DEMYSTIFYING ADJUNCT CHEESE CULTURES

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Sr. Scientist
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DEMystifying Adjunct Cheese Cultures

AGENDA

- Origin of flavor in cheese: overview
- Principles of flavor development
- Cheese Adjuncts
  - Types and functions
- Use of Adjuncts
  - Technical Information
- Application, Dose
Origin of Flavor

- Animal
- Breed
- Diet/Season
- Milk quality
- Equipment
- Process
- Enzymes
- Microorganisms
Origin of Flavor - Animal

Composition of Milk Solids

- Cow
- Sheep
- Buffalo
- Goat
- Horse
- Human

Legend:
- Casein
- Whey Protein
- Fat
- Carbohydrates
- Ash

0 2 4 6 8 10 12 14 16 18 20 %
Origin of Flavor - Breed

**MILK COMPOSITION BY BREED**

<table>
<thead>
<tr>
<th></th>
<th>HOLSTEIN</th>
<th>BROWN SWISS</th>
<th>AYRSHIRE</th>
<th>JERSEY</th>
<th>GUERNSEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>3.6</td>
<td>3.8</td>
<td>4.0</td>
<td>5.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Casein</td>
<td>2.5</td>
<td>2.6</td>
<td>2.7</td>
<td>3.0</td>
<td>2.9</td>
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<tr>
<td>Lactose</td>
<td>4.6</td>
<td>4.8</td>
<td>4.6</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>Total Solids</td>
<td>11.9</td>
<td>12.7</td>
<td>12.7</td>
<td>14.2</td>
<td>13.7</td>
</tr>
<tr>
<td>Whey Protein</td>
<td>0.53</td>
<td>0.55</td>
<td>0.60</td>
<td>0.61</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Each breed offers different milk composition that will dramatically affect the final taste and texture of the cheese you produce.

Source: WMMB and Wikipedia
Origin of Flavor - Diet/Season

Pasture vs silage
Drought effects
Season

Amount and composition of fat.
Size of fat globules
Reduced fat \rightarrow \text{increased citrate}
Summer reduction in whey protein, lactose increased
Spring - changes in fatty acid composition
Origin of Flavor - Milk Quality

- Animal Health
  - Citrate from mastitic cows
  - Treatment
  - Plasmin levels
- Microbiological quality
  - Farm management
  - Transportation
  - Age
  - Temperature
- Handling
Origin of Flavor - Equipment/Process

- Transport
- Milk treatment
  - Standardization (F/C, P/C)
  - Pasteurization
- Culture/Ripening
- Vats/Tables
- Rennet/Coagulants/Lipases
- Cut/Heal
- Cook
- Whey removal/Washing
- Salting
- Cheese properties - moisture and composition
Origin of Flavor - Enzymes and Microorganisms

- **Animal:** Cow, Goat, Sheep (e.g. alkaline phosphatase, lactoperoxidase, LPL - lipoprotein lipase)

- **Microorganisms:**
  - Bacteria in raw milk (heat-resistant extracellular proteinases and lipases produced by psychrotrophic bacteria)
  - Bacteria in heat treated milk (thermodurics)
  - Starter cultures
  - Adjuncts
  - NSLABs

- **Enzyme preparations:**
  - Coagulants
  - Lipases
Principles of Flavor Development

24 hours
Cheese manufacture

Primary starter culture

Weeks to years
Cheese ripening

Ripening culture

Cheese ripening:
- Propionic fermentation
- Proteolysis by
  - Penicillium/
  - Geotrichum/
  - Yeast/
  - Smearing bacteria
- Lactobacillus spp

Milk → Fresh curd → Mature cheese
Principles of Flavor Development

Cheese ripening step

- Milk fat
  - Lipolysis
- Lactose and Citrate
  - Glycolysis and Citrate conversion
- Casein
  - Proteolysis

Cheese curd

Flavor

[Diagram of the cheese ripening step with milk fat, lactose and citrate, and casein as subcategories, and pathways of lipolysis, glycolysis, and proteolysis leading to flavor.]
Principles of Flavor Development

Cheese

- Milk fat
  - Lipolysis
    - Fatty acids
    - Glycerol
    - Amides
    - Ketones
    - Aldehydes
    - Lactones
    - Alcohols
    - Esters

- Lactose & Citrate
  - Glycolysis & Citrate Conversion
    - Lactic acid
    - Acetic acid
    - Diacetyl
    - Acetaldehyde
    - Propionic acid
    - Ethanol

- Casein
  - Proteolysis
    - Peptides
    - Amino acids
    - Amines
    - Sulfur compounds
    - Fatty acids
    - Aldehydes
    - Alcohols
    - Keto acids

INTERACTION PRODUCTS
- Thioesters (fatty acids + thiol compounds)
- Esters (fatty acids + alcohols)
- Lactones (heating of milk fat in presence of water)
- Amides (ammonia + ethyl esters)
- Sulfur compounds (oxidation)
- Alkyl pyrazines (amino acid + carbonyls)
- Aldehydes from Strecker degradation

Principles of Flavor Development

Casein degradation: Proteolysis

- **Proteases**
  - Coagulant
    - Microbial vs. CHY-MAX vs. CHY-MAX M
  - Dosage
  - Starter
    - PI vs. PIII
  - Adjunct
  - NSLAB

Carbon dioxide, Ammonia, Sulphur compounds, Amines, Aldehydes, Alcohols, Lactones, Keto-acids, Phenol compounds, Esters
Principles of Flavor Development

Casein degradation: Secondary peptidolysis

- Rennet
- Starter proteases
- Rennet
- Starter peptidases
- Starter and Non-starter Peptidases
- Starter and Non-starter Peptidases

- Structure and consistency
- Taste formation
- Flavor formation

- Peptidases
  - Starter, adjunct, NSLAB
  - High PepN vs. low PepN
  - Inoculation rate
  - Lysis
  - High PepX vs. low PepX

Carbon dioxide, Ammonia, Sulphur compounds, Amines, Aldehydes, Alcohols, Lactones, Keto-acids, Phenol compounds, Esters
Principles of Flavor Development

Casein degradation: Amino acids degradations

- Casein
  - Rennet
  - Starter proteases
    - Rennet
  - Starter peptidases
  - Starter and Non-starter Peptidases
- Big peptides (Not bitter)
  - Small peptides (Bitter)
- Savory peptides
- Amino acids
  - Amino acid catabolites
    - Carbon dioxide, Ammonia, Sulphur compounds, Amines, Aldehydes, Alcohols, Lactones, Keto-acids, Phenol compounds, Esters
  - Starter, adjunct, NSLAB
    - Aminotransferases
    - Decarboxylases
    - Lyases
    - Deaminases
  - Species and strain variability

Structure and consistency
Taste formation
Flavor formation

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Principles of Flavor Development

Aroma Notes derived from Amino acids

Butanoic acid
Acetic acid
Diacetyl/acetoin
Ethylbutyrate

Isovaleric acid
Isobutyric acid
Methylbutanal

Valine
Isoleucine
Leucine

Aspartate
(Fat, Lactose, Citrate)

Methionine

Tyrosine
Tryptophane
Phenylalanine

Aroma notes from Curioni & Bosset (2002)
Adjuncts for Cheese
## Aerobic ripening cultures

<table>
<thead>
<tr>
<th>Type of microorganisms</th>
<th>Function</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moulds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillium candidum</td>
<td>White Sureface Mold</td>
<td>PCA1-PCA3-PC TT033</td>
</tr>
<tr>
<td>Penicillium roqueforti</td>
<td>Blue-Green Mold</td>
<td>PR1-PR3-PR4 PRG3</td>
</tr>
<tr>
<td>Geotrichum candidum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate yeasty</td>
<td>Yeast for Flavor</td>
<td>Geo CB Geo CA Geo CD1</td>
</tr>
<tr>
<td>Intermediate mouldy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mouldy</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yeast</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debaryomyces hansenii</td>
<td></td>
<td>LAF3 LAF7 LAF4-LAF5 TRIO</td>
</tr>
<tr>
<td>Candida colliculosa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kluyveromyces marxianus subsp.marxianus Blend (Anti-mucor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bacteria</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brevibacterium linens</td>
<td>Surface reipening</td>
<td>BL1-BL2 BC SALSA1-SALSA2</td>
</tr>
<tr>
<td>Brevibacterium casei</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micrococcaceae</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Penicillium candidum

What does it bring?

Produces a coating on the curd surface

The rind protects the surface against mucors and blue/black mould contaminants

- It grows just after geotrichum
- By its strong proteolysis, it metabolises casein and peptides which softens texture
- By its lipolysis, it produces fatty acids and methylketoens with strong flavor contribution
Penicillium roqueforti

What does it bring?

- Produces blue green veins in the curd

- Appears late in the ripening process (only visible after 15 days)
  By its strong proteolysis, it metabolises casein and peptides which softens texture

- By its lipolysis, it produces fatty acids and methylketones with strong flavor contribution
Geotrichum candidum

What does it bring to the cheese?

- It generates a coating on the curd surface
- The rind protects the surface against mucors and blue/black mold contaminants
- It avoids the excess of growth of \( P.\) candidum

- By means of its peptidase activity it de-bitters curd
- By its consumption of lactate, it neutralizes curd
  → it reduces the potential activity of acid proteases
  → it allows the growth of micrococcaceae and brevibacterium
- By means of its proteolytic, lipolytic activities and its amino acid catabolism, it brings various flavors: animal, cowhouse, fresh whey....

Appearance of the mycelium on curd (+anatto) after 12 days
Yeast

What does it bring?

- It generates a bio-film at the surface of the curd
- In some cases, it can inhibit mold contaminants.

- Fermenting yeast produce CO$_2$, alcohols which combine to fatty acids to generate esters (Fruity flavour)
- Non fermenting yeast consume lactate and neutralise curd → allow the growth of acid-sensitive bacteria.

Neutralisation on model cheese

Taste and flavor trends

- Sulphur (cabbage/garlic)
- Fermented (bread/cakes)
- De-bittering
- Sweet
- Cheesy
- Ammonia
- Mushroom
- Cellar
- Fresh sour (yoghurt/kiwi)

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Smear bacteria

What does it bring?

- It generates a bio-film at the surface of the curd.
- It colors the curd: on the whole surface (smeared cheese) or on a light layer (White and orange rind).

- Amino-peptidase activity reduces bitterness.
- By their metabolism on amino acid, they bring strong flavor (sulphur compounds by *B. linens* and thio-esters by *S. xylosus*).
## Anaerobic ripening cultures

<table>
<thead>
<tr>
<th>Culture Series</th>
<th>Performance</th>
<th>Product Form</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>CR 200/300</td>
<td><img src="image1.png" alt="De-bittering icon" /></td>
<td><img src="image2.png" alt="Sweetness icon" /></td>
</tr>
<tr>
<td>CR 500/FX-200</td>
<td><img src="image1.png" alt="De-bittering icon" /></td>
<td><img src="image2.png" alt="Sweetness icon" /></td>
</tr>
<tr>
<td>LH/EMFOUR</td>
<td><img src="image1.png" alt="De-bittering icon" /></td>
<td><img src="image2.png" alt="Sweetness icon" /></td>
</tr>
<tr>
<td>PS</td>
<td><img src="image1.png" alt="De-bittering icon" /></td>
<td><img src="image2.png" alt="Sweetness icon" /></td>
</tr>
<tr>
<td>ENZOBACT</td>
<td><img src="image1.png" alt="De-bittering icon" /></td>
<td><img src="image2.png" alt="Sweetness icon" /></td>
</tr>
</tbody>
</table>
CR 200/300 series

† The range CR 200 and 300 are composed of *Lactococcus lactis* spp *lactis* selected for their ripening properties.

<table>
<thead>
<tr>
<th>Culture</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR 213</td>
<td>Lac-, standardized in leu-pNa activity, debittering</td>
</tr>
<tr>
<td>CR 312</td>
<td>Lac-, high aminopeptidasic activity, debittering</td>
</tr>
<tr>
<td>CR 319</td>
<td>Lac+(slow), prt-: No proteinase activiy High aminopeptidasic activity, High autolysis, debittering</td>
</tr>
</tbody>
</table>

Reduction of hydrophobic peptides
LH series

- The LH range allows to increase ripening speed
- LH give matureness and sweetness

Reduction of hydrophilic and hydrophobic peptides by LH-B02

<table>
<thead>
<tr>
<th>culture</th>
<th>features</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHB01</td>
<td>Low proteolytic activity</td>
</tr>
<tr>
<td>LHB02</td>
<td>High proteolysis, Increases mature flavor and sweetness</td>
</tr>
<tr>
<td>LH-32</td>
<td>High proteolysis, high Pep-X activity (autolysis), Increases mature/cowhouse flavor</td>
</tr>
<tr>
<td>EMFOUR</td>
<td>Increases mature flavor, malt/nutty flavor</td>
</tr>
</tbody>
</table>

High increase of Soluble nitrogen with LHB02 and LH32
# CR-500 series: Power and balance

<table>
<thead>
<tr>
<th>CR-520</th>
<th>Features</th>
<th>Application</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Medium proteolysis</td>
<td>Complex cheese flavor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>→ Continental/Cheddar</td>
</tr>
<tr>
<td>CR-530</td>
<td>High aminopeptidasic activity</td>
<td>Increases mature flavor and nutty notes</td>
</tr>
<tr>
<td></td>
<td>High amino-acids catabolism</td>
<td>→ Continental/Cheddar</td>
</tr>
<tr>
<td>CR-540</td>
<td>High end acidification</td>
<td>Highly flavoring</td>
</tr>
<tr>
<td></td>
<td>High proteolysis</td>
<td>Fruity, nutty</td>
</tr>
<tr>
<td></td>
<td>High aminopeptidasic activity</td>
<td>→ Continental/Cheddar/Propionic cheeses/</td>
</tr>
<tr>
<td></td>
<td>High temperature resistance</td>
<td>hard cheeses</td>
</tr>
<tr>
<td>CR-550</td>
<td>No acidification</td>
<td>Increases broth/bouillon flavor</td>
</tr>
<tr>
<td></td>
<td>Low proteolysis</td>
<td>→ Soft and semi soft cheeses/Continental</td>
</tr>
<tr>
<td></td>
<td>High aminopeptidasic activity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High amino-acids catabolism</td>
<td></td>
</tr>
</tbody>
</table>
CR-500: power and balance

Sensory profile
Low fat continental cheese, 9 weeks old

Recommended dosage: 0.005-0.02%
DVS® Full Flavor

DVS® CR-Buttery 01
10X500 U Material 710314
For young cheeses / Mesophilic & Thermophilic cultures
Fresh buttery & Malt Chocolate flavor
Dose 500U/5000 ltr. milk

DVS® CR-Mature 01
10X500 U Material 710315
For all cheeses / Mesophilic & Thermophilic cultures
Farmhouse & savory notes
Dose 500U/5000 ltr. milk

DVS® CR-Bouquet 01
10X500 U Material 710317
For all cheeses - Mesophilic & Thermophilic cultures
Fresh fruity and nutty flavor
Dose 500U/5000 ltr. milk
DVS® Full Flavor

DVS® Building Blocks

Final products

DVS® CR-Bouquet 01

DVS® CR-Mature 01

DVS® CR-Buttery 01

DVS®

CR-Buttery 01

DVS®

CR-Mature 01

DVS®

CR-Bouquet 01

Debittering
Fruity
Nutty/Sweet
Sweet
Diacycle/buttery
Farmhouse
Onion
Roasted
Caramelized

Debittering
Fruity
Nutty/Sweet
Sweet
Diacycle/buttery
Farmhouse
Onion
Roasted
Caramelized

Debittering
Fruity
Nutty/Sweet
Sweet
Diacycle/buttery
Farmhouse
Onion
Roasted
Caramelized
Impact of primary mesophilic culture: Flavor, texture and appearance

Flora Fresh: High diacetylactis ➔ creamy/buttery taste ➔ high growth of the PC

Flora Danica: Higher post acidification ➔ higher proteolysis from the PC ➔ Very soft texture

Flora Tradi: Slow acidification slope ➔ High Leuco ➔ less growth of the PC ➔ traditional appearance
Application of Adjuncts

- How to use different adjuncts?
- What dose do I use?
- Where do I get adjuncts and guidance?
Application of Adjuncts

- Information from:
  - Product Specification Sheets
  - Product Technical/Information Sheets
  - My culture supplier
# Technical Sheets - product specification

**FD GEO CH\10U**

**Product Specification**

**Format**
- **Form:** Freeze-dried SWING
- **Item no:** 683643
- **Culture Composition:** Geotrichum candidum

**Identification**

**Performance**
- **Total cell count spores/U**

**Purity**
- Coagulase-positive staphylococci cfu/g
- Coliforms cfu/g
- Enterobacteriaceae cfu/g
- Enterococci cfu/g
- Foreign moulds cfu/g
- Foreign yeasts cfu/g
- Mesophilic aerobic total count cfu/g
- Listeria monocytogenes *
- Salmonella spp. *

**Strength/Activity**

<table>
<thead>
<tr>
<th>Specification</th>
<th>&lt;=5.6E+7</th>
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<tbody>
<tr>
<td><strong>Specification</strong></td>
<td>&lt;=1</td>
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<tr>
<td>&lt;=1</td>
<td>&lt;=10</td>
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<tr>
<td>&lt;=10</td>
<td>&lt;=10</td>
</tr>
<tr>
<td>&lt;=100</td>
<td>&lt;=500</td>
</tr>
</tbody>
</table>

**QC Specs**

* Environmental and statistically based product testing is carried out on an ongoing basis, details can be supplied on request.
**SWING GEO CH**

Product Information  
Version: 1 PI-EU-EN 12-12-2012

<table>
<thead>
<tr>
<th>Description</th>
<th>A selected single strain ripening culture with origin in traditional French cheese making. The SWING® GEO cultures contributes to the flavor, texture, and appearance of cheese. The culture is available as a conidia suspension.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxonomy</td>
<td>Geotrichum candidum</td>
</tr>
<tr>
<td>Packaging</td>
<td><strong>Material No:</strong> 683643  \  <strong>Size:</strong> 10 U  \  <strong>Type:</strong> Pouch(es) in box</td>
</tr>
<tr>
<td>Physical Properties</td>
<td><strong>Color:</strong> Colorless  \  <strong>Form:</strong> Freezedried</td>
</tr>
</tbody>
</table>
Technical Sheets - product information

Dose

Usage
The culture may be used in production of many types of cheeses including white mold surface (e.g. Camembert type), smeared and mixed rind, soft and semi-hard, and blue mold cheeses.

Suggested dosage
1U to 2U /1000 l of milk or 100 kg cheese.

Directions for Use
Add the culture to the milk before renneting and/or apply to the surface of the cheese a few hours after salting, by spraying or washing. For direct milk inoculation, which is the recommended inoculation method (except for veined cheeses), no particular cautions are required.
For surface application:
1) Dilute the suspension in sterile water with 1% salt (NaCl)
2) Shake well before use.
A prepared dilution using one litre of water is sufficient for about 250 kg of cheese, and should be used on the day of preparation.

Range
Several strains with diverse attributes can be found in the SWING® range. Please contact your local sales representative for further information.

Storage and handling
< -18 °C / < 0 °F

Shelf life
At least 6 months from date of manufacture when stored according to recommendations.
Technical Sheets - product information

*Geotrichum candidum* contributes to the ripening in different ways:

- Characteristic appearance of the cheese.
- Flavour and texture (proteolysis and lipolysis).
- Neutralisation of the curd.
- Stimulates red smear cultures by curd neutralisation.
- Moderates the growth and proteolytic activity of *Pencilium candidum*.
- Reduces bitter off flavours.
- Inhibits the growth of numerous mould contaminants (*Mucor*, blue mould etc).
Technical Sheets - product information

Flavor profile
Taste and flavor trends of the strain.
Evaluation of flavor and taste made on model cheese ripened at 12°C.
### Technical Sheets - product information

<table>
<thead>
<tr>
<th>Physiological Data</th>
<th>GEO CA</th>
<th>GEO CB</th>
<th>GEO CD-1</th>
<th>GEO CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspect on cheese</td>
<td>medium</td>
<td>medium</td>
<td>mouldy</td>
<td>yeasty</td>
</tr>
<tr>
<td>Aminopeptidase activity</td>
<td>high</td>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Proteolytic activity</td>
<td>medium</td>
<td>medium</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>Lipolytic activity</td>
<td>high</td>
<td>high</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>Salt effect</td>
<td>medium</td>
<td>high</td>
<td>high sensitivy (above 2%)</td>
<td>medium</td>
</tr>
<tr>
<td>Temperature effect</td>
<td>min. 4°C, max. 38°C, opt. 30°C</td>
<td>cowshed flower slight sulphur</td>
<td>neutral (allows cheese ageing)</td>
<td>milk, whey, sweet</td>
</tr>
<tr>
<td>Flavour profile</td>
<td>animal</td>
<td>nutty</td>
<td>slight sulphur</td>
<td>neutral (allows cheese ageing)</td>
</tr>
</tbody>
</table>
F-DVS CR-BOUQUET01

Product Information
Version: 3 Pf: EN 0815 2013

Description:
A defined adjunct culture blend which enhances the overall flavor intensity of the cheese by accentuating important flavor notes. It enhances the balanced, mellow, rounded and clean flavors and suppresses unwanted flavors like sour, bitter and flat. The culture contains a spoilage producing strain for promotion of bacteria types.

Taxonomy:
Lactobacillus delbrueckii subsp. lactis
Lactococcus lactis subsp. cremoris
Lactococcus lactis subsp. lactis
Lactobacillus plantarum

Packaging:
Material No: 712517
Size: 10000 U
Type: Bag(s) in box

Physiological Properties:
Color: Off-white to slightly reddish or brown
Form: Frozen pellets

Application:
The culture is primarily applied in the production of cheeses where normally mesophilic lactic acid bacteria are used. This culture is particularly used in Circular, Continental cheeses (mozzarella, low-fat cheese and cheese containing vegetable fat).

Recommended inoculation rate:
- Amount of milk to be inoculated: 2,500 U, 10,000 U, 20,000 U
- Amount of DVS culture: 510 U, 1,400 U, 2,000 U

Directions for Use:
Remove culture from the freezer just prior to use. Do not thaw. Disrupt the package prior to opening. Open the package and pour the frozen pellets directly into the pasteurized product. Agitate the mixture slowly for 10-15 minutes to distribute the culture evenly. For more information on specific applications please refer to our technical brochures and suggested recipes.

Storage and Handling:
< -40 °C / < -40 °F

Shelf Life:
At least 12 months from date of manufacture when stored according to recommendations.

Technical Data:
Acidiﬁcation curve:

Fermentation conditions:
Lab: 95 % (24 °C / 75 °F)
Inoculation rate: 500 / 1000 U

Analysis Methods:
References and analytical methods are available upon request.

Legislation:
Chr. Hansen's cultures comply with the general requirements on food safety laid down in Regulation 178/2002/EC. Lactic acid bacteria are generally recognized as safe and can be used in food; however, for specific applications we recommend to consult national legislation.

The product is intended for use in food.
How to Use, Dose?

- Use guidelines from Technical Sheet for “how to use”
- Start with recommended dose from Technical Sheet
- What units? grams, mLs, cell numbers, activity, units?
- In how much milk?
  - 1-2Units/100L of milk or 100kg of cheese
  - 500U/5000L milk
- **Record** how much you used, how you used it, and document your success ........ so you can repeat or improve next time.........
Some Adjunct Suppliers

- Fromagex: https://www.fromagex.com/
- Cheesemaking Supply Company: http://www.cheesemaking.com/
- Dairy Connection Inc.: http://www.dairyconnection.com/
- CHR Hansen: http://www.chr-hansen.com/
- Midwest Supplies: http://www.midwestsupplies.com/
- DSM: http://www.dsm.com/