Syrning og koagulering i mozzarella produktion

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Global Cheese Application

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Mozzarella is the biggest category in the commercial cheese market

23%* of all cheese produced is Mozzarella type cheese. That's **5 Million MT** per year!

For every mozzarella launched in supermarkets **8 more new products**** are launched with mozzarella inside

Mozzarella Industrial use is expected to rise by **3.4% p.a.** by 2017

Source: Chr. Hansen internal (*) Including direct sales and self-consumption, (**) Mintel GNPD

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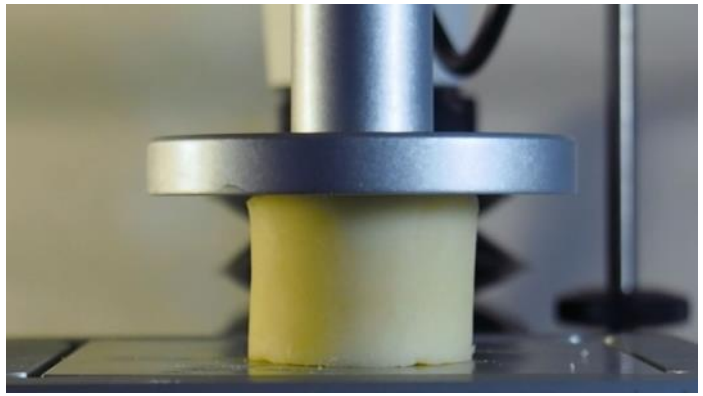
Functional properties refer to the characteristic behavior of the cheese when it is shredded, sliced or heated

Functional properties can roughly be divided into **unheated** and **heated** functional properties

Unheated



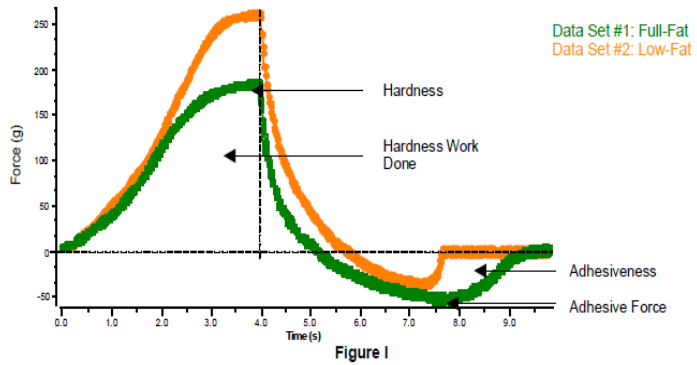
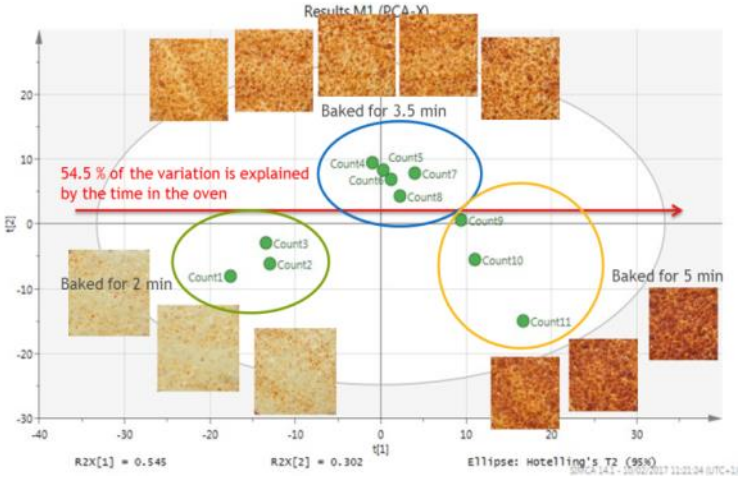


Figure I

Heated



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1 Pasta filata make in brief

2 Coagulants for Pasta filata

3 Cultures for Pasta filata

4 Optimized Pasta filata process

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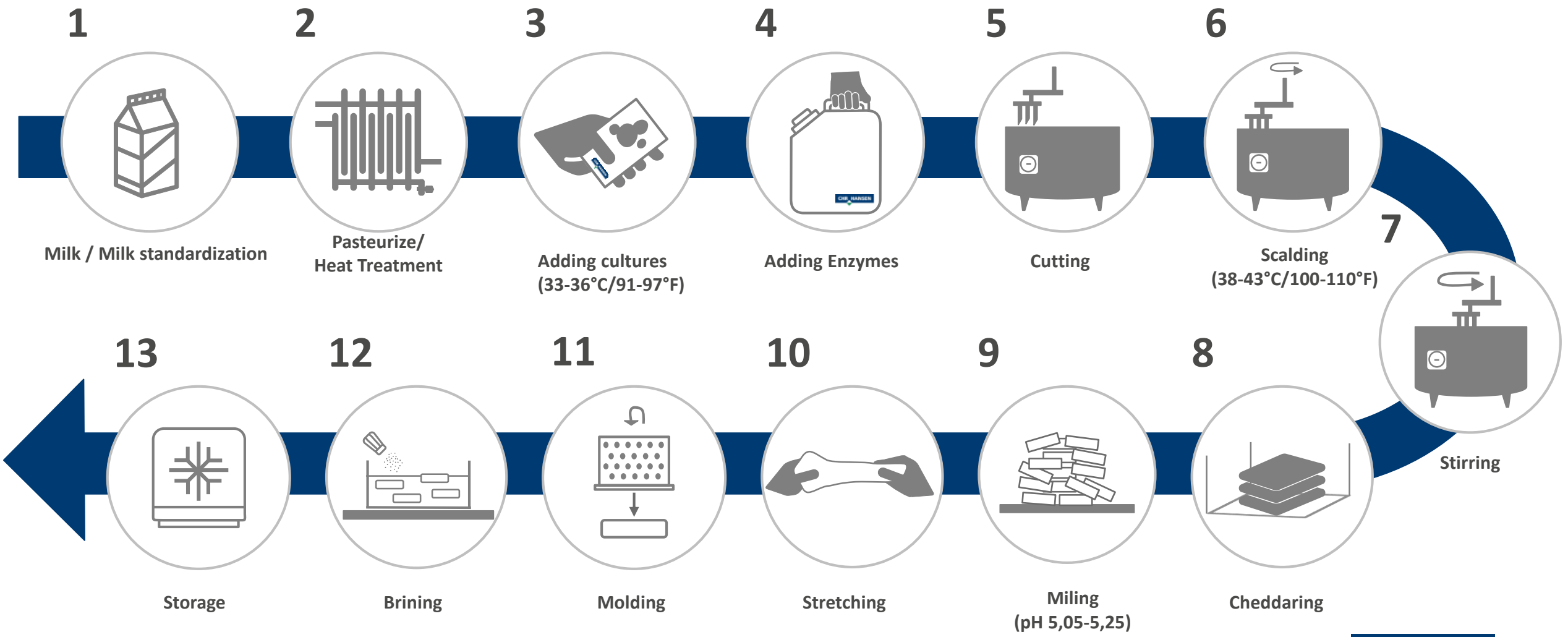
Cheese Making Process – Pasta Filata

1



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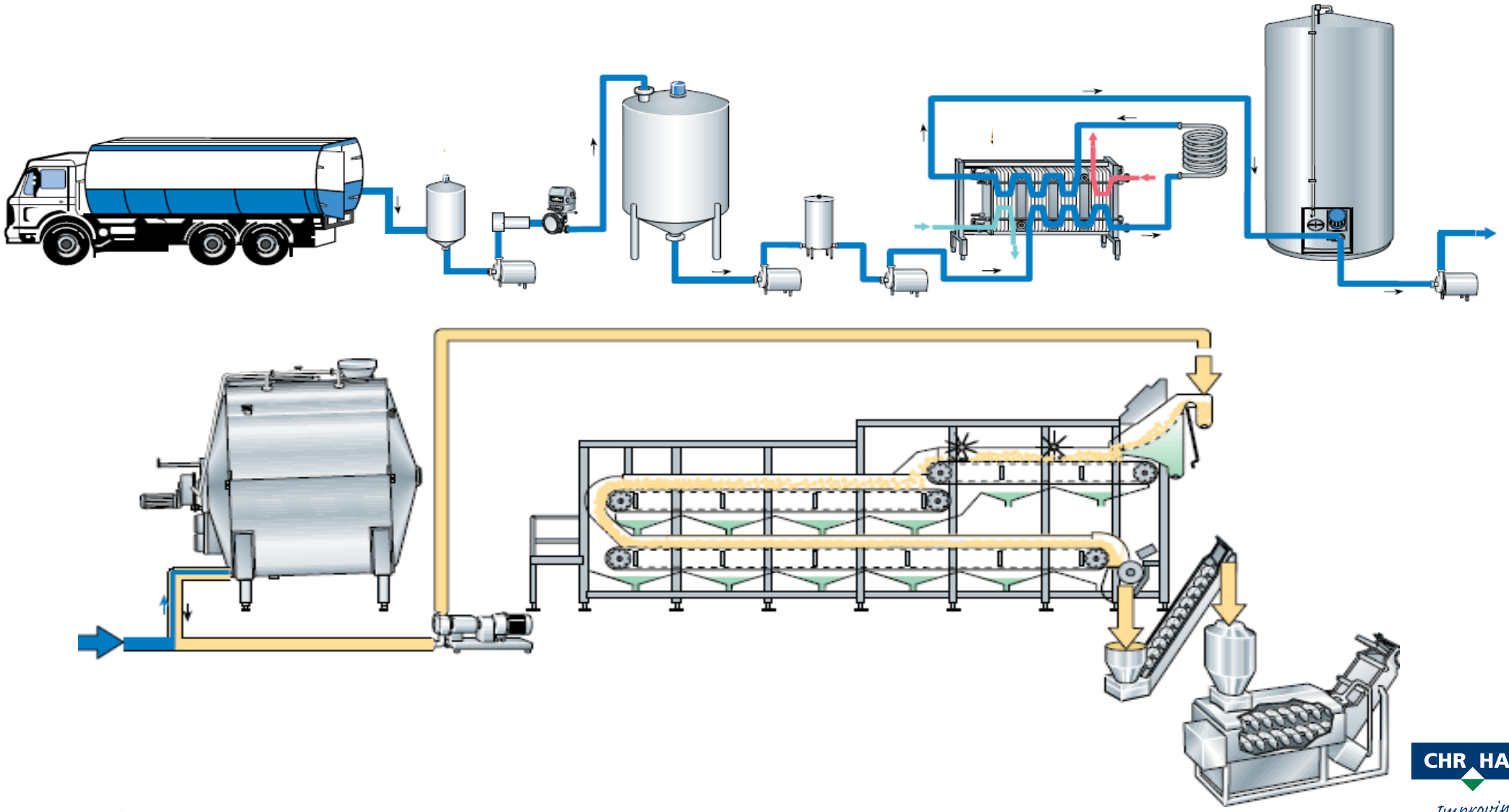
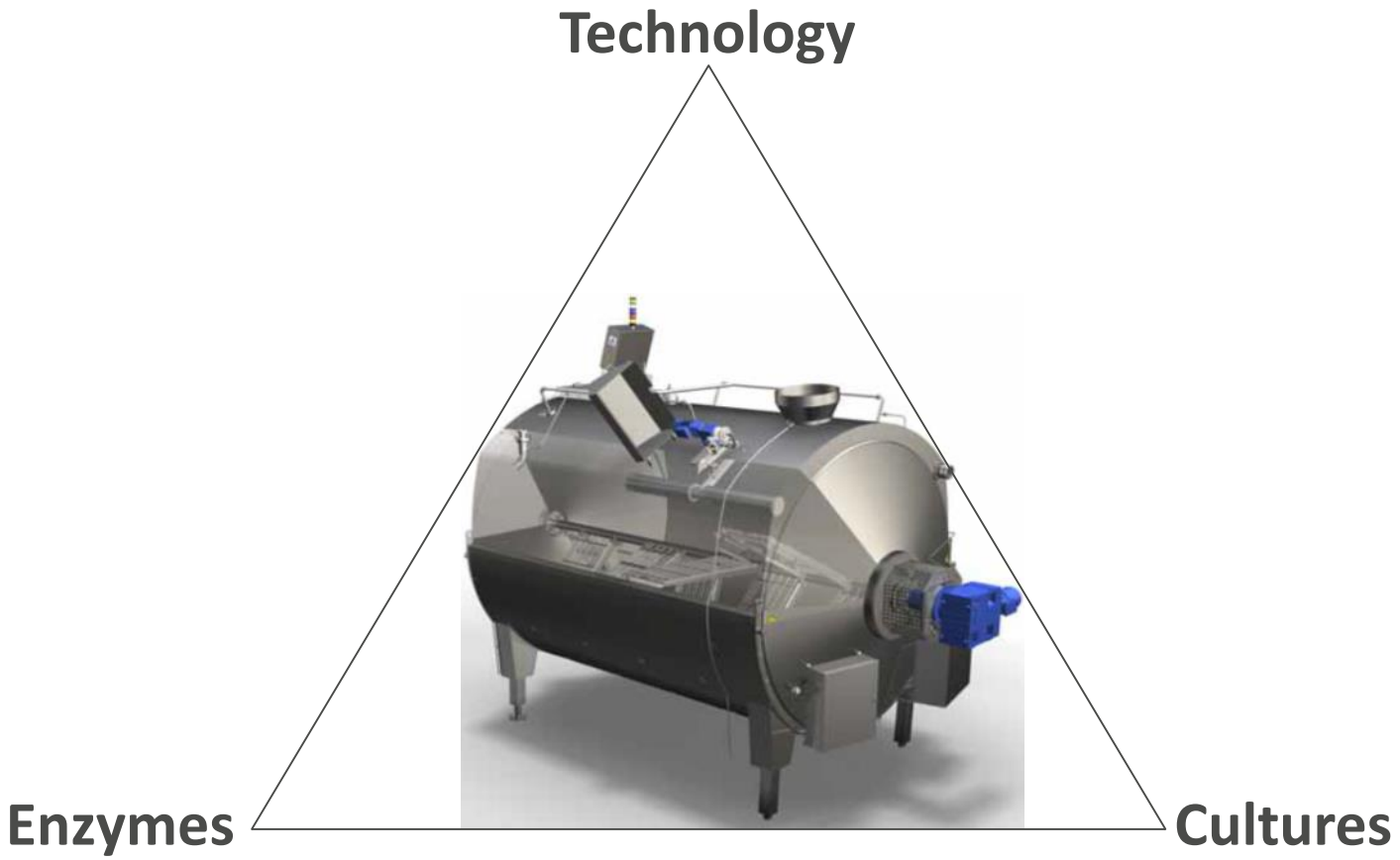
Example of Pasta Filata setup in an industrial plant



Source: Tetra Pak

A global approach



Let’s briefly cover the role of coagulants in cheese making

Coagulation

Enabling efficient cheese make

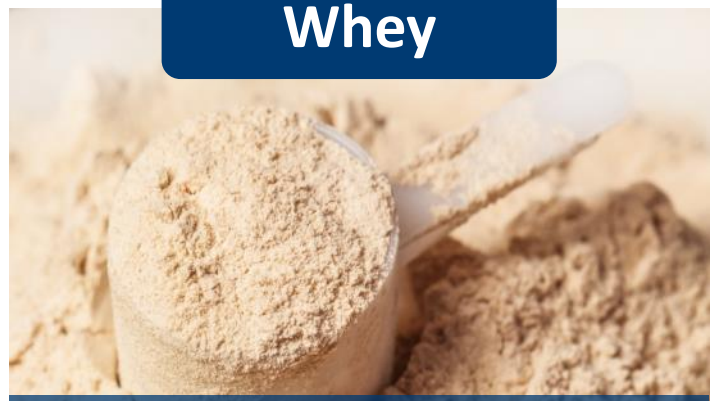
Efficient coagulation consists of mainly two things – time to coagulate and optimizing cheese yield. Coagulation is impacted to a large extent by the specific coagulant, but also the milk preparation in scope.

Ripening

… and cheese functionality

Choice of coagulant plays a role also in the ripening of the cheese. This links to the level of proteolysis delivered by the coagulant that impacts flavor and texture development as well as other key functionalities.

Whey



No longer a bi-product

Focus on whey is ever increasing. The choice of coagulant impacts among others the break-down of whey proteins into small low-value peptide fractions. Also, the ability to inactivate the coagulant is important.

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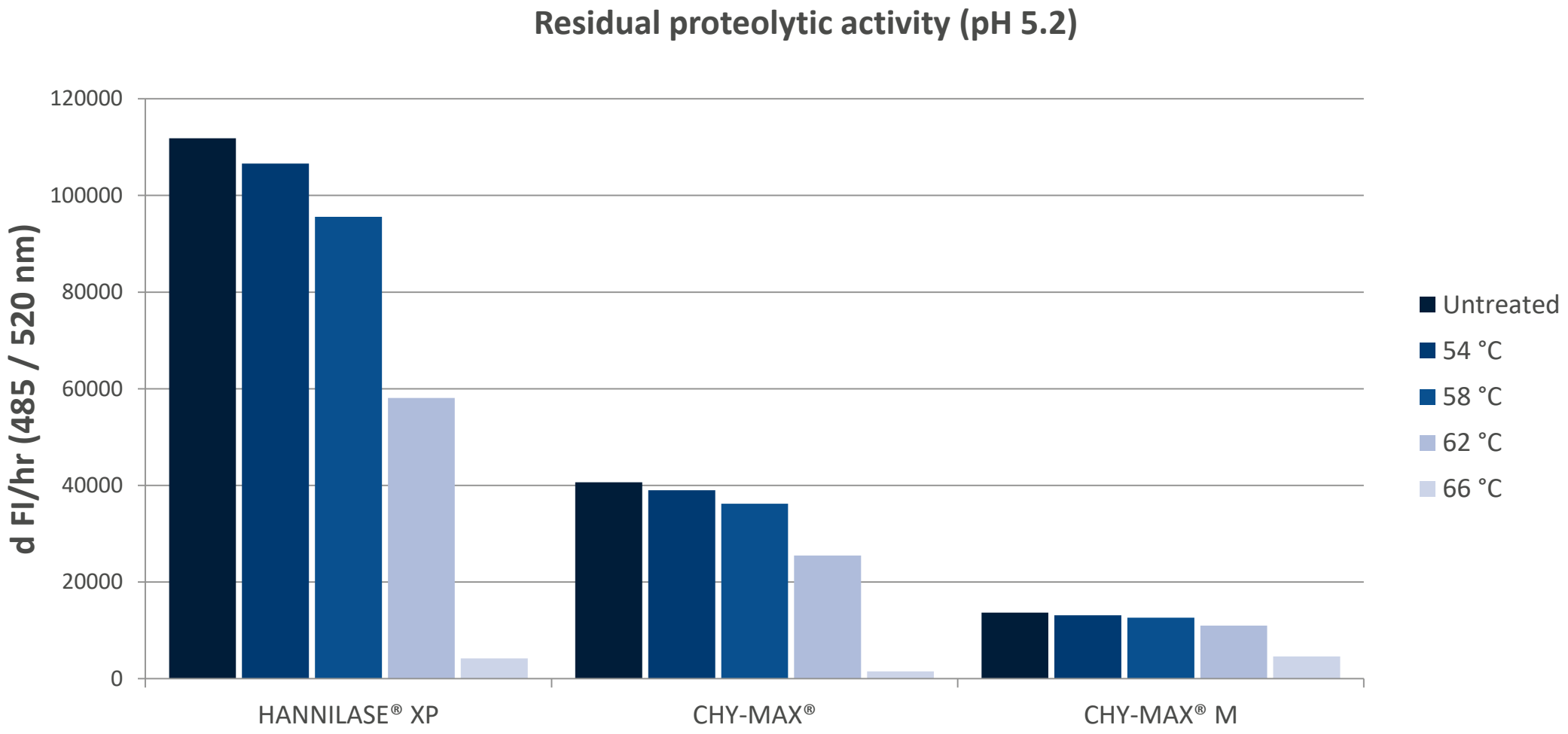
Heat treatment has tremendous impact on proteolytic activity after 5 min at different temperatures

2



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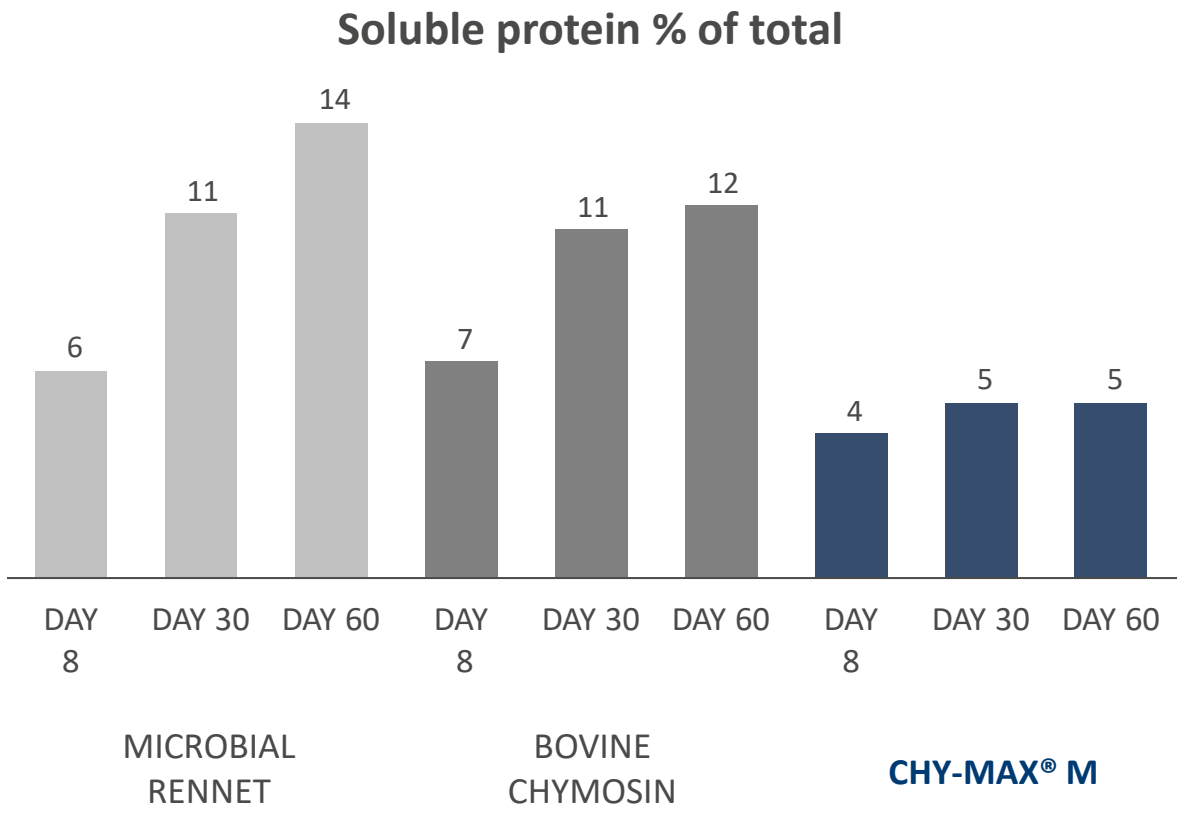
Managing and/or reducing the protein breakdown is key to ensure optimal cheese functionality



CHY-MAX® M ensures

the highest level of intact protein

throughout shelf life

Source: Chr.Hansen trial data in Pasta Filata, 2015

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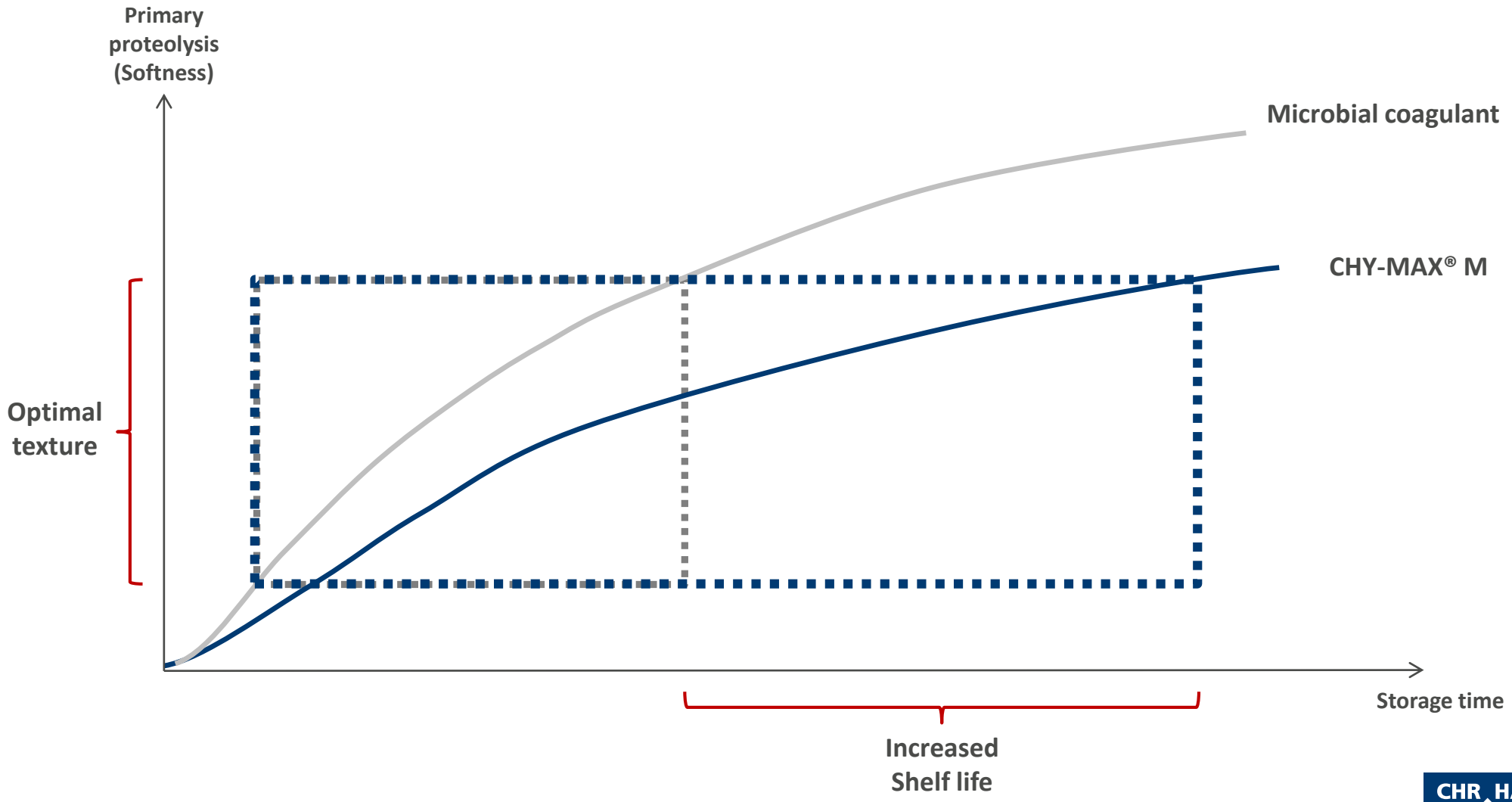
Optimal texture for shredding and slicing



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Coagulant choice for Mozzarella

Coagulant	Advantages	Disadvantages
Hannilase® (Mucor coag.)	Low purchase price Fastest ripening	High cost in use Low cheese yield High residual proteolysis
Chymax® (Bovine chymosin)	Good cheese yield Good ripening	Some residual proteolysis Not the highest cheese yield
Chymax® M (Camelus chymosin)	Highest cheese yield Low dependency of pH & CaCl2 Low cost in use	Very little ripening
Chymax® Special (Camelus chymosin)	Highest cheese yield Some ripening Low cost in use	

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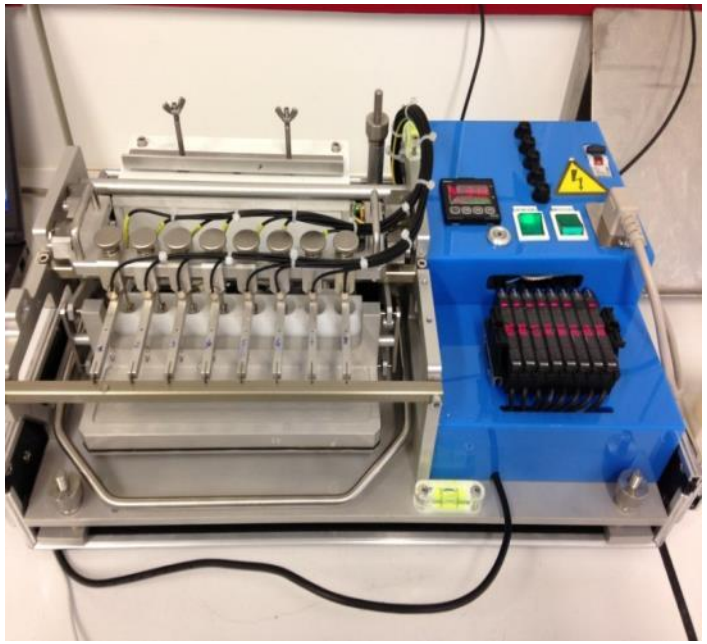
Cutting the curd at the right firmness is very important for optimizing production output and quality

2

Traditional firmness appreciation

CHYMOgraph®



The CHYMOgraph® is a patented Chr. Hansen tool developed in 2011, in cooperation with a French Dairy School

Coagusens™

Coagusens™ is a patented equipment developed by Rheolution. Chr. Hansen has an agreement to distribute product globally.
An industrial version of the CHYMOgraph®

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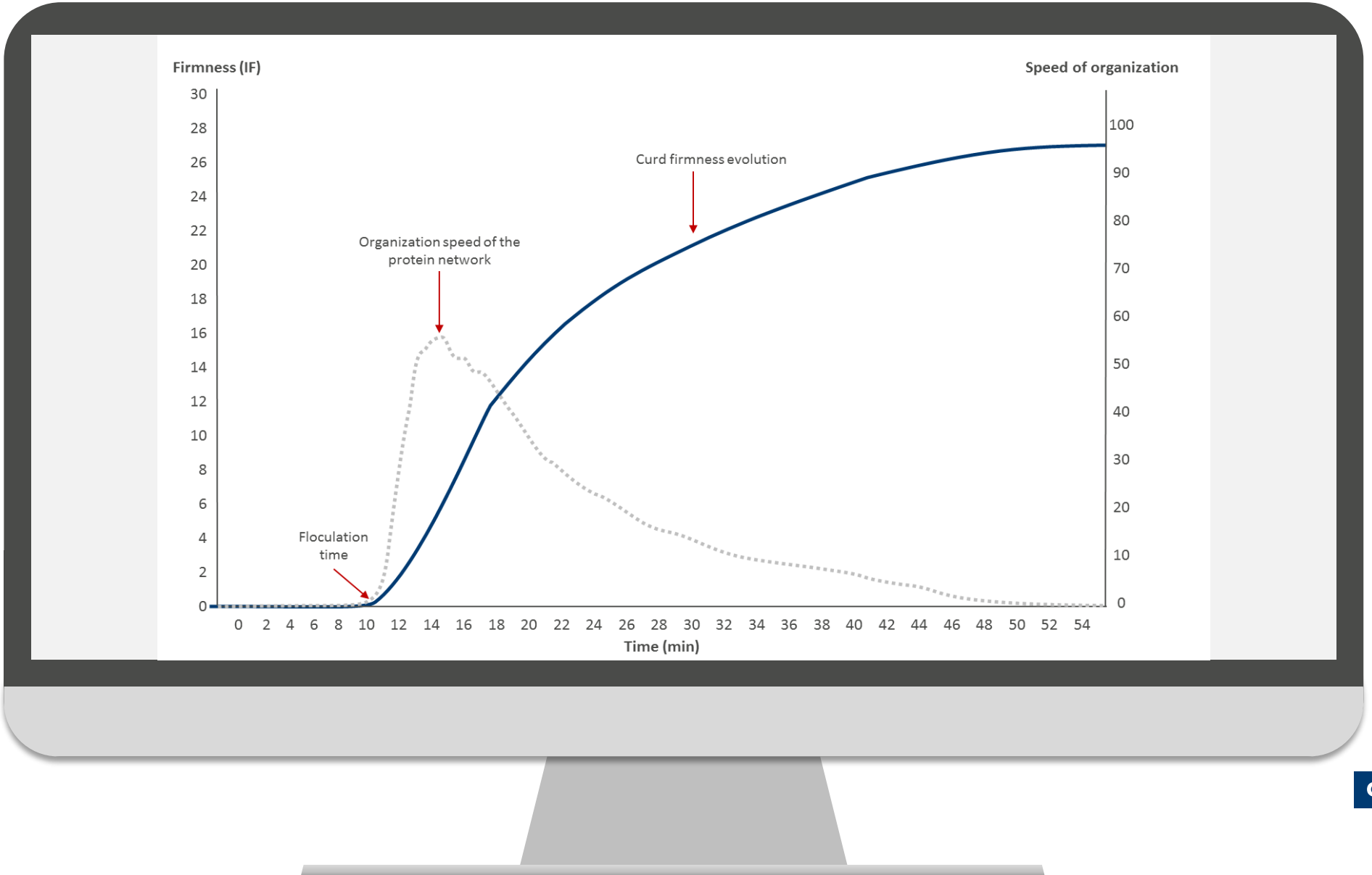
The CHYMOgraph® and the CoaguSens™ delivers graphic indicators to help optimize coagulation…

2



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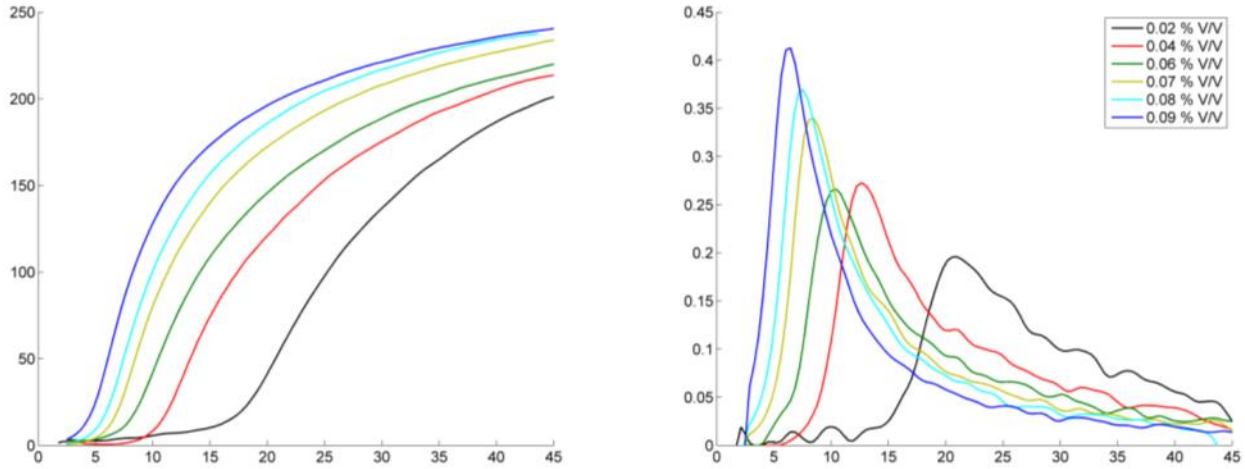
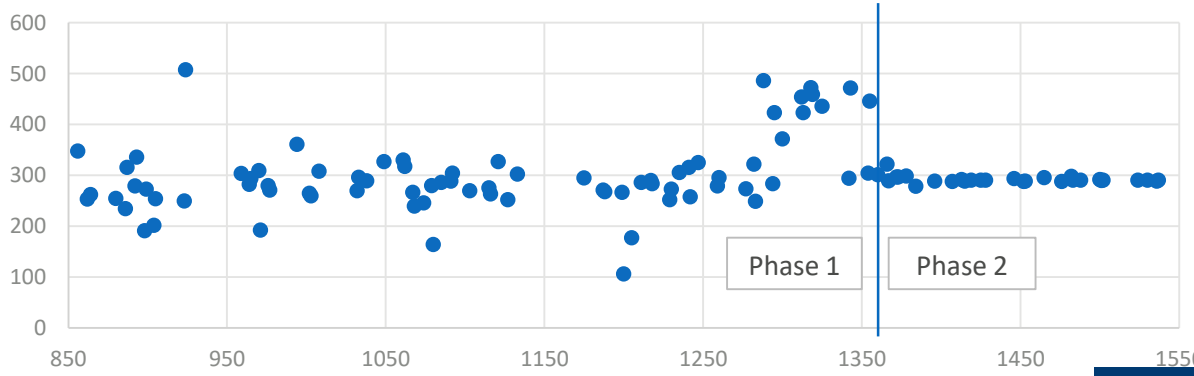
CoaguSens™ is a tool to reduce variability and optimizing yields

Network speed and curd firmness development



Cutting firmness as function of batches



Mintel GNPD, 2016

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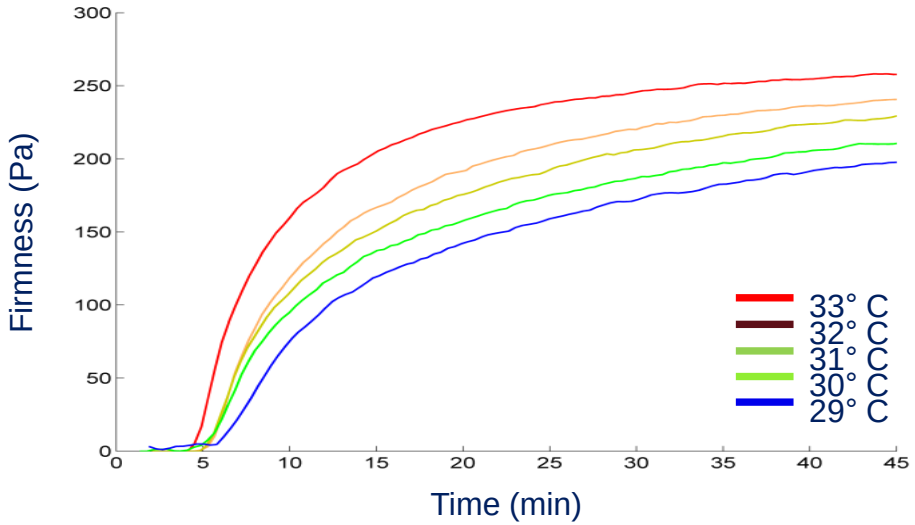
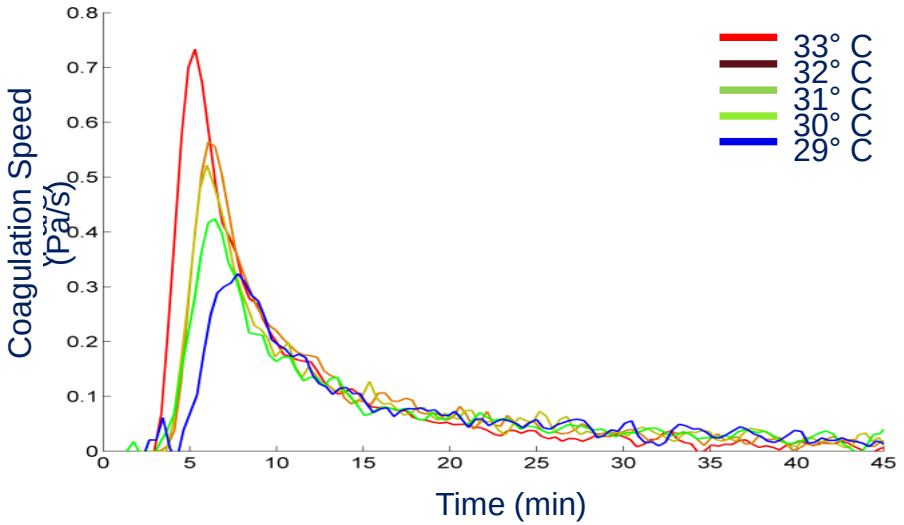
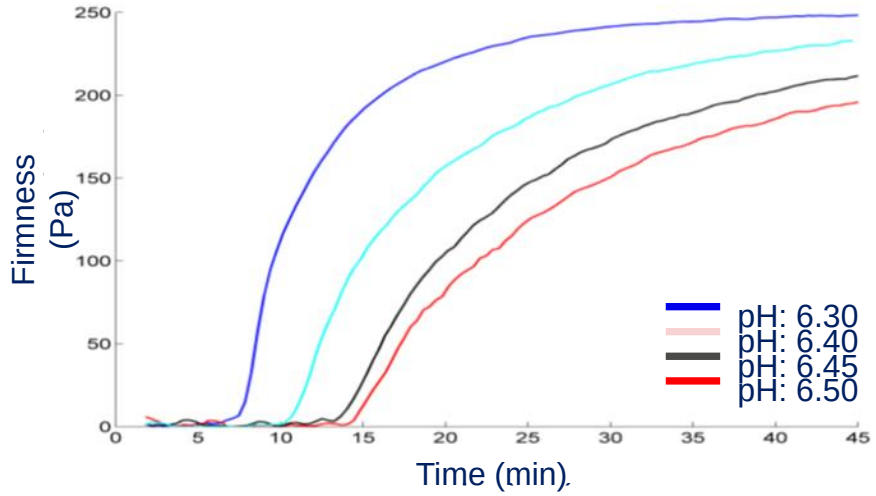
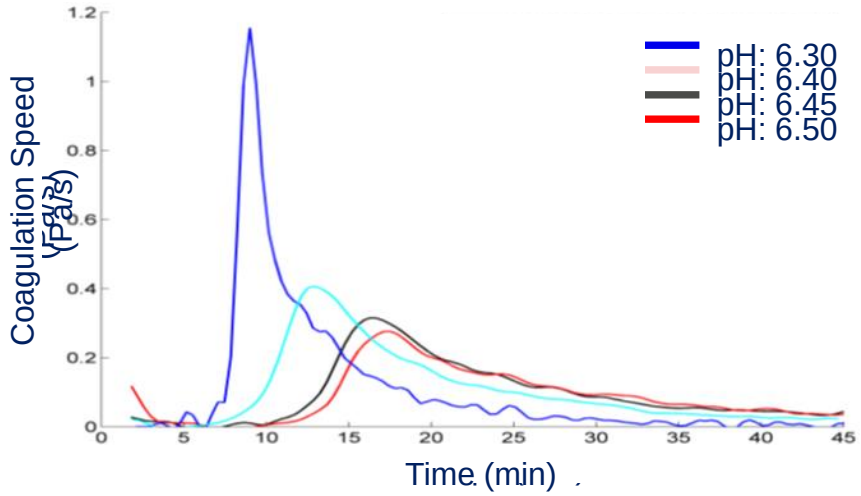
Sensitivity to Coagulation Temperature and to milk pH

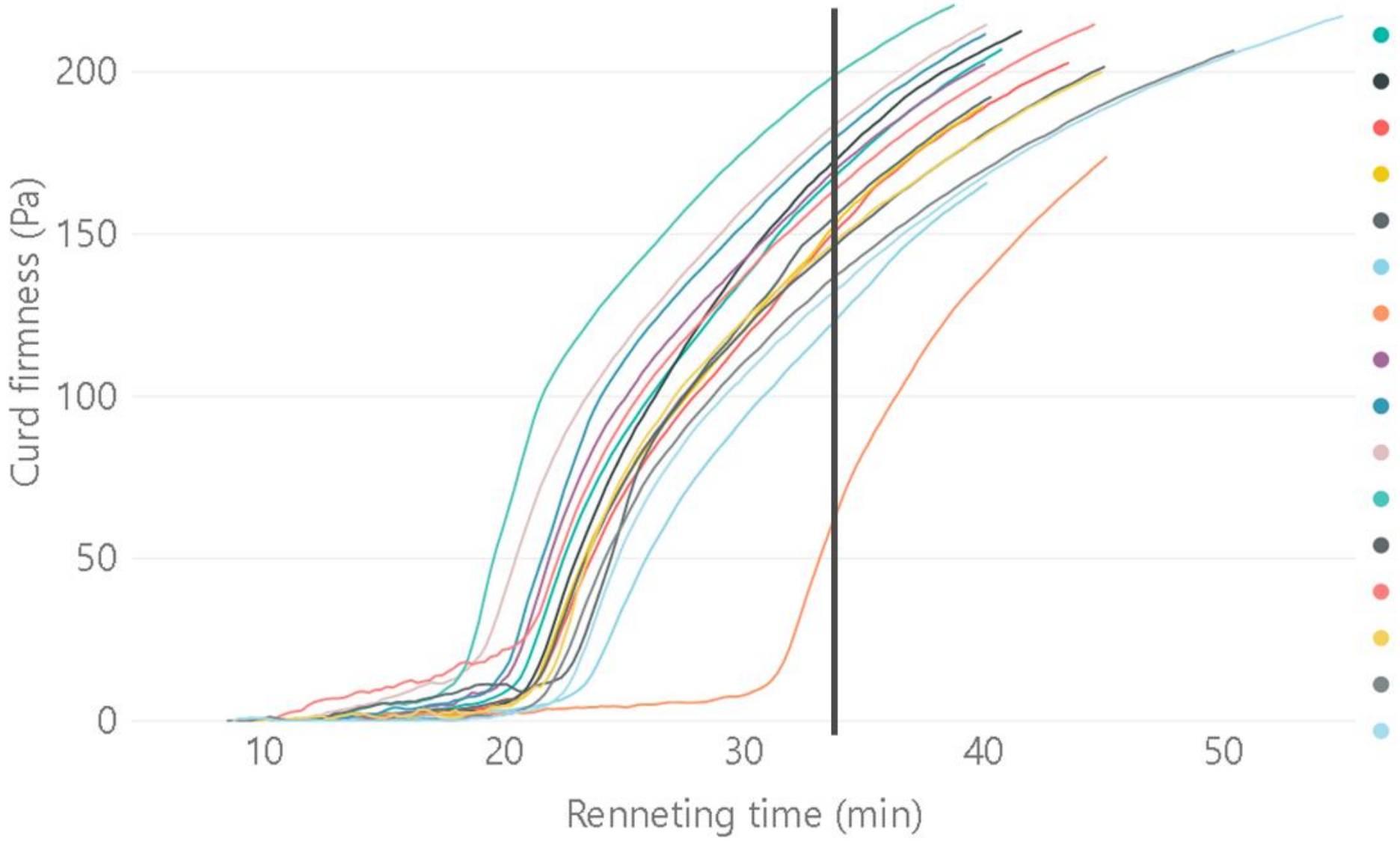








Field data - Curd firmness of different trials



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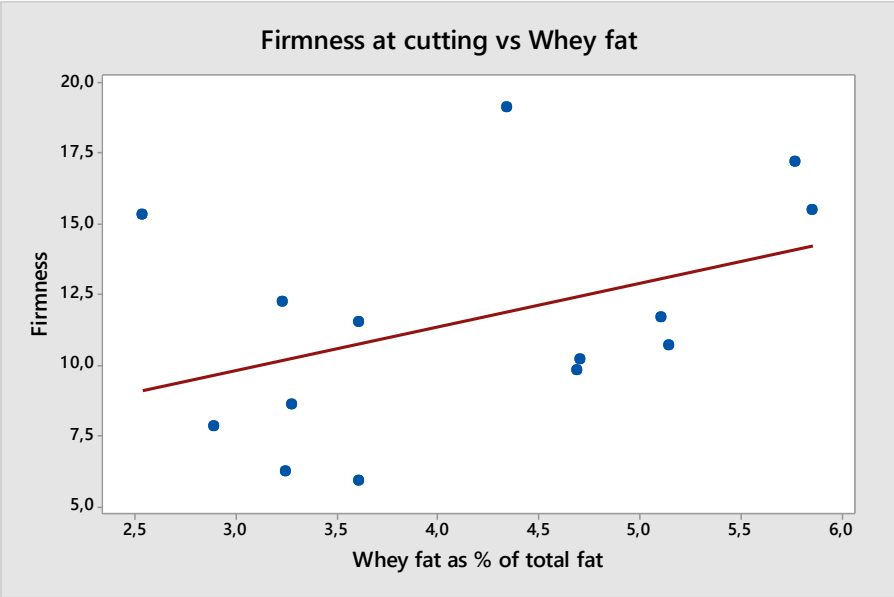
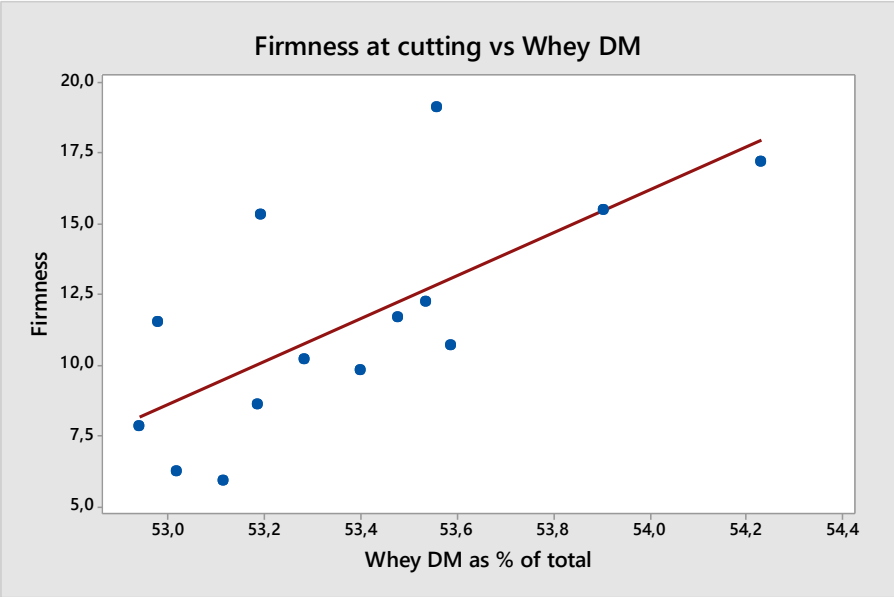
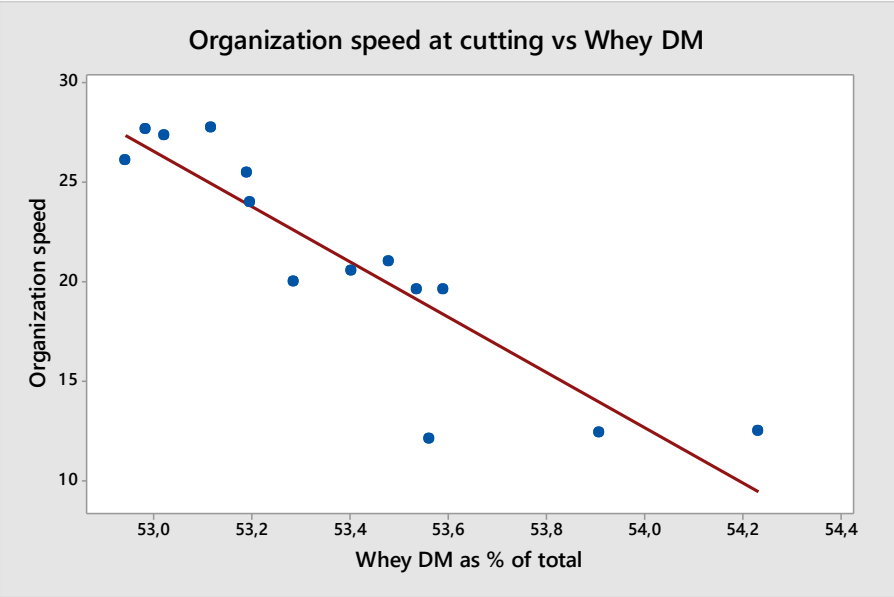
Yield optimization Correlation graphs







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Effect of increased coagulant dose and reduced coagulation time

- Faster gel organization speed – better gel organization - less losses to the whey
- Faster immobilization of culture strains and phage – less ‘sub-critical’ phage attack – less moisture variation
- Better effect on reducing losses of fat and TS by optimizing on organization speed rather than firmness

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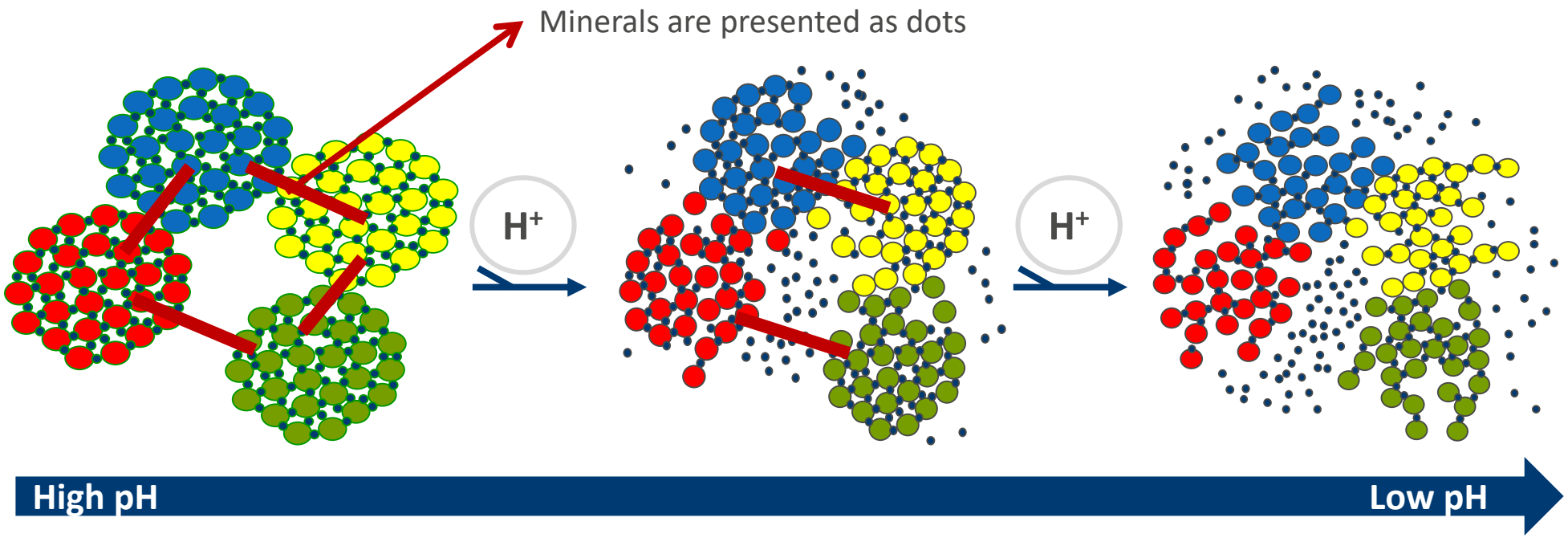
Cultures

3

Demineralization happens as a consequence of acidification



Rigid, rubbery and no curd knitting

pH > 5.3

Elastic, pliable and **stretchable**

Loss of structure, pasty, gummy,

pH < 5.0

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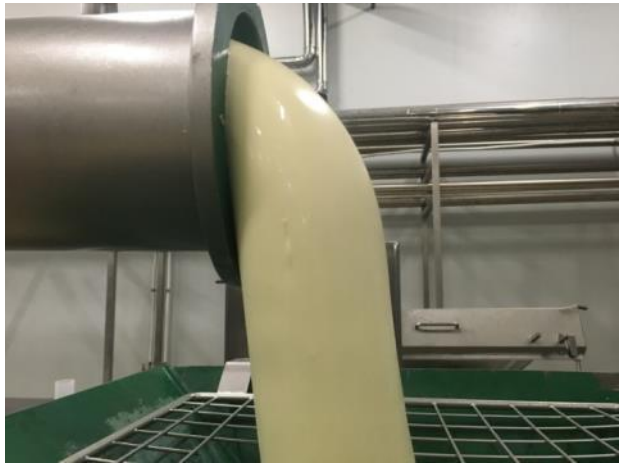
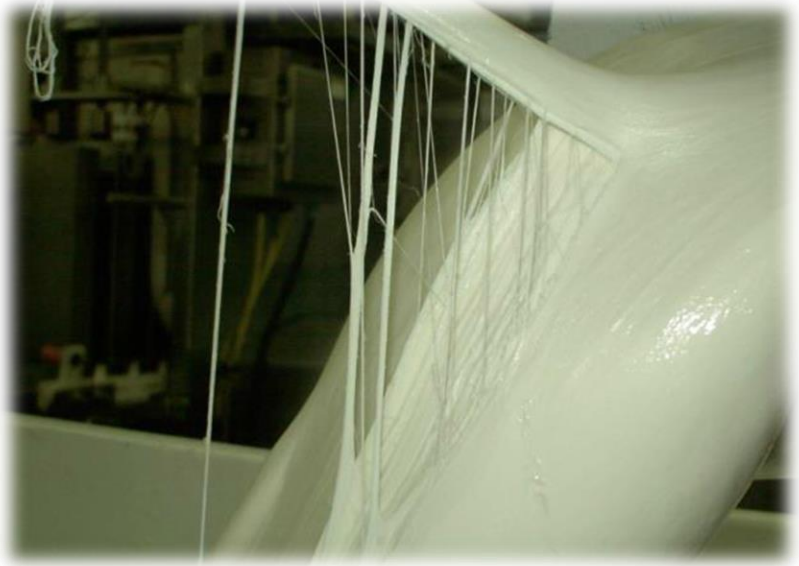
Stretching



‘Bad’ Stretch



‘Good’ Stretch

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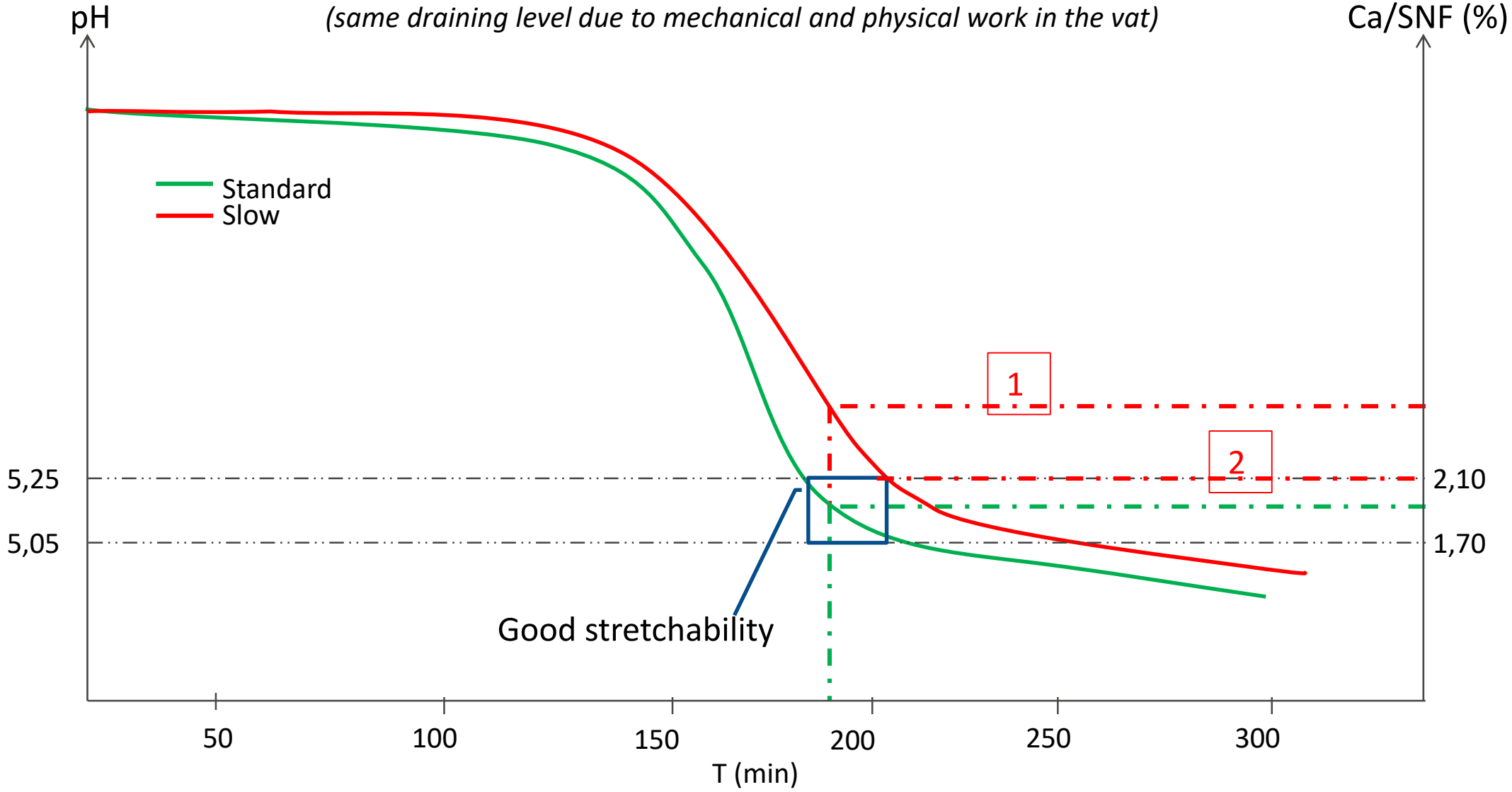
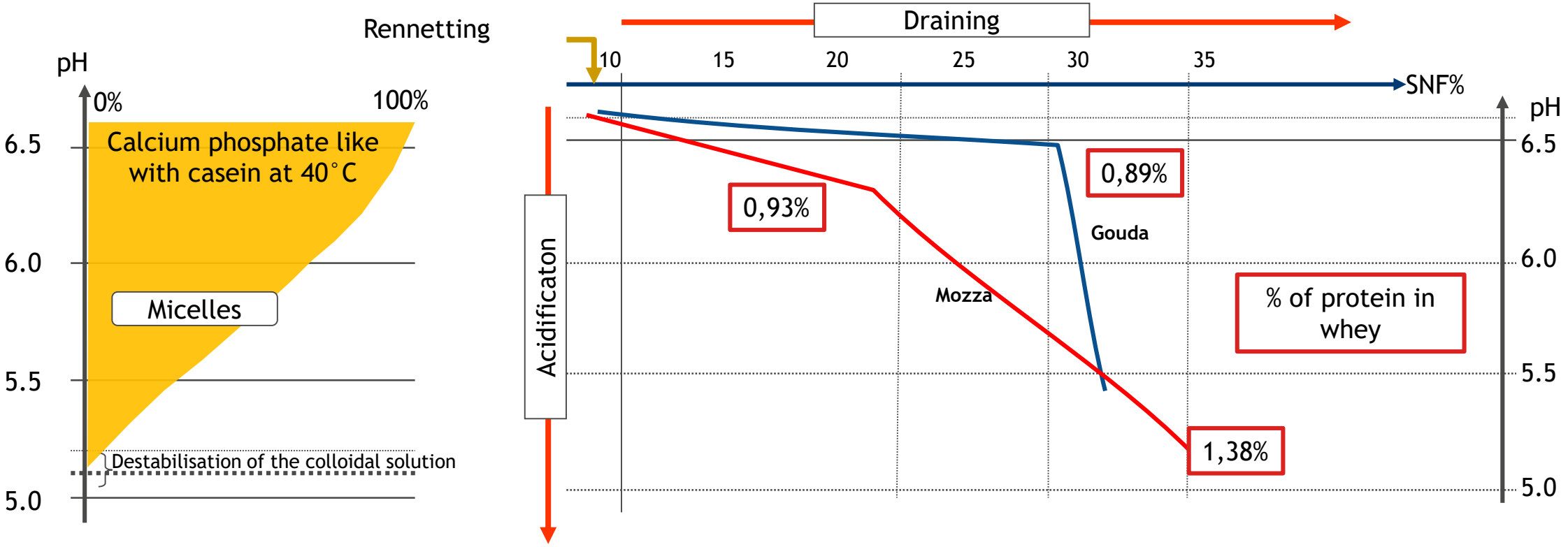
Consequence of inconsistent acidification

(same draining level due to mechanical and physical work in the vat)



1. Stretching is more difficult due to insufficient demineralization level
2. Streching is more difficult due to higher dry matter
3. Less proteolysis (because of higher buffer capacity and/or dry matter) lead to less meltability and flavor in mozzarella

Relative importance of draining and acidification during cheesemaking



Draining in vat	Acidification in vat
Gouda : 90-92%	Gouda : 20%
Mozza : 70-72%	Mozza : 28%

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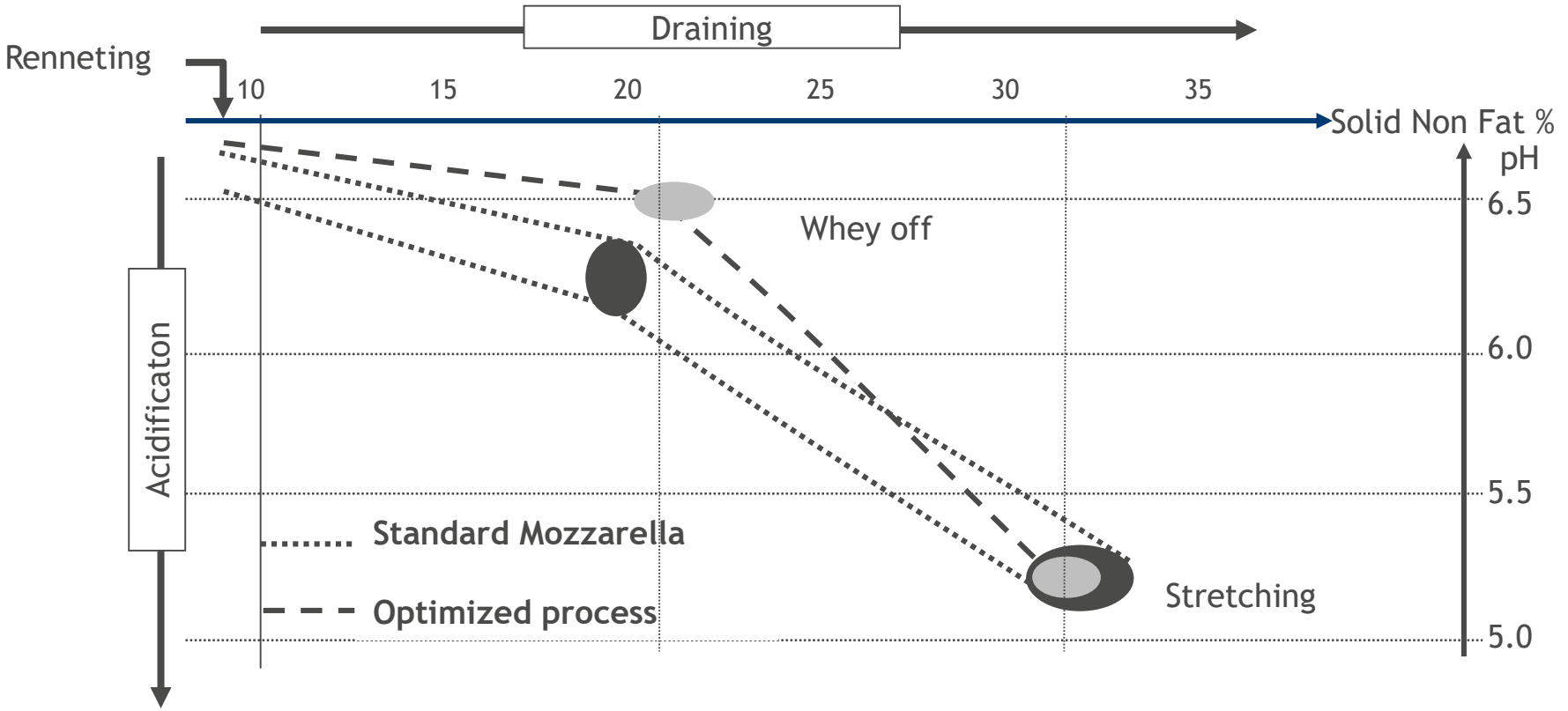
Relative importance of draining and acidification rate during cheesemaking (Standard Mozzarella-LMPS and optimized process)



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Effect of increased culture dose and reduced milk ripening time

- More competition against NSLAB
- Less advantage for phage's generation time/burst size
- Later, but faster acid development – higher solids retention

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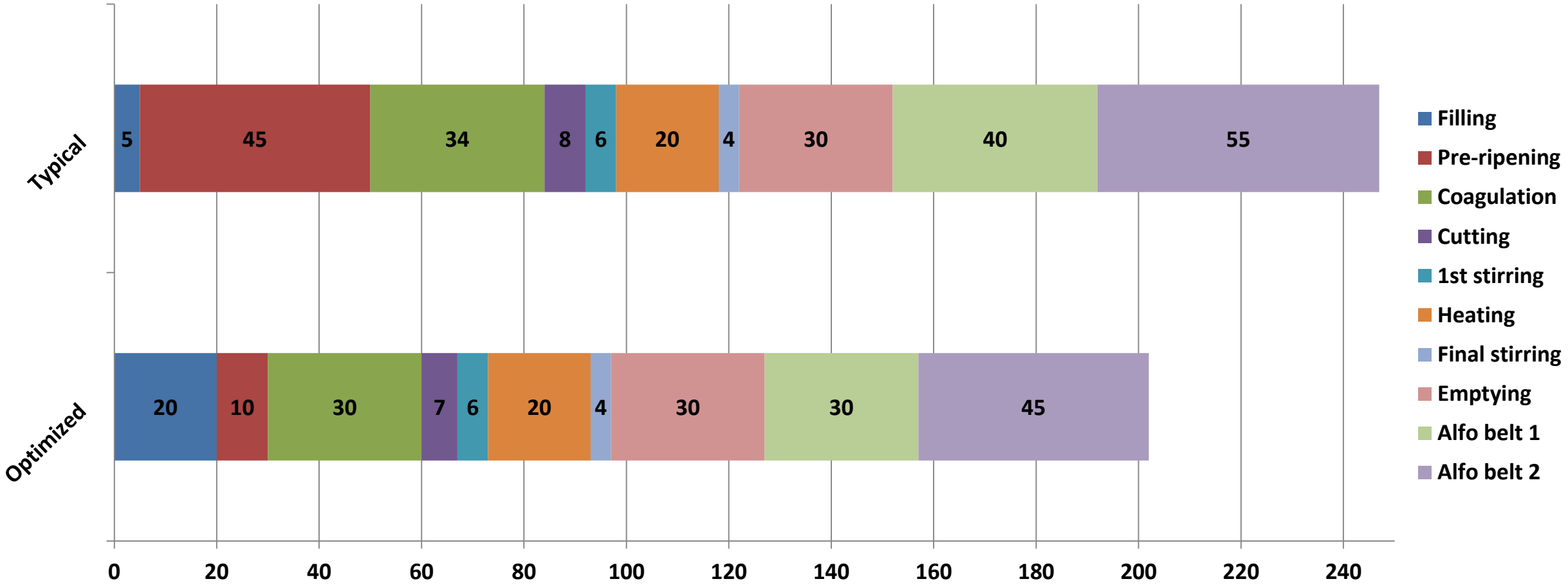
Cheese making profiles



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Changes in the cheese making profile

Typical

- Culture dose: 500-1000U DVS in 20.000L
- Coagulant
  - Microbial: 3500 IMCU/100L
  - Chymosin: 2000 IMCU/100L
- Set/Scald: 35C/39C
- Milk ripening: 45-60 min
- Vat time: 152 min
- Belt time: 95 min
- Total time: 247 min

Optimized

- Culture dose: 2000U DVS in 20.000L
- Coagulant
  - Chymosin: 2500-3000 IMCU/100L
  - Chymax M: 2500 IMCU/100L
- Set/Scald: 34C/40-40,5C
- Milk ripening: 5-10 min
- Vat time: 127 min
- Belt time: 75 min
- Total time: 202 min

Total yield increase: 1-1,2%

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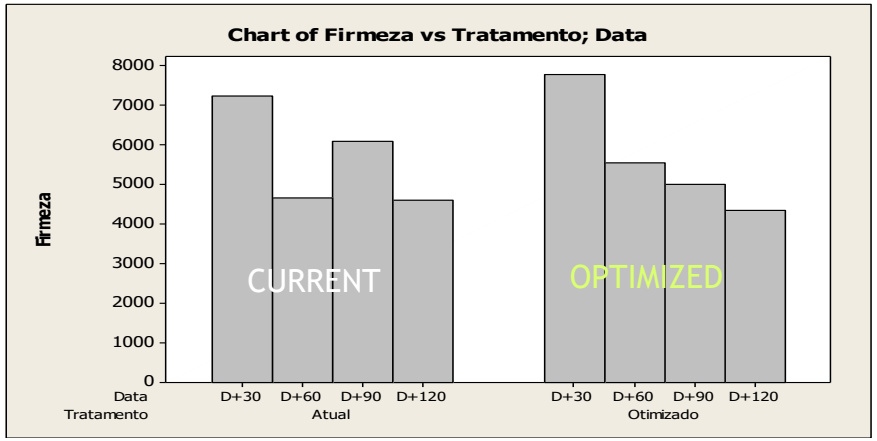
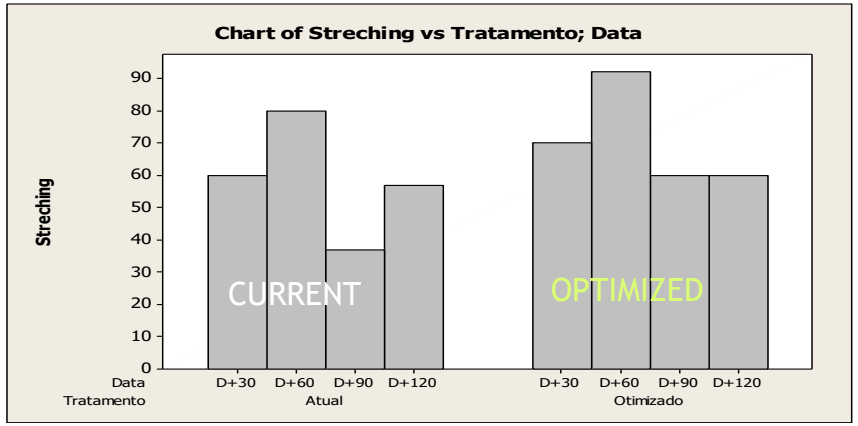
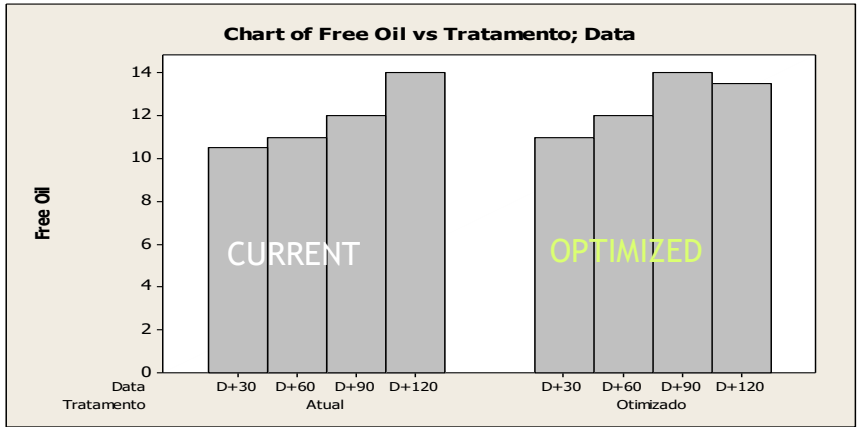
Functionality



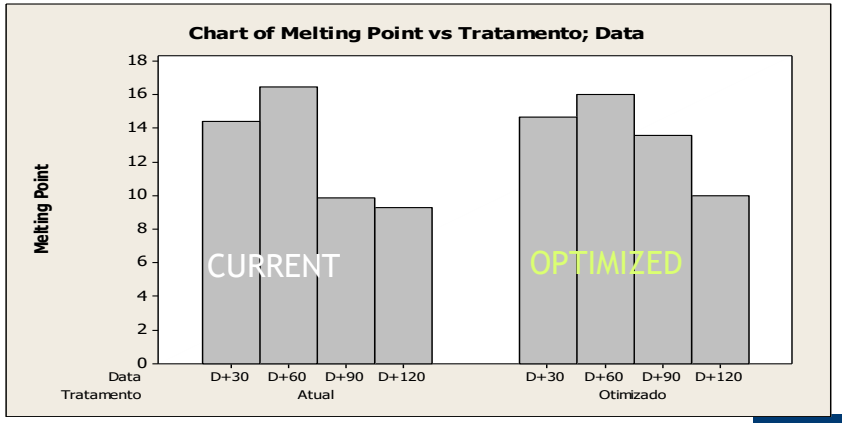
Firmness



Stretching



Oiling off



Melting point

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In summary

- Choice and dosage of coagulant is crucial for yield and functional properties

- Dosage of cultures have a strong impact on yield

- Using an optimized process can give 1-1,2% higher yield without affecting the functional properties

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