, YC-X 11, BY Premium and protein 4.7% (SMP+WPC) + 1% fat
 - c) Texture was negatively affected with Creamy 1.0, Premium 1.0, Premium 4.0, Mild 1.0, YF-L 950

* Dosage is slightly culture-milk base dependent and may increase with amount of WPC. Adding more lactase than the recommended dose will eventually lead to lactose free but will not increase the sweetness.

LACTASE Rapid Test

Fast and quantitative test for lactose in low lactose and lactose free milk and dairy products

lactosens®

directsens
Biosensors

lactosens®

directsens
Biosensors

DILUTION BUFFER

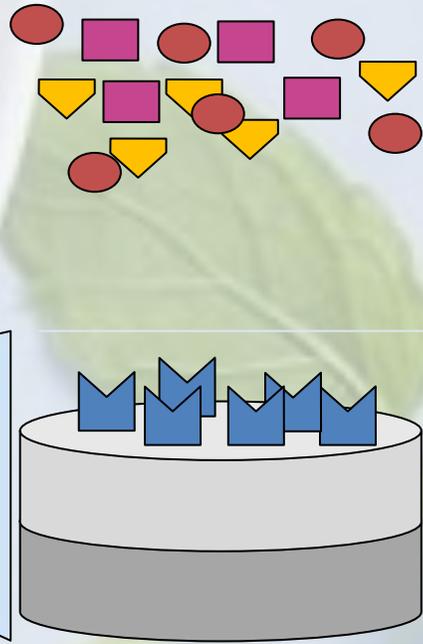
DILUTION BUFFER

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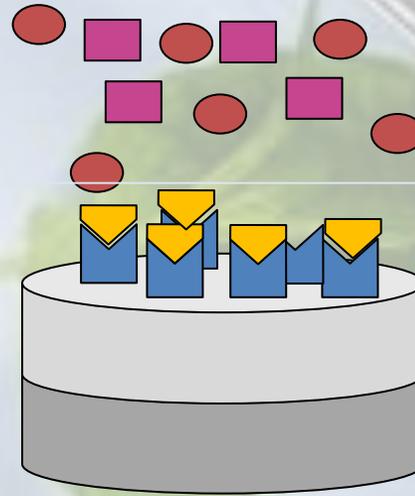
Improving food & health



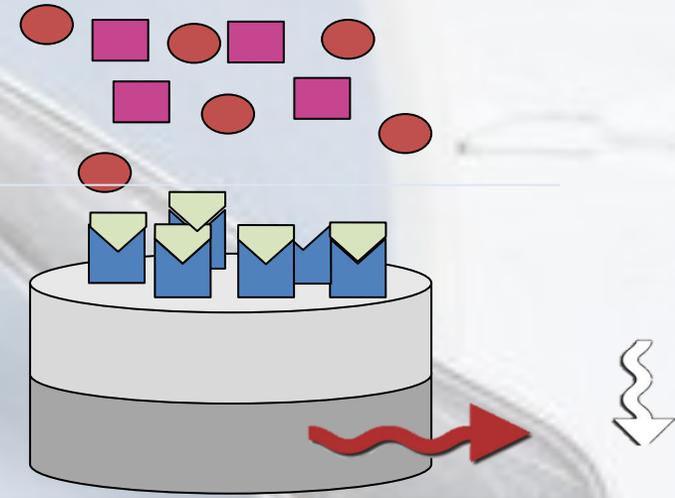
Lactose reader principle: Lactose-specific enzyme generates a current depending on lactose amount



The sensor with immobilized enzyme and liquid with a mix of sugars.



ONLY lactose binds to the immobilized enzyme. Glucose and galactose do not interfere.



The enzyme oxidizes lactose and generates electrons that are picked up and measured by the biochip and the reader

Testing may increase production throughput and secure brand value

FAST

- Instant results - less than 3 minutes complete assay time
- ✓ Fast product release & delivery
- ✓ Optimization of production capacity

ACCURATE

- Very low quantitation limit - 0.02%
- High accuracy - 90-110% recovery
- Excellent precision - $\leq 5\%$ standard deviation
- ✓ In house quality control
- ✓ Strong and protected brand

SIMPLE

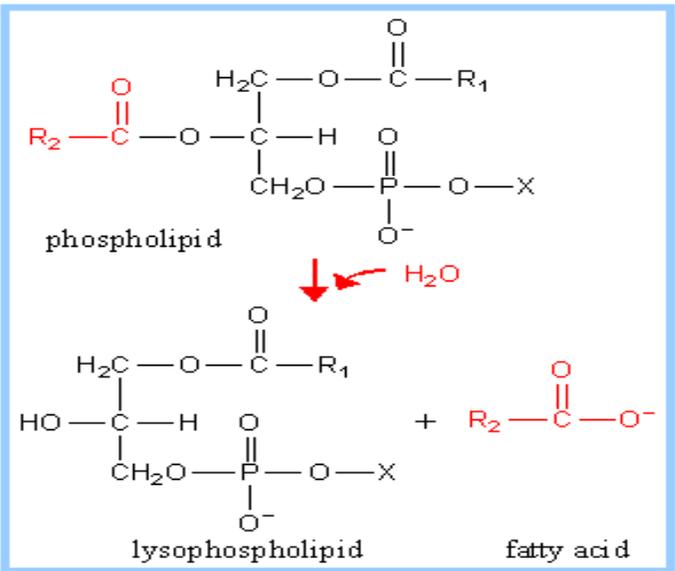
- Easy sample preparation - simple dilution
- ✓ Very little training required
- Simple handling



Cheese enzymes solutions



Mozzarella and pizza cheese Fosfolipase



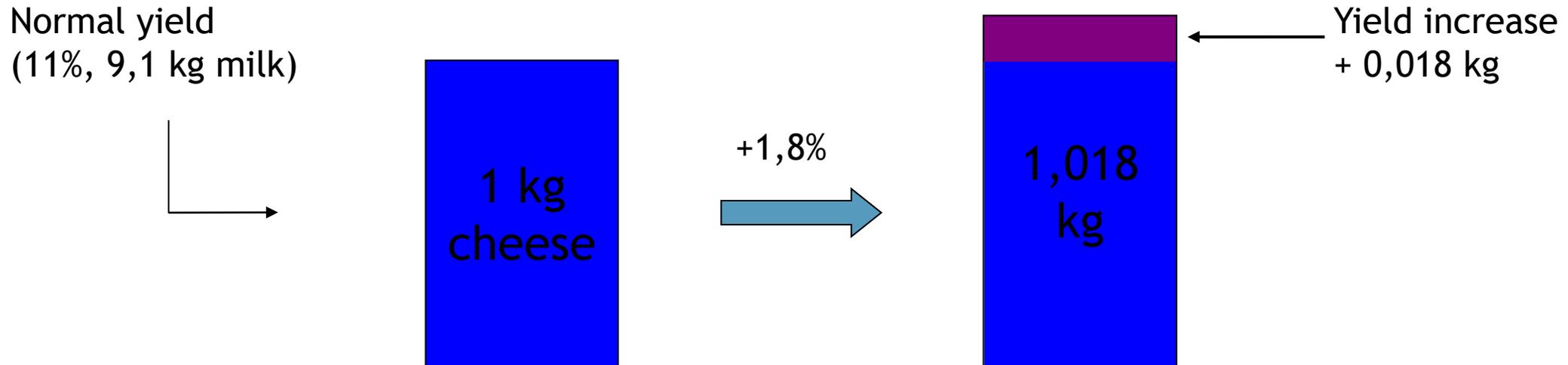
What is fosfolipase for?

- Higher yield in production of mozzarella and pizza cheese



How much more cheese?

- 1,8% yield increase is the official figure:



- ▼ Cheeses with higher fat content may give higher yield improvement...!

So, what does it do?

- Normal Mozzarella



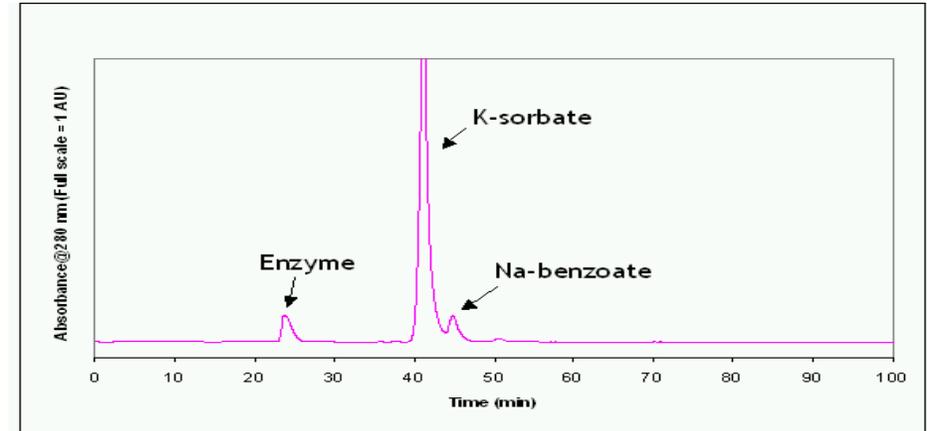
- ▼ Mozzarella with fosfolipase PL

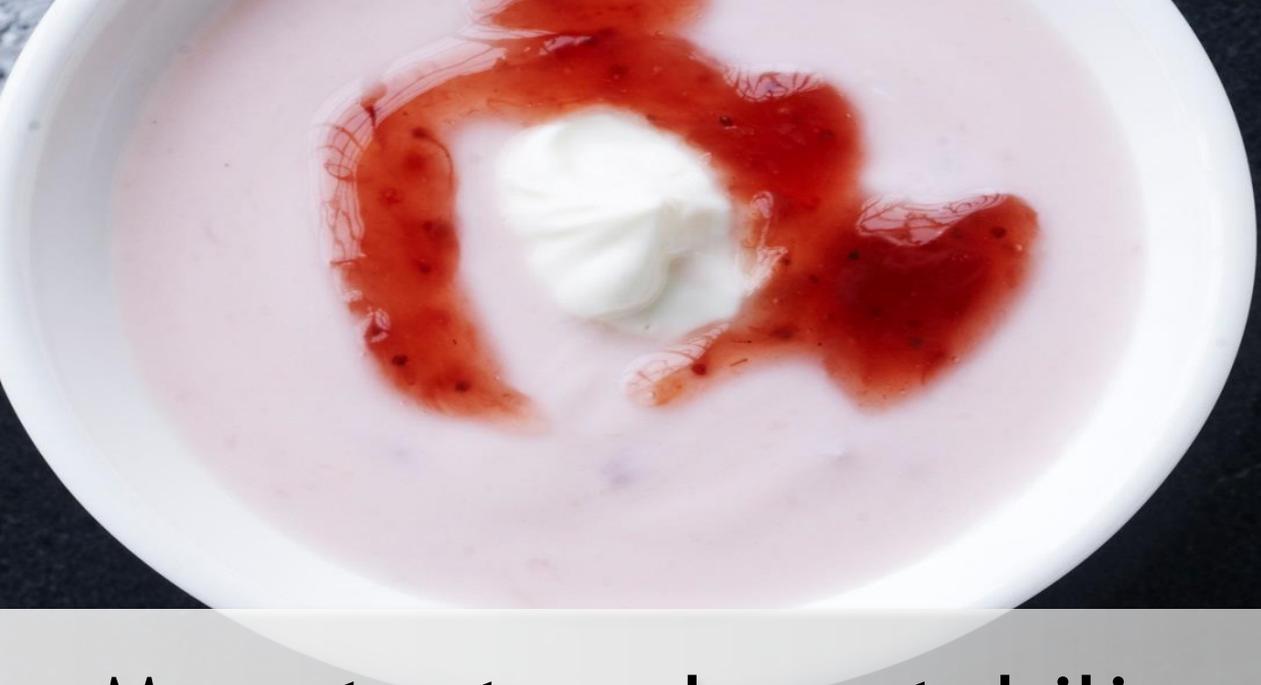


Addressing customer concerns

- ▼ Side activities removed
 - ▼ Esp. amylase and glucoamylases absent

- ▼ No fosfolipase effects seen on functionality
 - ▶ Stretchability
 - ▶ Meltability
 - ▶ Browning
 - ▶ Oiling off





More texture less stabilizers
Mild, Premium & Creamy
- Benefit your product and your business



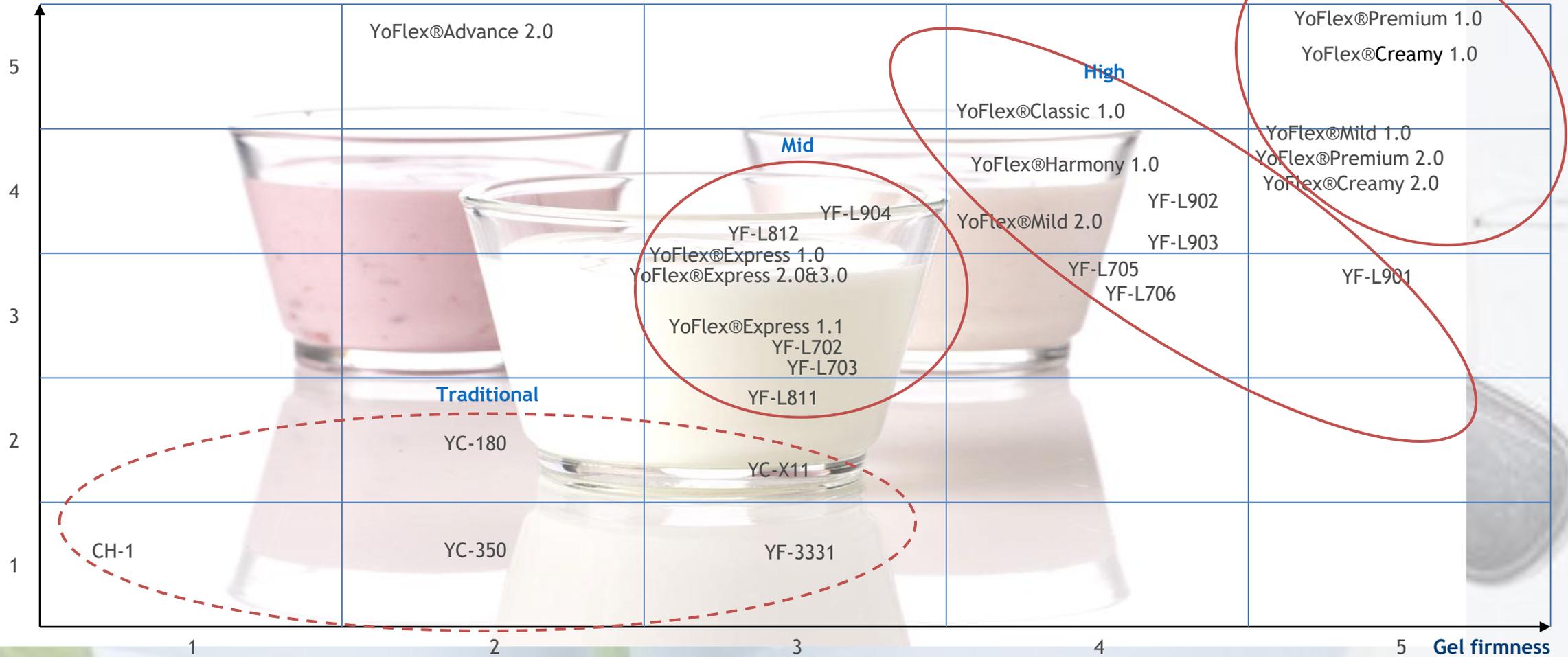
Premium and Creamy cultures combine superior texturizing properties with very low post-acidification



- Raising the bar on low/no fat yogurt - low fat tastes and looks like full fat
- Takes all natural and indulgent yogurt to a new level
- Creamy, Mild flavor - great balance between yogurt flavor and mildness
- Extra taste of richness with Creamy cultures

YoFlex Premium and Creamy provide the best thickness and firmness

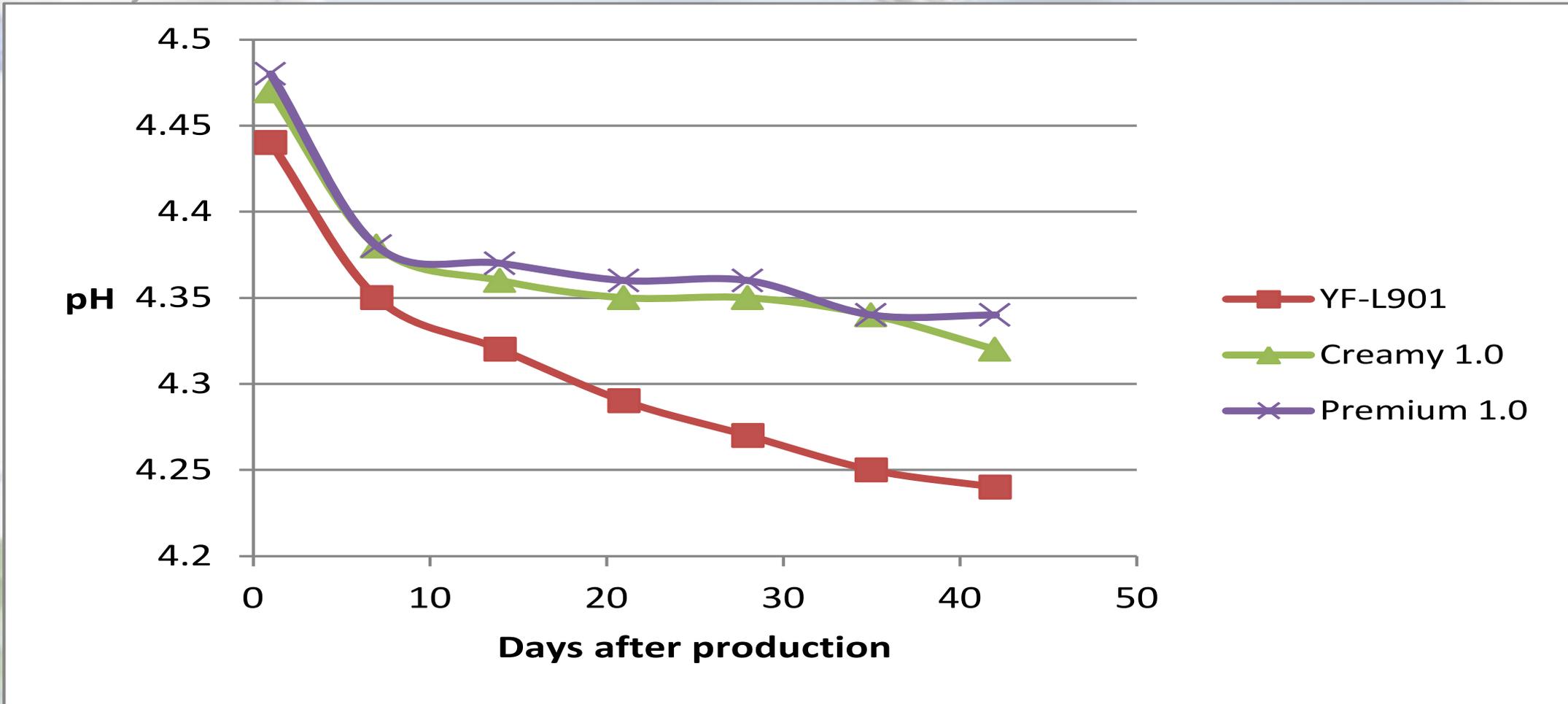
Mouth thickness



SOURCE: Chr. Hansen, competitor webpage

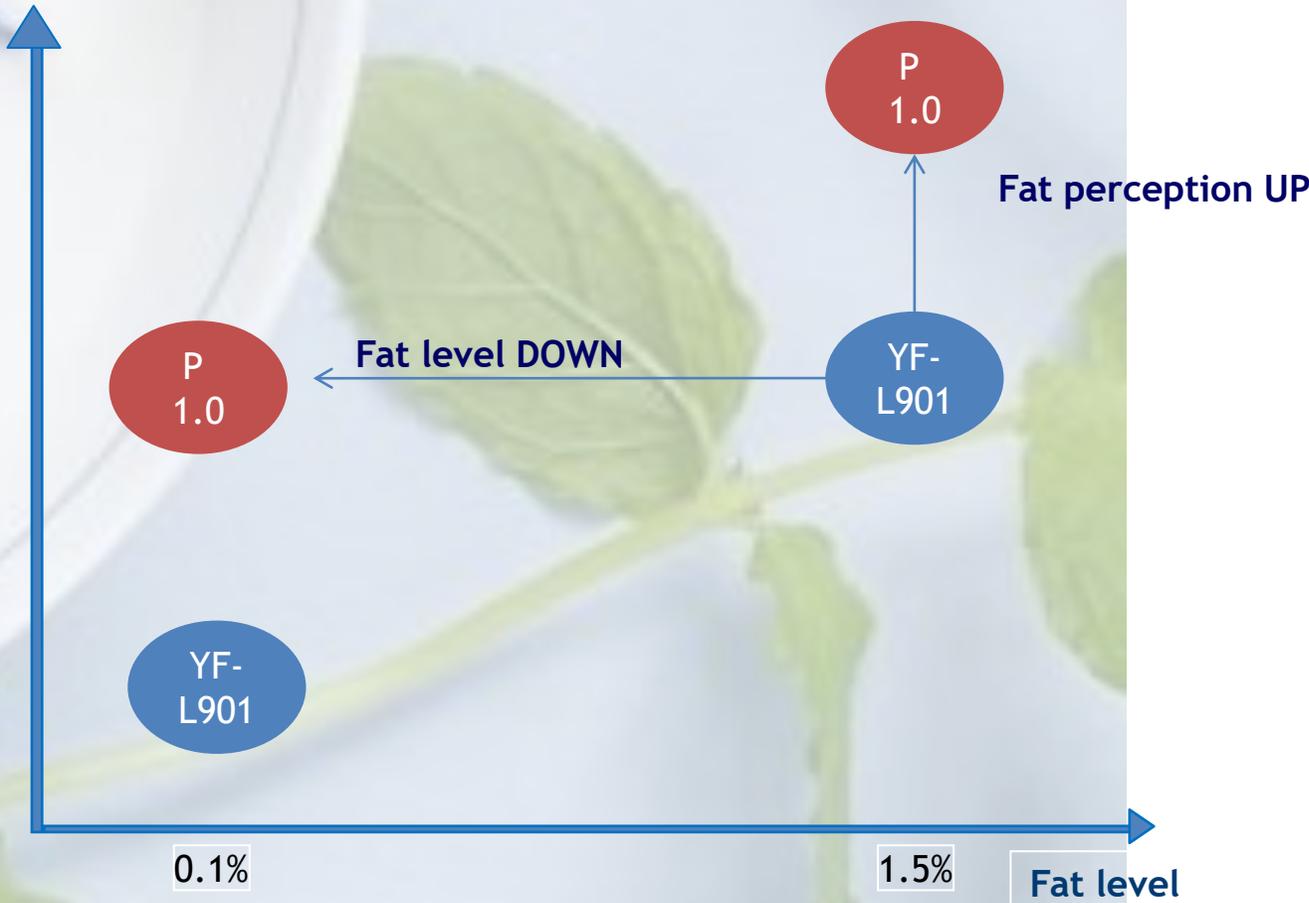
Premium and Creamy cultures result in lower post-acidification than other high texturing cultures from Chr. Hansen.

42 days at 5°C



Thick, creamy and satisfying... and no fat¹

Fat perception



The new cultures provide fabulous texture without thickeners:

- ▶ Premium 1.0 gives a much higher fat perception in 0.1% yogurt compared to YF-L901
- ▶ Based on several blind tests run on yoghurt perception



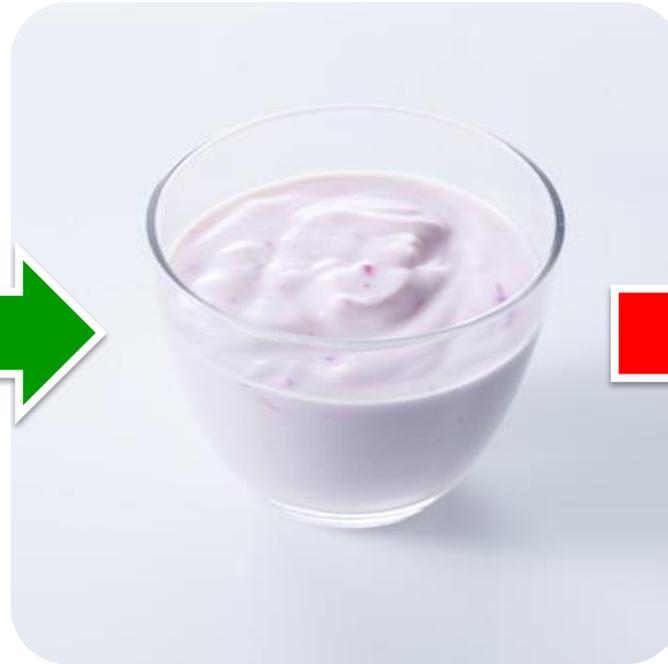
¹ Test run with internal sensory panel

Make yoghurt even healthier by all natural culture solutions

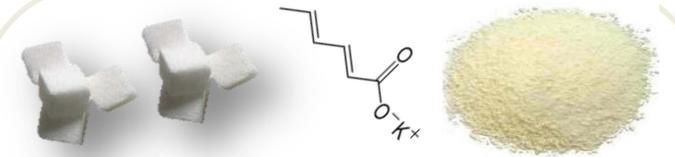
Cultures

Taste
Texture
Appearance
Shelf life
Health benefits

Add in



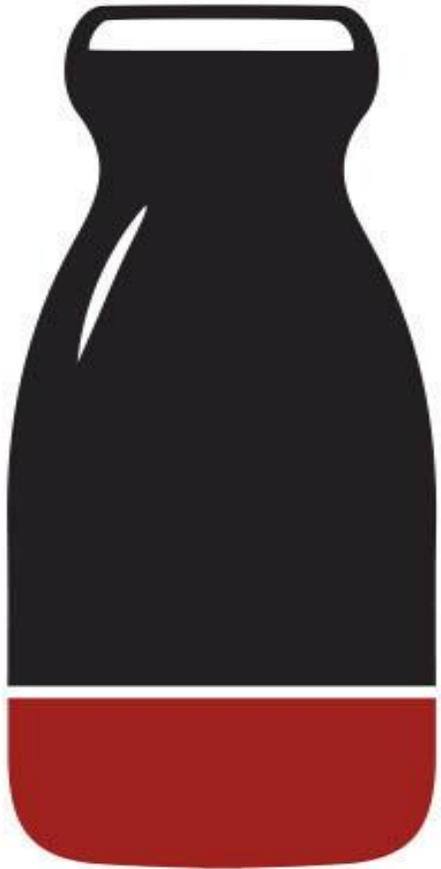
Take out



Sugar, Fat, and Lactose
Texturizers & Stabilizers
Preservatives

A collection of dairy products including a pitcher of milk, yogurt containers, a bowl of yogurt, and blocks of cheese.

Bio-Protection:
FreshQ protective cultures
Protecting your business and improving quality

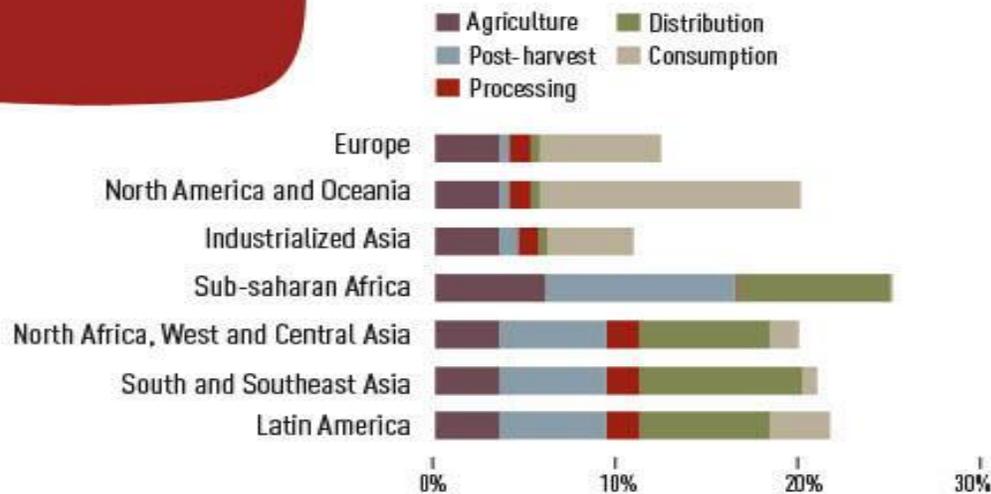


20% DAIRY FOOD LOSSES

In Europe alone, 29 million tonnes of dairy products are lost or wasted every year.



This is the same as
574 billion eggs.



Reduction of scrap in production, distribution and consumption has large value potential

INGREDIENTS UNDER SCRUTINY

66% of consumers worldwide check the labels of food and drinks before purchasing a product



Consumers pay attention to (in %)



- 67%** easy to understand ingredient information
- 62%** no artificial additives
- 61%** free from preservatives
- 60%** no artificial colourants

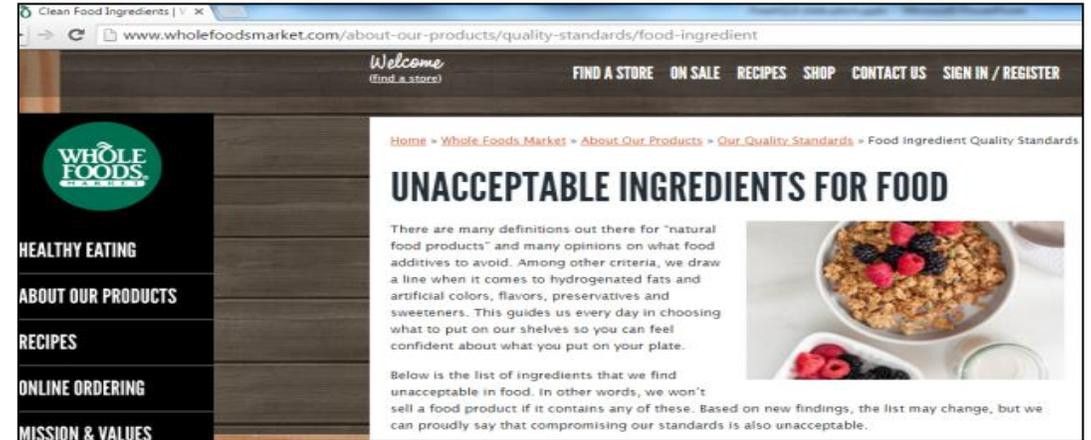
General attitude towards shopping for groceries

63% take time to get an overview of the range of products

47% enjoy going to the supermarket



Example of retailer taking products with artificial preservatives off their shelves



Pricing of products without artificial preservatives suggest consumer are willing to pay more for yogurt without artificial preservatives



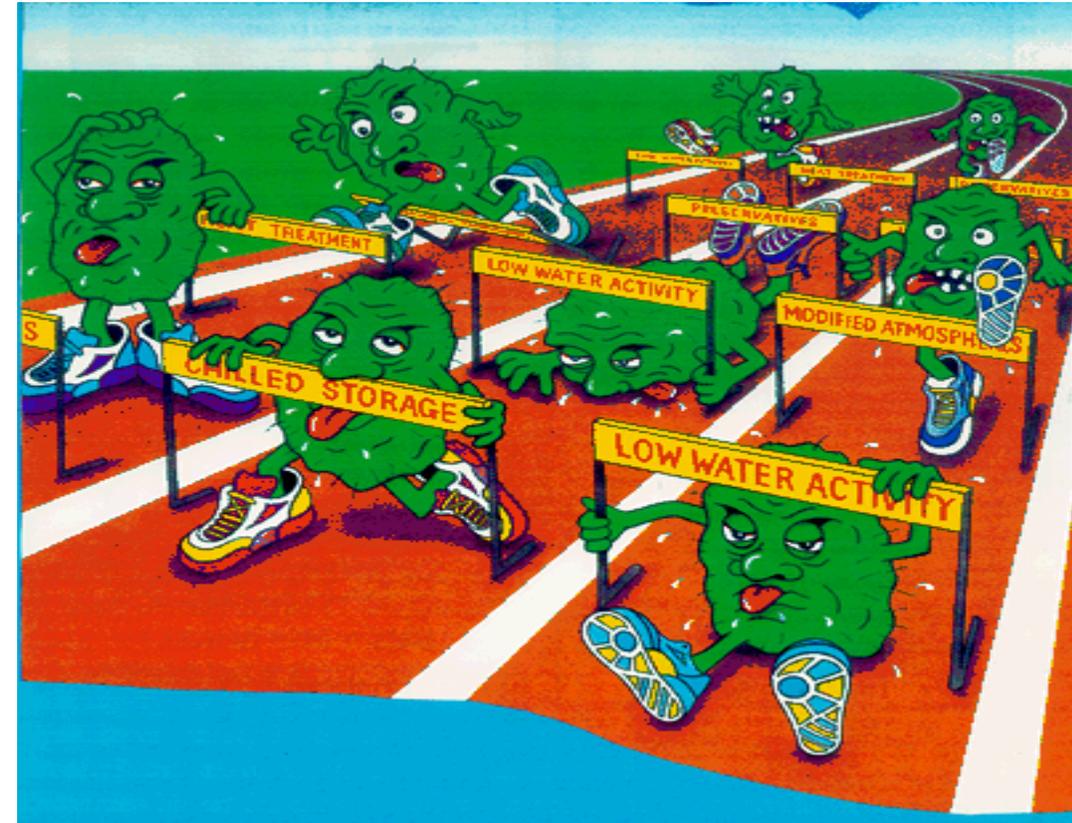
Natural preservation

What is it?

- Natural microorganisms inhibiting contaminants like yeast and mold through fermentation
- BioP can be an additional hurdle to help manage end product quality by exerting a fungi-static effect.
- **BioP enhances the effectiveness of your sanitation program**

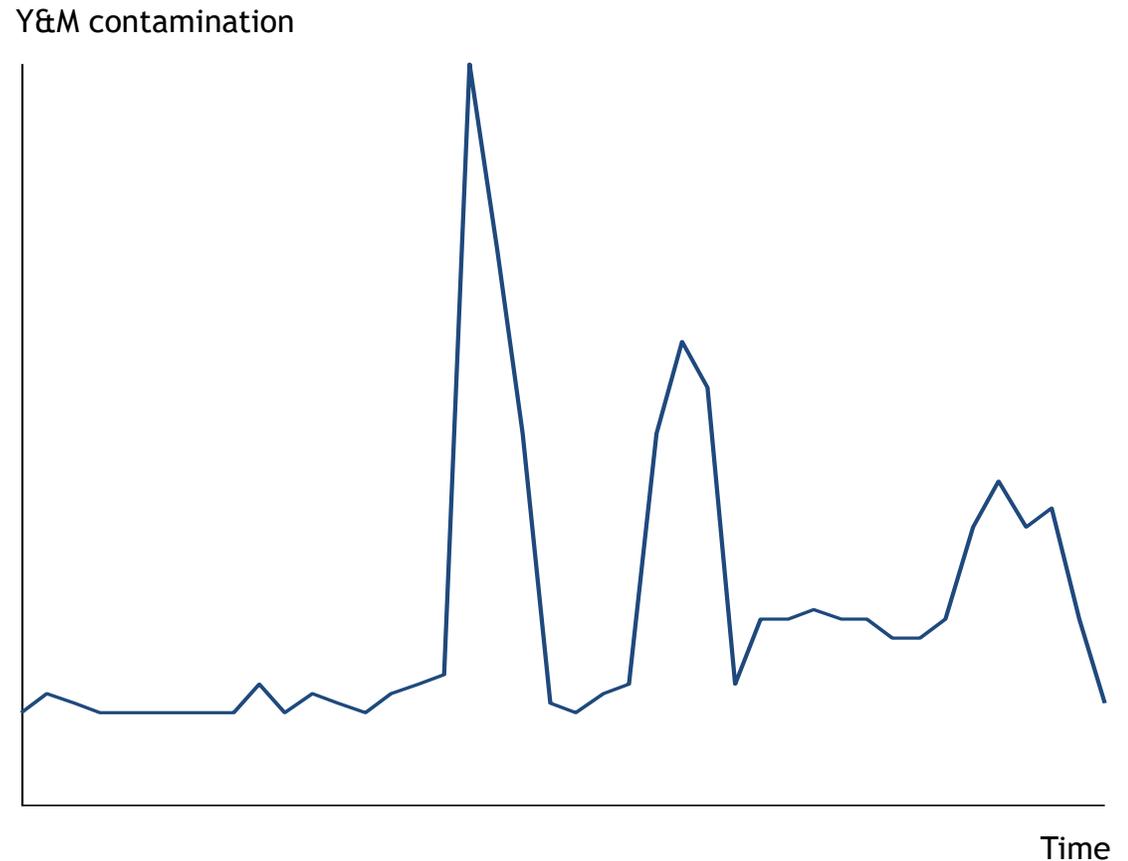
What is it not?

- An alternative to cleaning and hygienic design in the production.



The best brand need the best insurance

- Yeast and mold contamination levels are seldom constant
- A whole world of risks can create a peak:
 - High production capacity utilization / Season - pressure on sanitation program
 - Weather conditions
 - Use of ingredient with higher risk of contamination (ex. Fruit preps)
 - Use of higher risk processes
 - Deviation from standard production
 - Etc.



BioP culture guide

		FreshQ® 1	FreshQ® 2	FreshQ® 4	FreshQ® 5	FreshQ® Cheese 1
Applications		Mesophilic: Sour Cream, Quark, Fromage Frais, Kefir	Thermophilic: Yoghurt (Set, Stirred, Drinking, Greek, Skyr)			Cheese: White Brined Cheese (Feta), Cottage Cheese, Tvarog, Pasta Filata
Protection	Broad protection against yeasts and molds	✓	✓	✓	✓	✓
	Specific protection			Improved inhibition of Zygomycetes molds		
Flavor impact	No negative flavor impact	✓	✓	✓	✓	✓
	Freshness throughout shelf life	✓	✓	✓	✓	✓
	Other		Creamy note	Mild Creamy note	Minimal impact	

Choice between FQ2, 4 & 5 is primarily linked to flavor impact. Looking only at inhibitory effect, we recommend to start with FQ4, which has the broadest protection level of the three.

Parameters evaluated when developing BioP cultures

- ▶ Yeast & mold inhibition
- ▶ Fermentation time and post acidification
- ▶ Flavor and volatiles
- ▶ Texture



BioP - best performing bioprotective cultures

FreshQ®1 in 6% sour cream

Challenge test with high contamination level, 30 days @ 7°C

Reference

Benchmark

FreshQ® 1



P. commune *A. versicolor*

P. brevicompactum *P. crustosum* *P. glabrum*

BioP protective cultures in SKYR

Securing shelf life quality and protecting your business

Reduce levels of yeast and mold contamination

Introducing extra processing steps increase risk of contamination. FreshQ® cultures have proven good antifungal effect in SKYR



Improve sensory experience, especially towards the end of shelf life

High protein containing products are vulnerable to sensory changes throughout shelf life. FreshQ® cultures have shown to counteract the development of 'stale and old' taste in SKYR.



Our range of FreshQ cultures

Used as adjunct cultures together with the starter culture

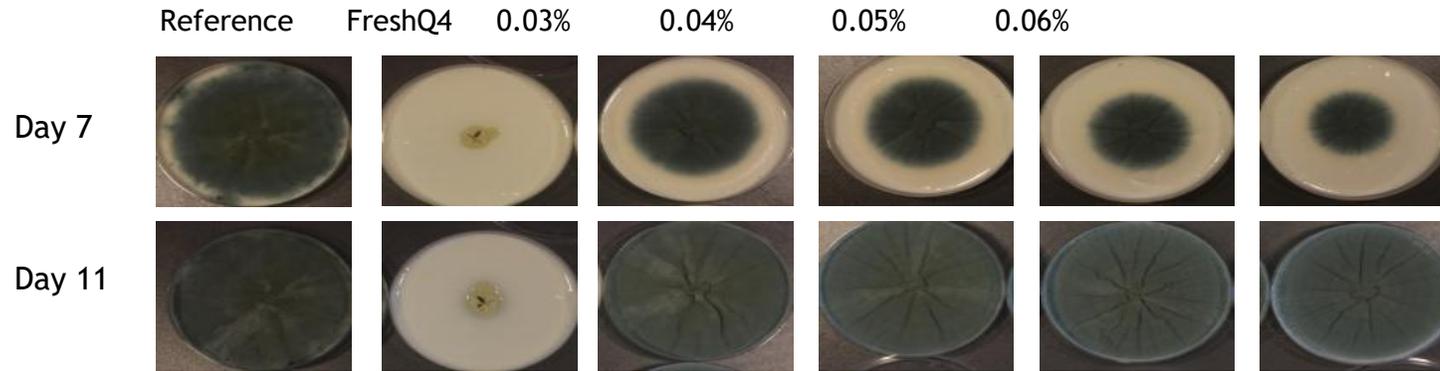
		FreshQ® 1	FreshQ® 2	FreshQ® 4	FreshQ® 5	FreshQ® Cheese 1
Applications		Mesophilic applications: Sour Cream, Quark, Fromage Frais, Kefir	Thermophilic applications: Yoghurt (Set, Stirred, Drinking, Greek, Skyr)			Cheese applications: White Brined Cheese (Feta), Cottage Cheese, Tvarog
Protection	Broad protection against yeasts and molds					
	Specific protection			Improved inhibition of Zygomycetes molds		
Flavor impact	No negative flavor impact					
	Freshness throughout shelf life					
	Other		Creamy note	Mild Creamy note	Minimal impact	

Possible benefits of FreshQ®

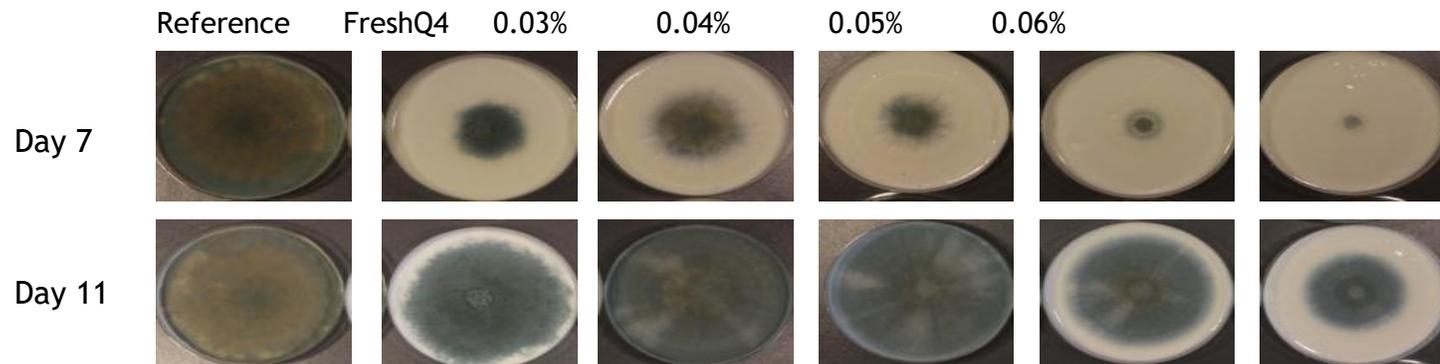
- ▶ **Get in control** - Reduce scrap throughout value chain caused by Y&M spoilage
- ▶ **Protect your business** - Reduce risk of spoilage, brand damage and product recalls
- ▶ **Stay fresh** - Improve consumer quality experience till the end of shelf life
- ▶ **Extend shelf life** - Reduce scrap in value chain due expiration
- ▶ **Extend shelf life** - Improve productivity and logistic
- ▶ **Extend shelf life** - Reach new markets
- ▶ **Go natural** - Improve consumer attractiveness

Inhibitory effect of sorbate vs. BioP

Growth of *P. carneum* stored at ambient temperatures



Growth of *P. roqueforti* stored at ambient temperatures



What can BioP do for me?

1

- **Go natural** - Improve consumer attractiveness

2

- **Get in control** - Reduce scrap throughout value chain caused by Y&M spoilage

3

Protect your business - Reduce risk of spoilage, brand damage and product recalls

4

Stay fresh - Improve consumer quality experience till the end of shelf life

5

Extend shelf life - Reduce scrap, improve productivity, reach new markets





¡Muchas gracias!

¿Preguntas o comentarios?



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CHR HANSEN

Improving food & health