



CHY-MAX[®] Supreme

News about cheese production

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About Chr. Hansen

- ▼ Chr. Hansen is a leading, global bioscience company.
- ▼ We develop natural ingredient solutions for the food, nutritional, pharmaceutical and agricultural industries.
- ▼ We develop and produce cultures, enzymes, probiotics and natural colors.
- ▼ Established 1874.



Content

› MARKET OPPORTUNITIES

Cheese producers and converters need to generate maximum value while at the same time meeting customer demand for functionality

› OUR NEW SOLUTION

CHY-MAX[®] Supreme helps producers and converters meet customer needs with improved functionality and increased yield to deliver a greater commercial return

› TECHNICAL ASPECTS

Discover the technical aspects of CHY-MAX[®] Supreme in continental cheese. The references will be microbial coagulant 1st gen and FPC 1st and 2nd gen.

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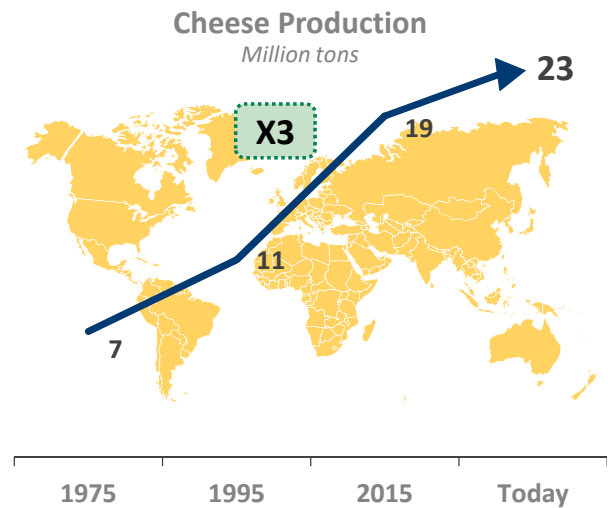
Global cheese production volume reached 23million tons in 2019

EMEA is the biggest cheese production area with 52% volume share followed by North America (28%) and LATAM (17%)



THE WORLD **PRODUCES MORE CHEESE** THAN COFFEE, TOBACCO, TEA AND COCOA BEANS COMBINED

Cheese production has tripled over last 4 decades to reach total volume of 23 million tons

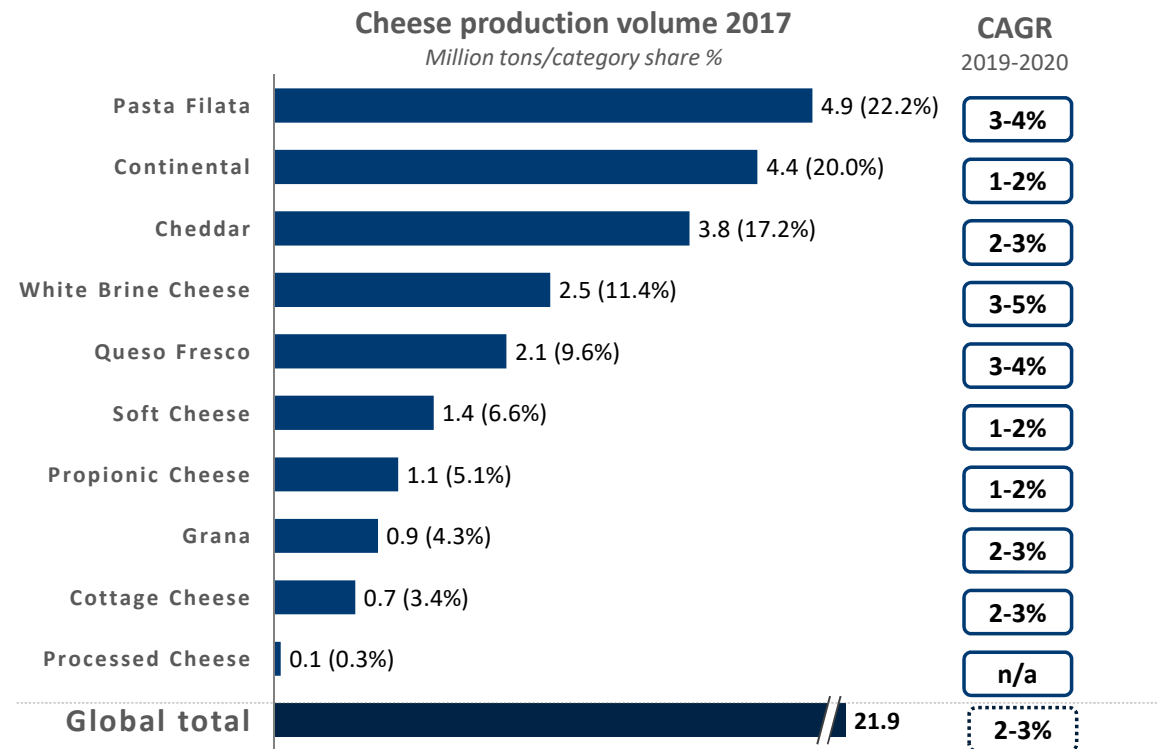


Source: Chr. Hansen MI mapping, 2017



How much of cheese being produced?

Pasta Filata / Pizza cheese the most globalized cheese type and still growing



Source: Chr. Hansen MI mapping, 2017

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The demand for cheese as an ingredient and in convenient formats are growing

USA

Incremental sales across all formats.

Cubed	\$ 123.5 million up 9.1%, units <u>up 10.1%</u>
Sliced	\$ 2.2 billion up 3.3%, units <u>up 3.6%</u>
Shredded	\$ 4.8 billion up 1.1%, units <u>up 1.2%</u>

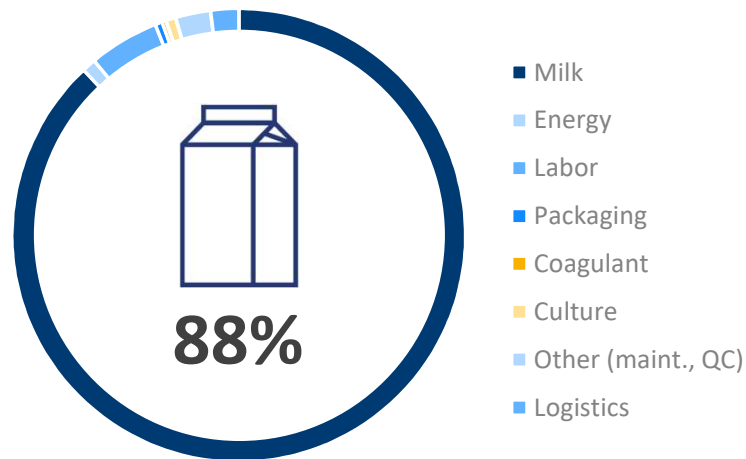
Source: Mintel GNPD, IRI Market research, and Euromonitor 2018. Global value at Manufacturer Selling Price (MSP, Producer) and Retail Selling Price (RSP, Retailer) respectively



Milk and labor are two of the most valuable resources when making cheese

CHEESE PRODUCTION COST¹

Percentage of total cost



FOCUS ON MAXIMIZING VALUE

- › About **93%** of the cost of producing cheese comes from milk (88%) and labor (5%)
- › In addition to good hygiene, higher yields with lower proteolysis ensure that you **get the most out of your milk**
- › Faster production enables you to **optimize labor costs**
- › The coagulant makes up only about 0.3% of total cost but can **make all the difference**

¹Data based on conversations with our global customers



Small change, big difference

Getting the most value out of your precious resources, milk and time, is the big difference CHY-MAX[®] Supreme can deliver for you.

FASTER COAGULATION

Increased number
of tanks in less time



HIGH SPECIFICITY COAGULATION

More cheese from
your milk and better
whey quality



REDUCED PROTEOLYSIS

Faster precision
slicing with less
giveaways



INCREASED YIELD AND FASTER PRODUCTION

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The best ingredients in the dairy industry for almost 150 years - Including the market leading cheese coagulant portfolio



NATUREN®

Keeping traditions alive

- Chr. Hansen's range of **Animal Rennet**
- Different chymosin / pepsin ratios are available
- Preferred range for traditional products, incl. DOP, AOC or other labeling requirements
- Includes NATUREN®, BioRen®, BioRen® Paste and Dried vells

MICROLANT®

Making organic possible

- Chr. Hansen's range of multi-purpose **Microbial coagulants**
- A good option for organic production and special labeling
- Includes HANNILASE®, MICROLANT® Supreme and THERMOLASE®

CHY-MAX®

For the modern cheese maker

- Chr. Hansen's range of pure, Fermentation-Produced Chymosin (**FPC**)
- Ideal milk-clotting enzymes delivering superior properties for cheese and whey
- Includes CHY-MAX®, CHY-MAX® Special, CHY-MAX® M and CHY-MAX® Supreme
- 55% of all cheese is made by FPC

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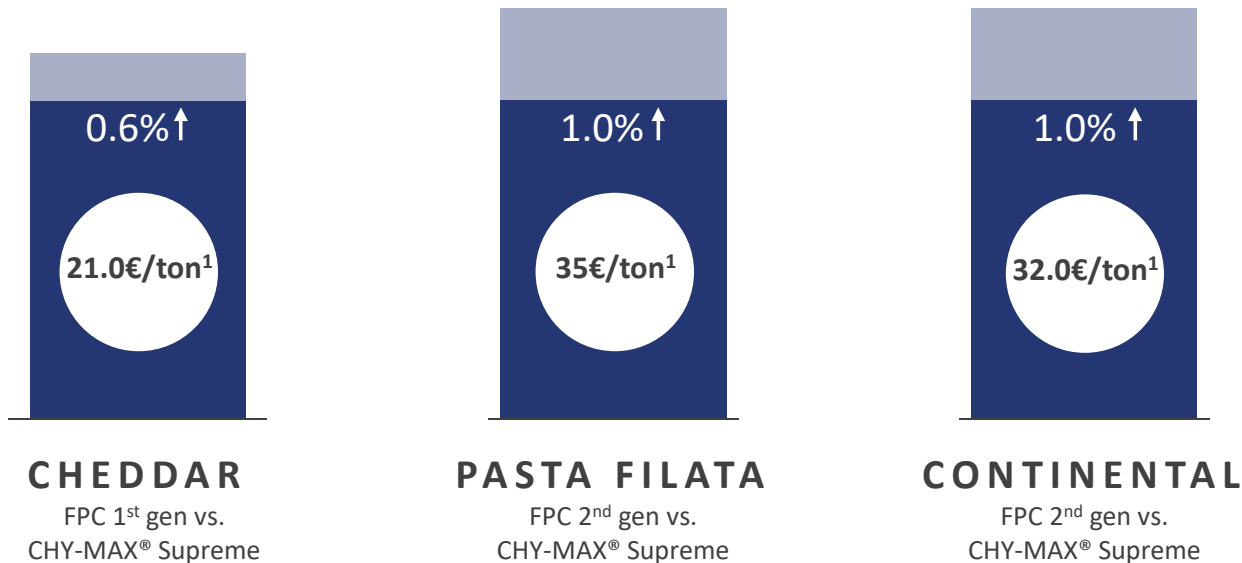
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Maximizing value

More yield, longer shelf life, and less giveaways mean greater profits – effectively paying for itself

YIELD AND PROFIT INCREASES IN DIFFERENT CHEESE TYPES USING CHY-MAX[®] SUPREME



Trial results reveal:

- › CHY-MAX[®] Supreme is the outstanding performer in the market-leading CHY-MAX range
- › Yield increase of 0.6-1% on average per ton²
- › More product from less milk delivering a higher profit margin
- › Customers confirm these ratios of yield benefits

¹Based on latest cheese prices informed on www.ec.europa.eu January 17, 2019 - All factors the same using recommended dosage of coagulant

Yield differences can be explained by studying the C/P ratio

THE C/P RATIO¹

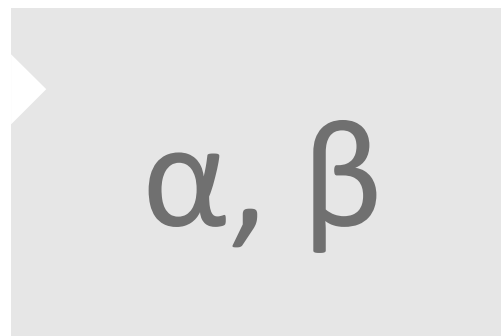


CASEIN SUBSTRATE



ANALYSIS METHOD

› 50 IMCU / liter of milk at pH 6.50



- › Curd simulation
- › Peptides extraction

¹ C/P is the ratio between specific clotting activity (IMCU/ml) and general proteolytic activity. Reference method by E045.

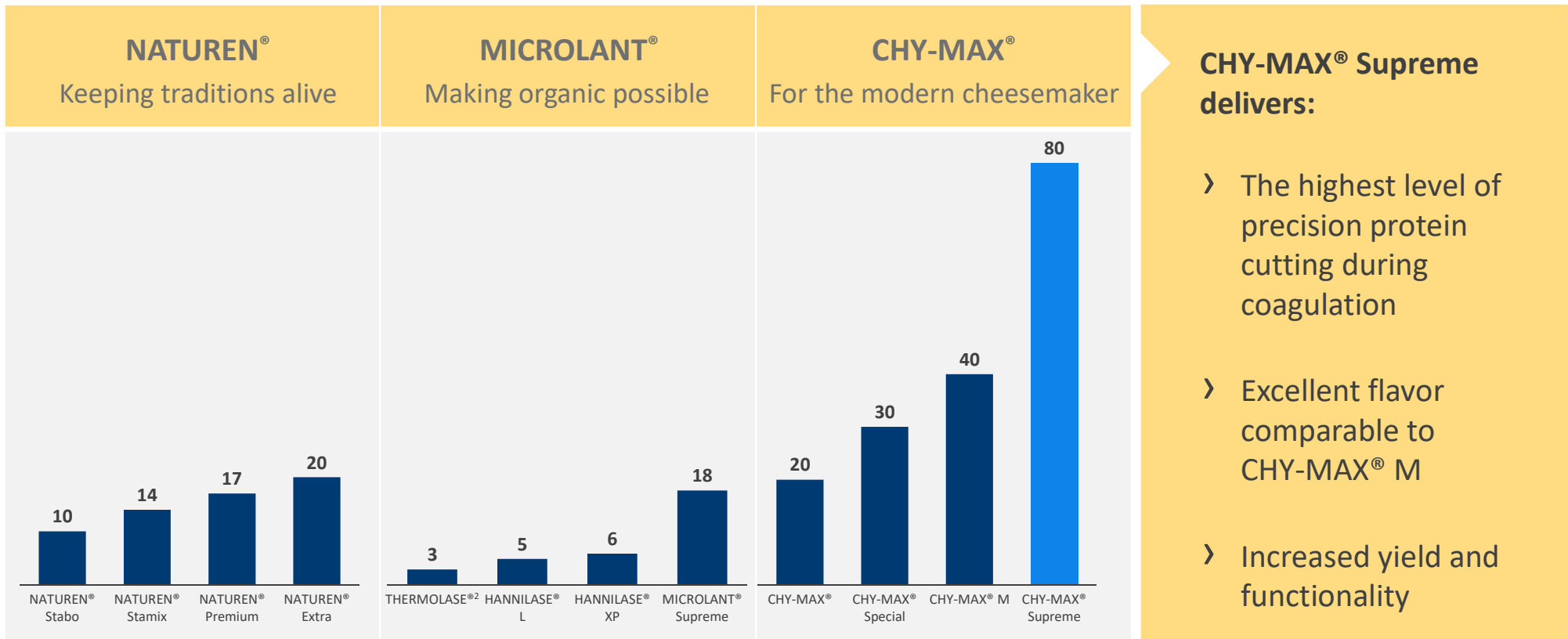
NOTE: Enzyme producing companies calculate the P differently – so comparing C/P ratios btw companies is difficult.

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High C/P ratio enables higher yield

Reduced proteolysis comes when you have a higher C/P ratio, indicating greater specificity during coagulation

SPECIFICITY (C/P)¹



¹ C/P is the ratio between specific clotting activity (IMCU/ml) and general proteolytic activity

² Thermolase is generally not compatible with organic cheese production

Small change, big difference

Technical aspect of CHY-MAX[®]

Supreme in Continental application:

Coagulation behavior

Yield

Functionality

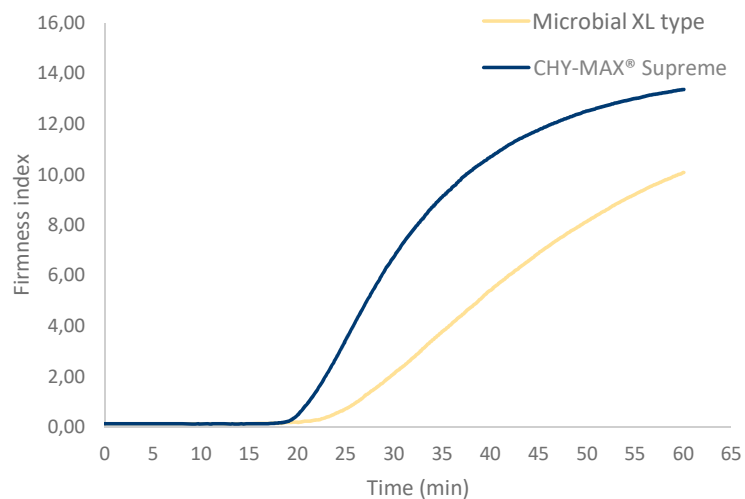
Whey quality

CHY-MAX[®] Supreme's performance is verified with trials conducted by NIZO

When dosed properly, CHY-MAX[®] Supreme can save time and increase yield

COAGULATION PROFILE FOR CONTINENTAL¹

Firmness over time (40 IMCU/L)



Protein: 3.44%

pH at renneting: 6.63

Fat: 3.6%

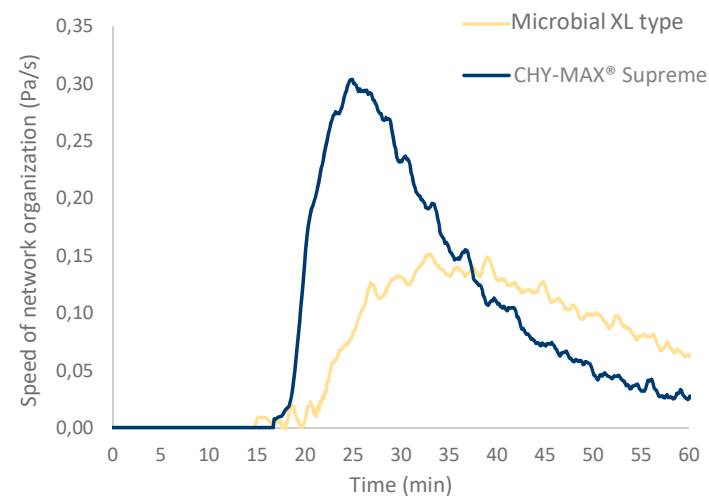
Temperature at renneting: 32°C

¹Trials at NIZO, 2018

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NETWORK ORGANIZATION SPEED¹

Pa/s



TREND:

- › With same IMCU dosage, the start of gelation is earlier. The firming rate of the coagulum goes much faster with CHY-MAX[®] Supreme
- › Coagulation time is reduced by 33% with CHY-MAX[®] Supreme compared to microbial coagulants

NIZO
FOR BETTER FOOD & HEALTH

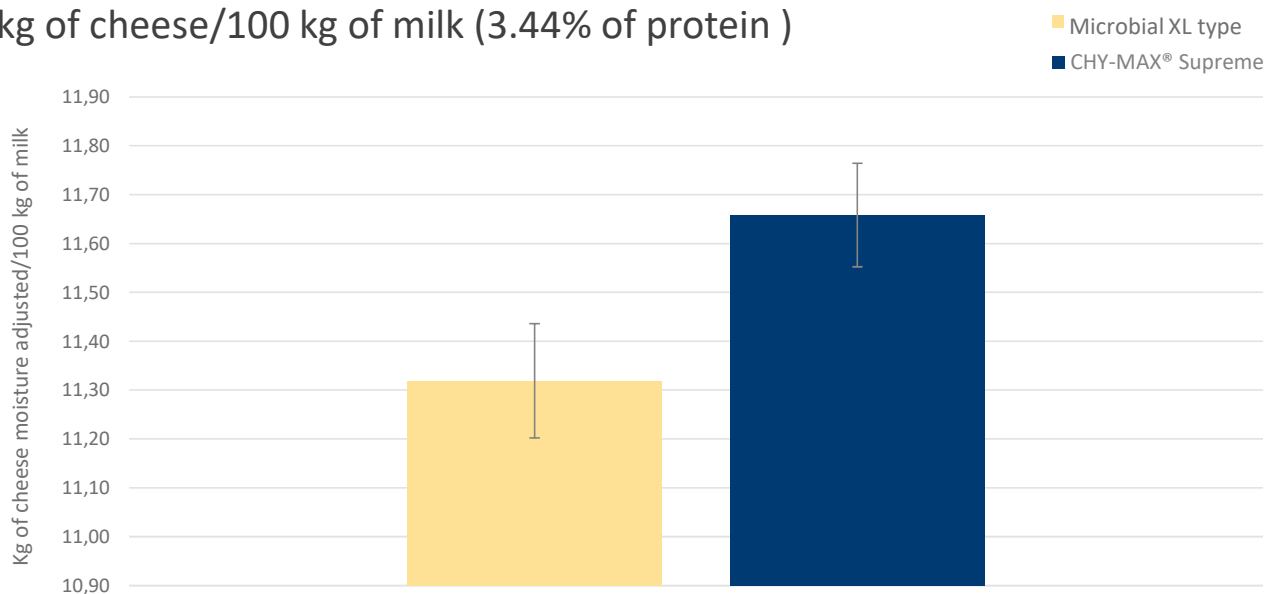
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Trials at NIZO show 2.9% yield increase with CHY-MAX[®] Supreme compared to a classic microbial coagulant

MOISTURE ADJUSTED CHEESE YIELD¹

kg of cheese/100 kg of milk (3.44% of protein)



TREND:

- › Pilot scale cheese trial (Gouda-type, foil-ripened cheeses) at the NIZO Institute (June 2018)
- › Moisture-adjusted cheese yield improves by 2.9% with use of CHY-MAX[®] Supreme compared to microbial coagulant (XL-type) due to higher fat and protein recovery in the cheese

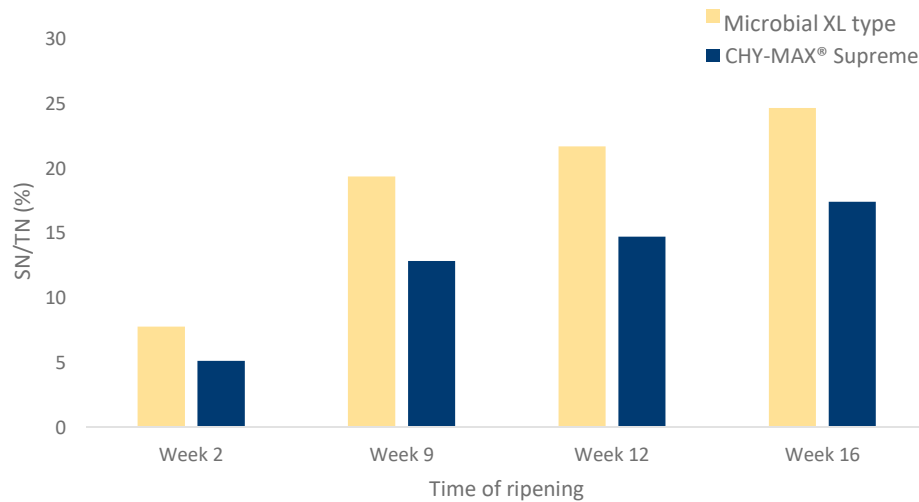
¹Trials at NIZO, 2018

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Cheeses produced with CHY-MAX[®] Supreme remains firmer in comparison to control during shelf-life due to the lower levels of proteolysis

PROTEOLYTIC ACTIVITY OVER 16 WEEKS¹

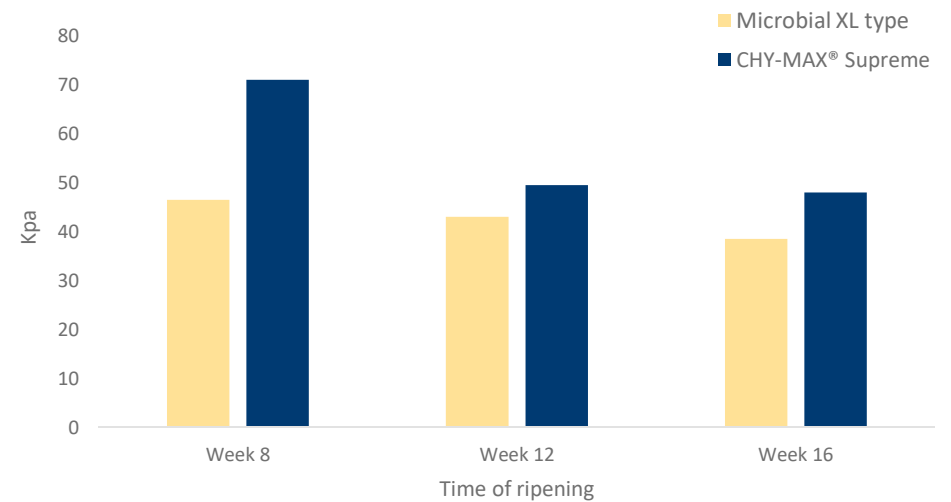
SN/TN as a function of ripening time



CHY-MAX[®] Supreme is 30% less proteolytic after 16 weeks

FRACTURE STRESS OVER 16 WEEKS¹

Fracture stress (Kpa) as function of ripening time

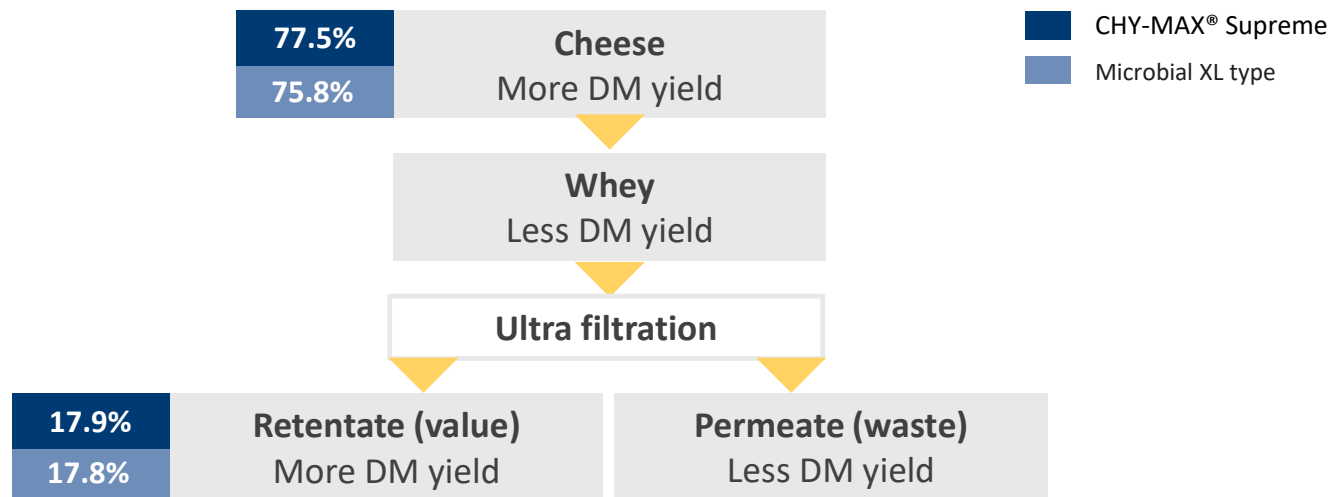


CHY-MAX[®] Supreme remains more firm compared to microbial XL type

¹Trials at NIZO, 2018
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CHY-MAX® Supreme secures 1.8% more valuable proteins than Microbial XL type

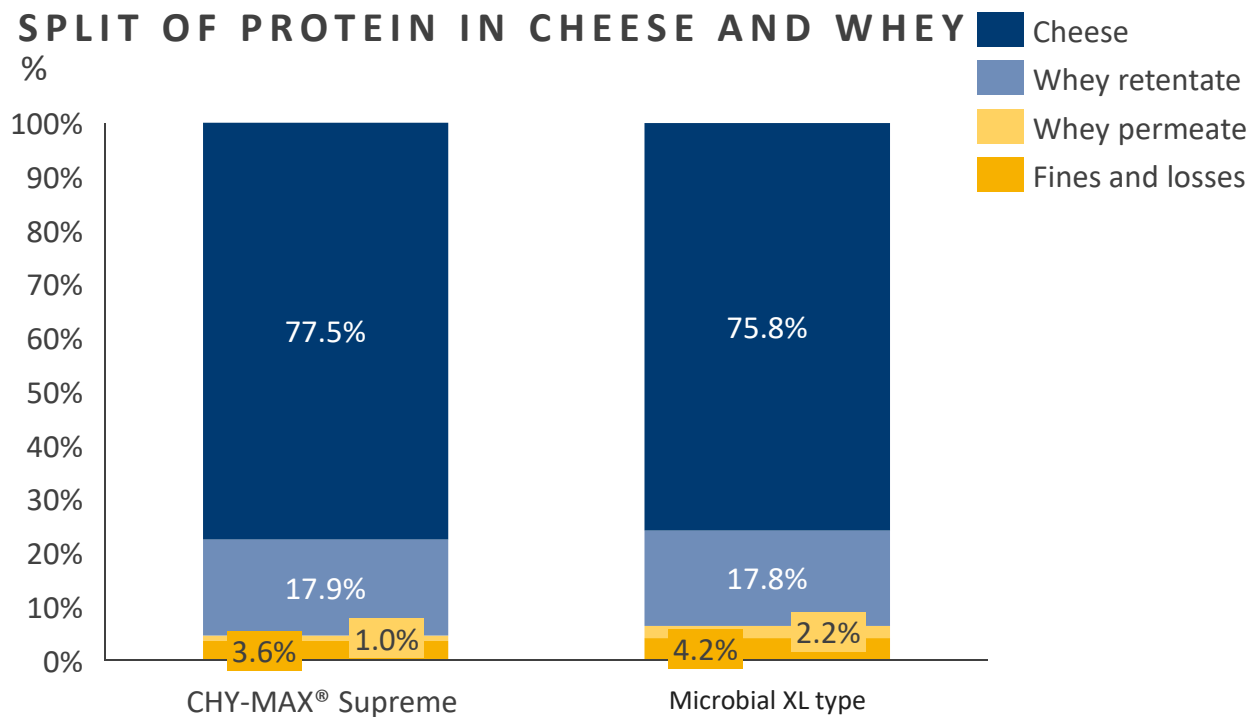
PROTEIN RECOVERY PROCESS COMPARISON¹



With CHY-MAX® Supreme higher levels of valuable proteins are retained in the cheese. Also, very low levels of protein end up in the whey permeate compared to when using other coagulants

¹ Study conducted by National Dairy School in France, Maj 2019, 450 Kg whey produced

CHY-MAX[®] Supreme increases not only yield but also proteins when cheese is produced



MORE PROTEINS WITH CHY-MAX[®] SUPREME

- › Total protein recovery (retentate and cheese):
 - › CHY-MAX[®] Supreme: 95,4%
 - › Microbial XL-type: 93,6%
- › Sum of non valuable protein (fines and losses and permeate)
 - › CHY-MAX[®] Supreme: 4,6%
 - › Microbial XL-type: 6,4%

1 Study conducted by National Dairy School in France, Maj 2019, 450 Kg whey produced

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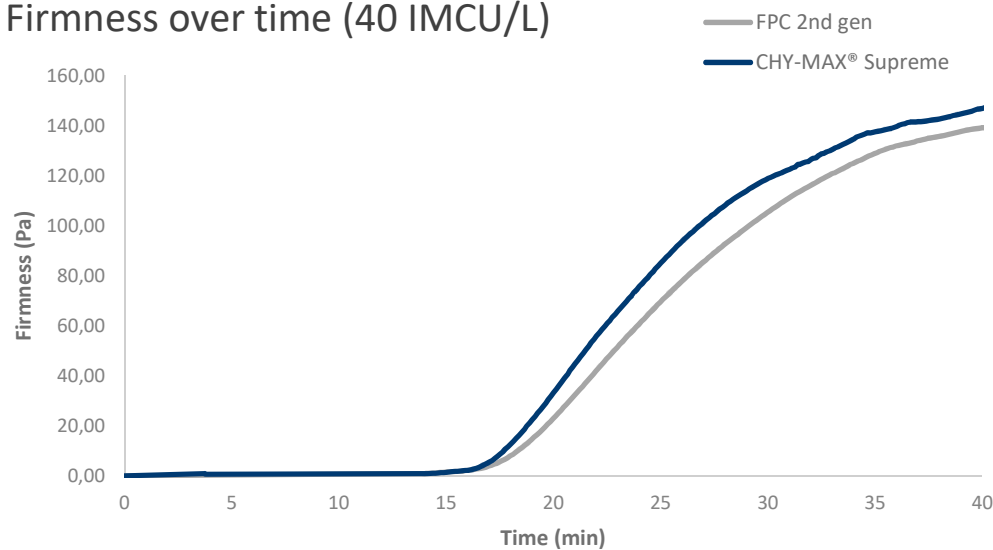
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When compared to FPC 2nd generation coagulants, CHY-MAX[®] Supreme still outperforms

When dosed properly, CHY-MAX[®] Supreme can save time and increase yield compared to FPC 2nd generation

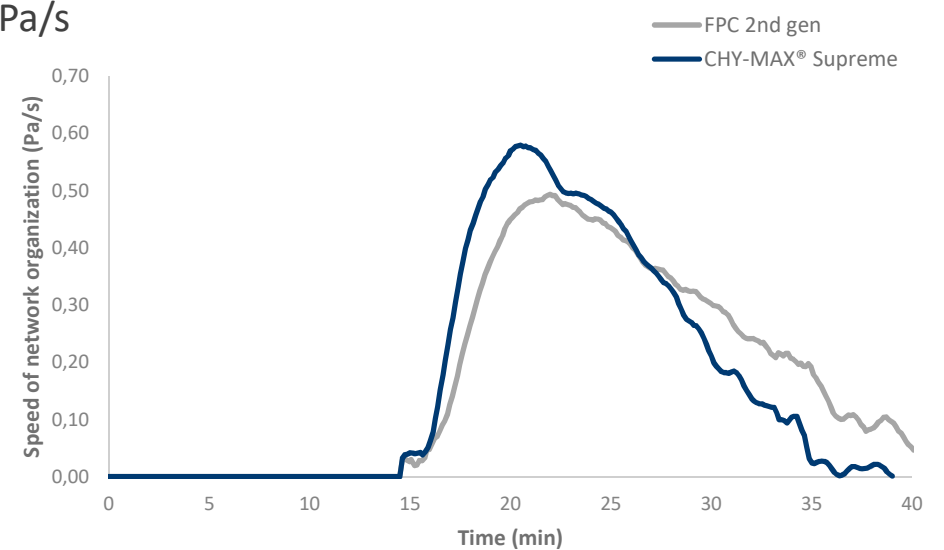
COAGULATION PROFILE¹

Firmness over time (40 IMCU/L)



NETWORK ORGANIZATION SPEED¹

Pa/s



Protein: 3.55%

pH at renneting: 6.69

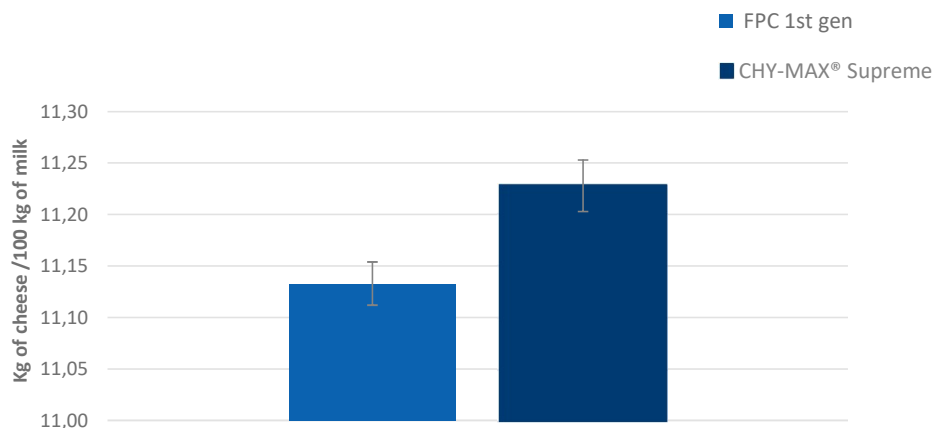
Fat: 3.90%

Temperature at renneting: 32°C

¹Trials in Chr. Hansen's facility
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The superior C/P-ratio translates to significantly higher yield compared to market leading coagulants

MOISTURE ADJUSTED CHEESE YIELD¹ kg of cheese/100 kg of milk (3,7% of protein)

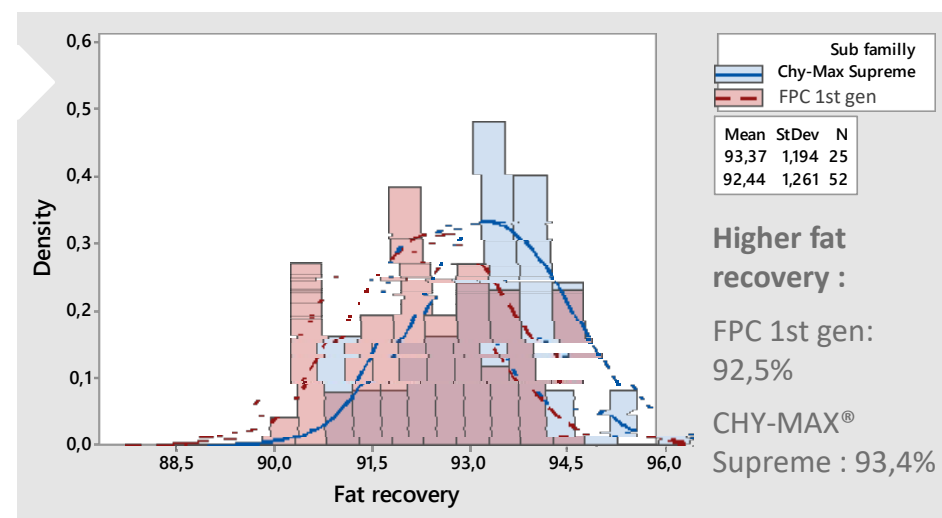


Continental cheese:

- › Customer trial: Cheese yield increasing by 0.85% (moisture adjusted, +60,000 kg produced)

¹Customer trials August, 2018

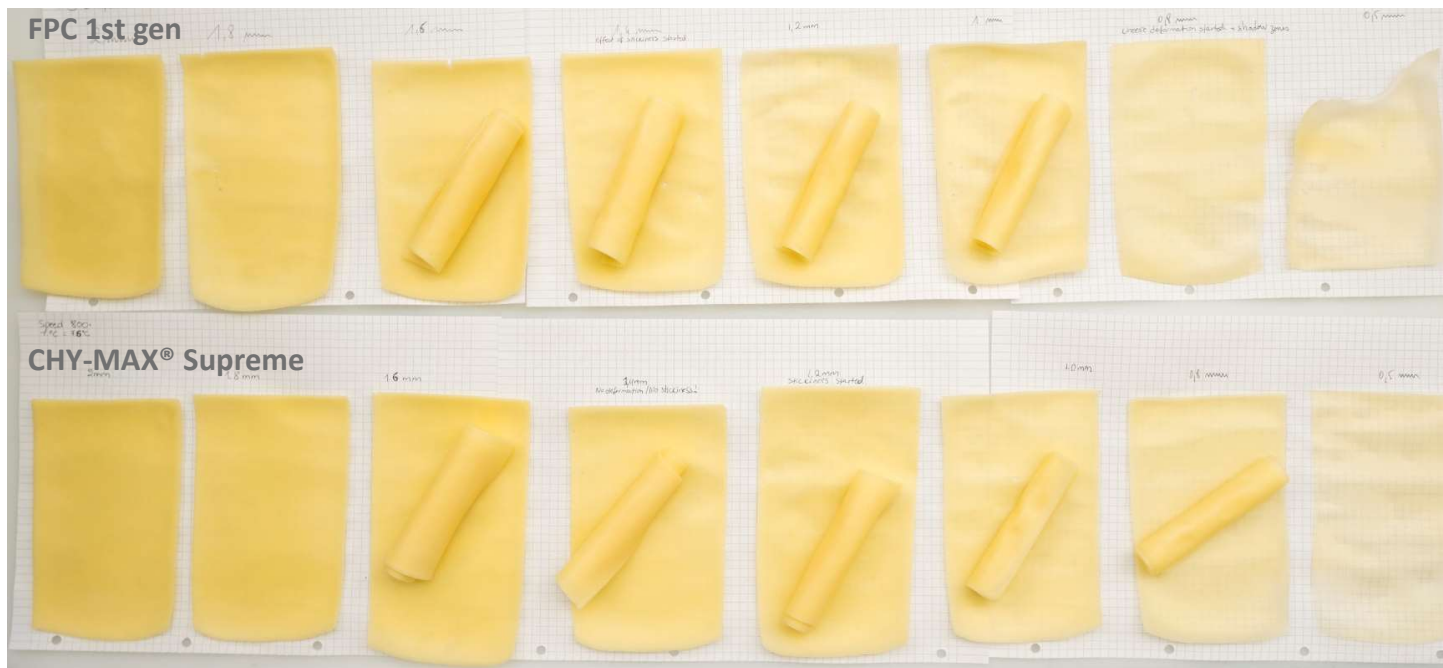
HISTOGRAM OF FAT RECOVERY¹ Density / Fat recovery



CHY-MAX[®] Supreme has better performance during slicing

SLICED CHEESE PRODUCED WITH A FPC 1st GEN COAGULANT AND CHY-MAX[®] SUPREME

Same force and same thickness applied



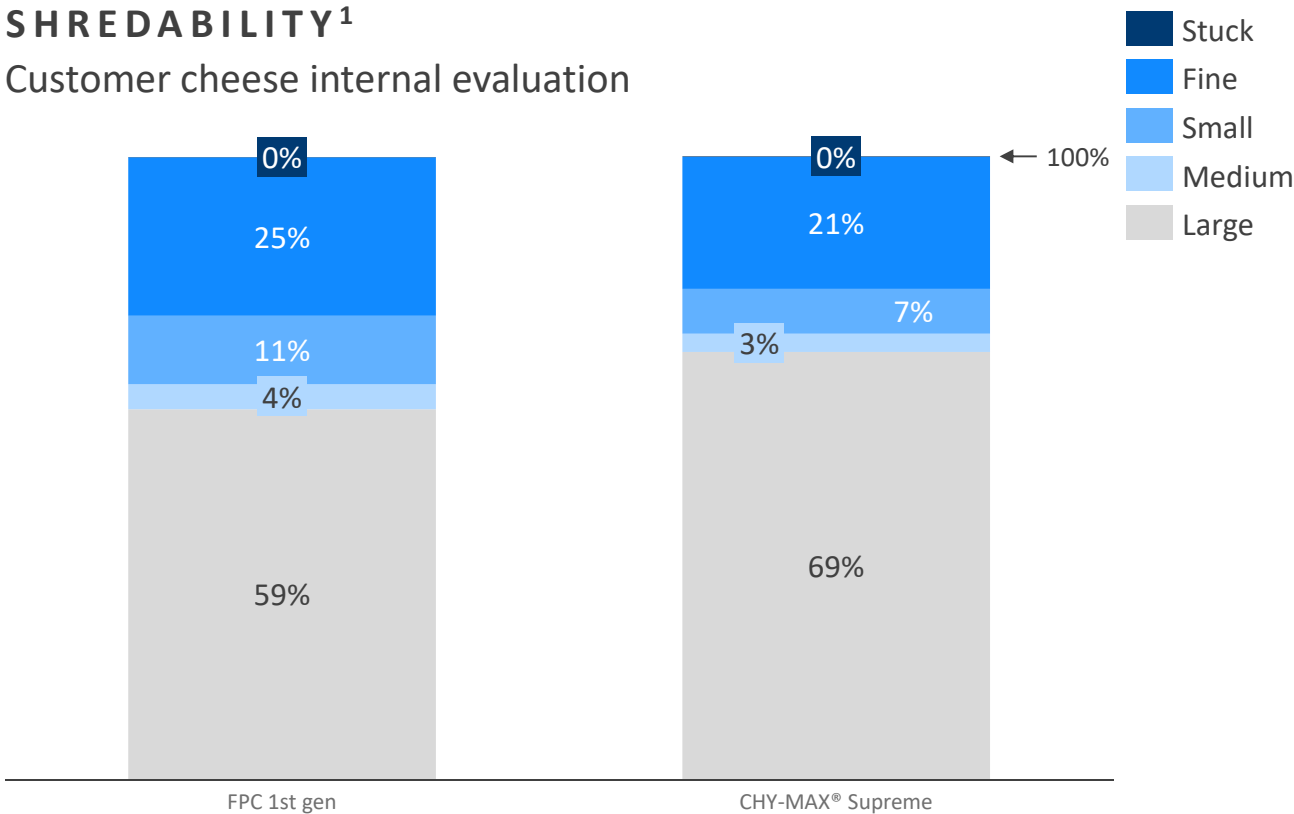
Even during ultra thin slicing, CHY-MAX[®] Supreme slices were:

- › More consistent
- › More even
- › Less deformed
- › Less sticky

We see a difference between trial and control cheese when evaluating the shredability of continental cheese

SHREDABILITY¹

Customer cheese internal evaluation



TREND

- > 16% less fines with CHY-MAX® Supreme
- > 17% more large shreds with CHY-MAX® Supreme

¹Chr. Hansen trial data: Shredding evaluation performed at Chr. Hansen using cheese produced at at customer

What is the functionality difference?



FASTER SLICING



LONGER SHELF LIFE



**LESS PAPER DIVIDERS
FOR SLICES**



**LESS STARCH FOR
SHREDDED**

- › Faster slicing means thin slices with up to **10% more cheese** processed per day¹
- › If you are slicing your cheese in an 8 hr shift, you can save over **45 minutes** and slice the same amount of cheese

It's a small change for the cheese producer that can make a big difference to cheese texture, making it easier and more efficient to cleanly slice and grate

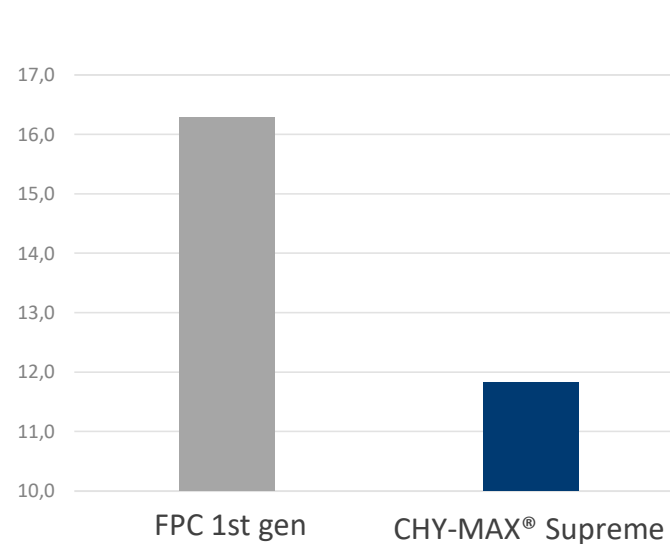
¹ Previous research conducted by Chr. Hansen



Improved whey quality

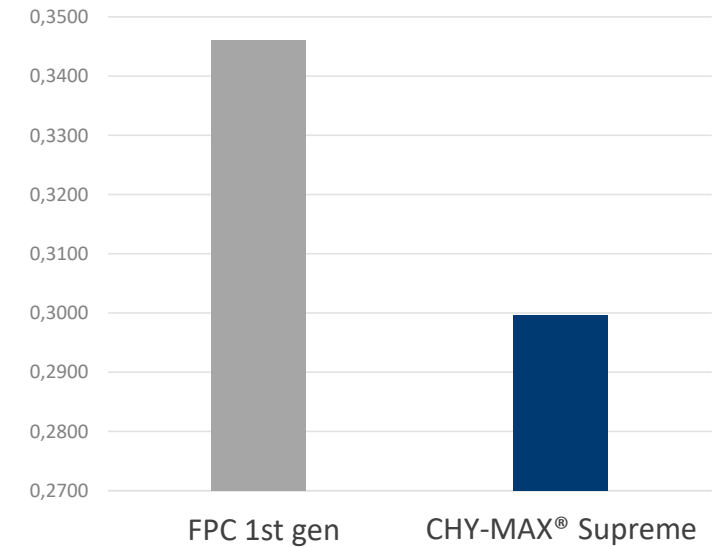
CHY-MAX[®] Supreme minimizes fines and fat in whey reducing re-processing and revenue loss

FINES IN THE WHEY¹ ml/L



**-27% fines in the whey with
CHY-MAX[®] Supreme**

FAT IN THE WHEY¹ % of total volume



**-13% of fat in the whey with
CHY-MAX[®] Supreme**

¹Customer trial producing over 300 tons of continental type cheese

With maximized value and functionality at its core,
CHY-MAX[®] Supreme delivers superior value for cheesemakers

Small change, big difference



HIGHER YIELD

Deliver up to a 1% yield increase with no compromise on flavor, functionality or whey quality



FASTER AND MORE PRECISE PRODUCTION

Process more milk and cheese in less time with faster and more precise coagulation



SUPERIOR FUNCTIONALITY

Produce thinly sliced and grated cheese with a low protein breakdown due to the reduced proteolysis