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Yogurt & Fermented Dairy Products
Process fundamentals

What Are Fermented Dairy Products?

Fermented dairy products are made by adding live microorganisms to milk, which converts lactose into lactic acid.

Main examples:

Yogurt

Greek Yogurt

Skyr

Sour Cream

Kefir

Drinkable Yogurt

Why fermented dairy matters ?

VALUE-ADDED TRANSFORMATION OF MILK

IMPROVED SHELF LIFE & FOOD SAFETY

TEXTURE DEVELOPMENT THROUGH PROTEIN STRUCTURING

HIGH CONSUMER DEMAND (PROTEIN, GUT HEALTH, CLEAN LABEL…)

STRONG MARGIN CATEGORY IN DAIRY

The science

What Happens During Fermentation?

MILK (PH 6.6) → BACTERIA CONSUMES LACTOSE → LACTIC ACID IS PRODUCED → PH DROPS TO 4.6 (ISOELECTRIC POINT) → MILK PROTEIN COAGULATES

What does fermentation changes in the milk ?

Parameter	Before fermentation	After fermentation
PH	~6.6 (neutral)	~4.6
Protein structure	Proteins dispersed	Casein aggregation
Texture	Liquid structure	3D gel network

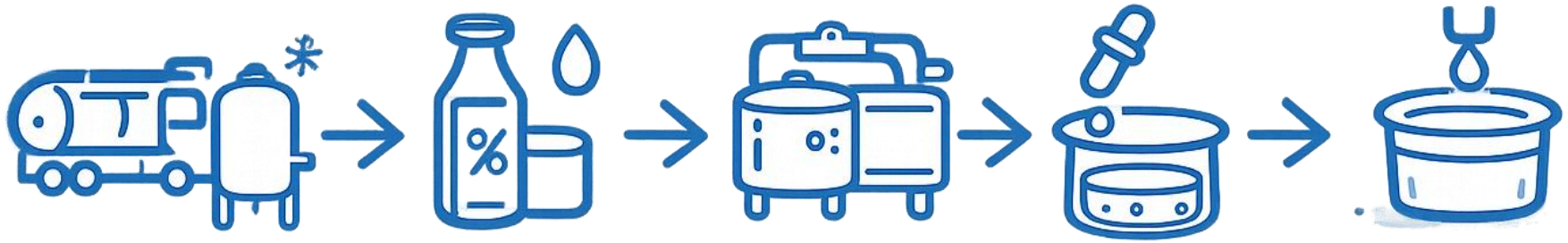
Fermented dairy products comparison

Parameter	Yogurt	Greek Yogurt	Skyr	Kefir	Drinkable Yogurt
Main Cultures	LAB (*S. thermophilus* + *L. bulgaricus*)	LAB (same as yogurt)	Icelandic LAB strains	LAB + Yeasts	LAB (same as yogurt)
Fermentation Temp	42–45°C	42–45°C	40–43°C	20–30°C (lower)	42–45°C
Whey Removal	No	Yes (straining or UF)	Yes (curd cutting + straining)	No	No
Protein Level	Moderate	High	Very High	Low–Moderate	Moderate (can vary)
Texture	Smooth / Gel	Thick / Creamy	Dense / Structured	Drinkable	Fluid / Smooth
Gas Production	No	No	No	Yes (CO_2)	No
Alcohol Formation	No	No	No	Trace amounts	No
Positioning	Classic cultured dairy	High-protein	High-protein / Low-fat	Probiotic beverage	On-the-go / Beverage format

Traditional Yogurt manufacturing process

Overview of Manufacturing Steps

1. Milk Standardization
2. Homogenization & Pasteurization
3. Inoculation & Fermentation
4. Cooling & mixing
5. Filling & Packaging



Step 1: Milk Standardization

Objectives:

- Control fat-to-protein ratio
- Reduce whey separation

Methods

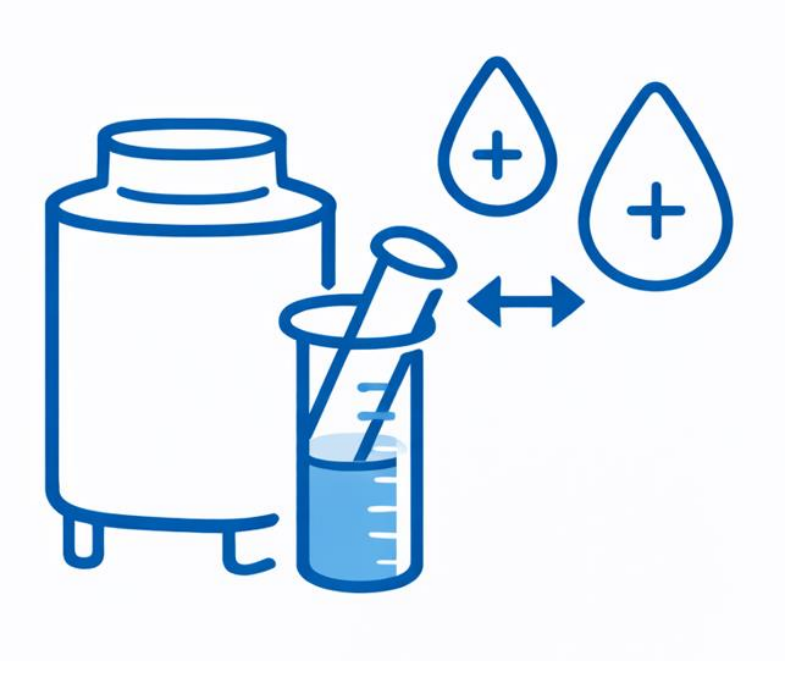
- Cream separation
- Skim milk powder addition
- Ultrafiltration

Engineering relevance

- Direct impact on viscosity & yield

Sales relevance

- Reduces product variation complaints
- Improves texture



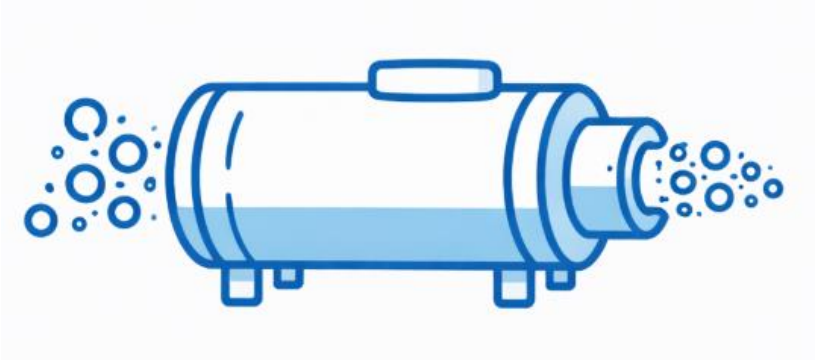
Step 2: Homogenization

Objectives:

- Reduce fat globule size
- Prevent cream separation
- Improve texture & mouthfeel
- Enhance emulsion stability

Methods

- High-pressure homogenization (2,000–3,000 psi)
- Two-stage homogenization
- Valve-type homogenizer



Engineering relevance

- Influences heat transfer & fermentation behavior
- Impacts viscosity

Sales relevance

- Direct impact on viscosity & yield

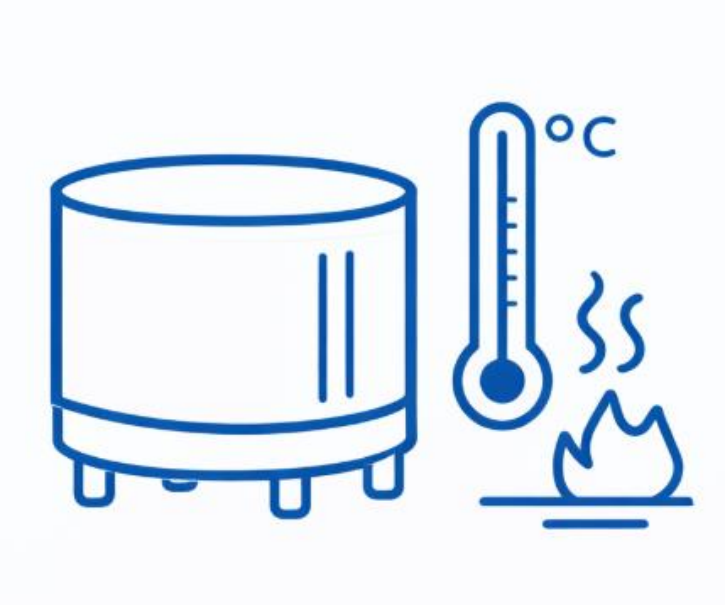
Step 3: Pasteurization

Objectives:

- Destroy pathogenic microorganisms
- Ensure product safety
- Denature whey proteins
- Improve final gel strength

Methods

- High-temperature batch treatment (~185°F, 5–10 min typical)
- Plate heat exchanger systems
- Controlled time–temperature profile
- Holding tube / legal pasteurization controls



Engineering relevance

- Impacts protein functionality & gel network formation
- Ensures regulatory compliance

Sales relevance

- Enables shelf-life optimization

Step 4: Inoculation & Fermentation

Objectives:

- Introduce active starter cultures
- Ensure controlled acidification
- Achieve desired texture profile
- Build & stabilize gel structure

Inoculation :

- Addition of direct-vat-set (DVS) or bulk starter cultures
- Controlled dosing system (manual or automated)
- Gentle mixing for uniform distribution

Fermentation:

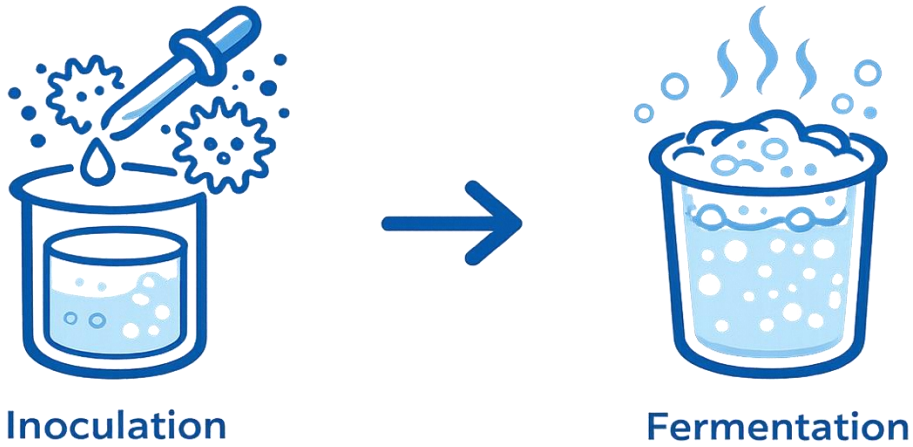
- Incubation at ~100°F (thermophilic cultures)
- Continuous pH monitoring
- Fermentation time: 4–12 hours typical

Engineering relevance

- Precise dosing controls fermentation curve
- Temperature & pH endpoint define final viscosity

Sales relevance

- Defines flavor & texture differentiation



Step 4: Inoculation & Fermentation

Production styles:

SET-STYLE

- Fermented in final cup (fermentation chamber)
- No post-fermentation agitation
- Static incubation → firmer gel

STIRRED

- Fermented in tank
- Agitated after fermentation
- Pumped to filler

Step 5: Cooling & Shear Impact

Objectives:

- Rapidly stop fermentation
- Stabilize final pH
- Preserve gel structure
- Achieve target texture profile

Methods

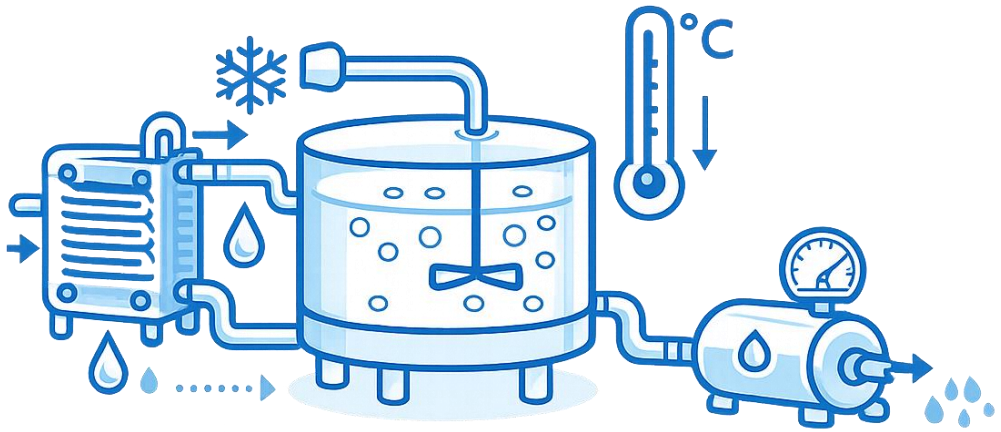
- Rapid cooling via plate or tubular heat exchanger
- Controlled agitation during cooling
- Shear management through mixer speed control
- Positive displacement pumps (low shear transfer)

Engineering relevance

- Pump selection critical for texture preservation
- Cooling rate impacts final viscosity

Sales relevance

- Reduces risk of over-acidification defects
- Protects premium texture claims



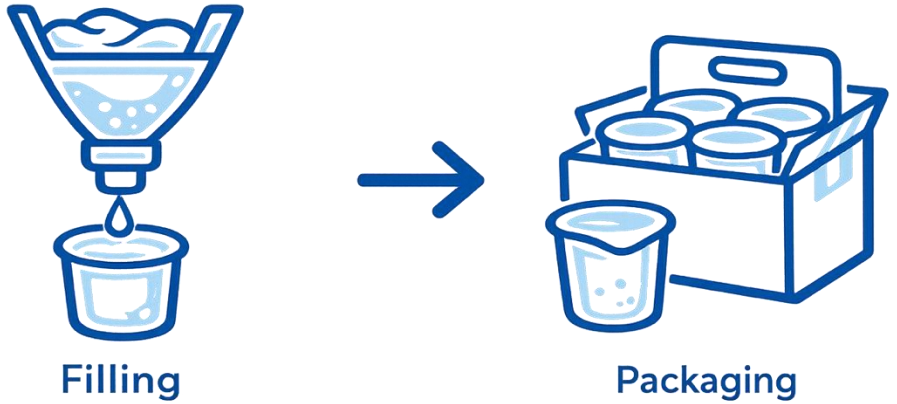
Step 6: Filling & Packaging

Objectives:

- Preserve product integrity after fermentation
- Incorporate flavors, fruit, or sweeteners
- Ensure hygienic, accurate portioning
- Prepare product for distribution

Methods

- Fruit / sugar addition (pre- or post-fermentation)
- Static or dynamic inline mixing
- Smoothing valve (texture refinement)
- Hygienic filling system (cup, bottle, pouch)
- Sealing & secondary packaging



Engineering relevance

- Mixing method impacts shear & final texture
- Flavor addition timing affects fermentation kinetics

Sales relevance

- Enables product line diversification (fruit-on-bottom, blended, drinkable)
- Impacts cost-per-unit & production speed

Other fermented dairy products production

Product	What's Different VS typical yogurt	Key Process Lever	Equipment Impact	Market Impact
Greek / High-Protein Yogurt	• Higher protein concentration • Thicker texture	Whey removal after fermentation (straining / centrifugation) OR ultrafiltration before fermentation	• Additional separation system • Higher viscosity handling • Whey management required	• Premium positioning • High-protein claim • Higher price per unit
Skyr	• Very high protein-to-fat ratio • Dense, creamy texture • Mild acidity	• Low-fat milk base • Curd cutting + straining • Extended fermentation	• Curd knives or cutting system • High-capacity straining • Robust agitation control	• Lean, high-satiety product • Strong health positioning • "Clean protein" branding
Kefir	• Mixed culture (LAB + yeasts) • Slight effervescence • Drinkable viscosity	• Lower incubation temperature • CO_2 production • Minor alcohol formation	• Pressure-tolerant tanks • Degassing control • Gentle mixing & hygienic bottling	• Functional beverage category • Probiotic/gut-health focus • High growth niche segment

Critical control points for every products

Parameter	Why it matters	How do we control it ?
Temperature	Controls fermentation speed	• Jacketed tanks • HTST control loops • Automated temperature PID control
pH	Determines texture & flavor	• Continuous monitoring • Automated fermentation stop (cooling trigger)
Solids content	Influences viscosity & yield	• Standardization step • Ultrafiltration • Density / solids measurement
Homogenization pressure	Impacts creaminess & stability	• 2 or 3 stage homogenizer • Pressure control valves • Recipe-based setpoints
CIP	Prevents contamination	• Validated CIP cycles • Conductivity & temperature verification • Automated cleaning sequences

Innovations & trends

Health Driven Cultured products

MICROBIOME ENGINEERING
- Added probiotic strains
- Symbiotic formulations

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PROBIOTIC PRODUCTS
- Gut health & immune support

FIBER FORTIFICATION
- Soluble fiber fortification
- Adjusted viscosity

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FIBER ENRICHED PRODUCTS
- Digestive health claim
- Nice body & mouthfeel

TEXTURE ENGINEERING
- EPS starter culture
- Stabilizer reduction

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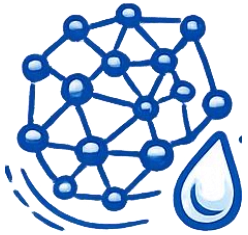
CREAMY PRODUCTS
- Clean label



PROTEIN ENHANCEMENT
- UF/Protein concentration
- Higher total solids

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HIGH PROTEIN PRODUCTS
- Sport & GLP1 positioning

SPECIALTY MILK
- A2/Grass Fed / Lactose free/ regenerative

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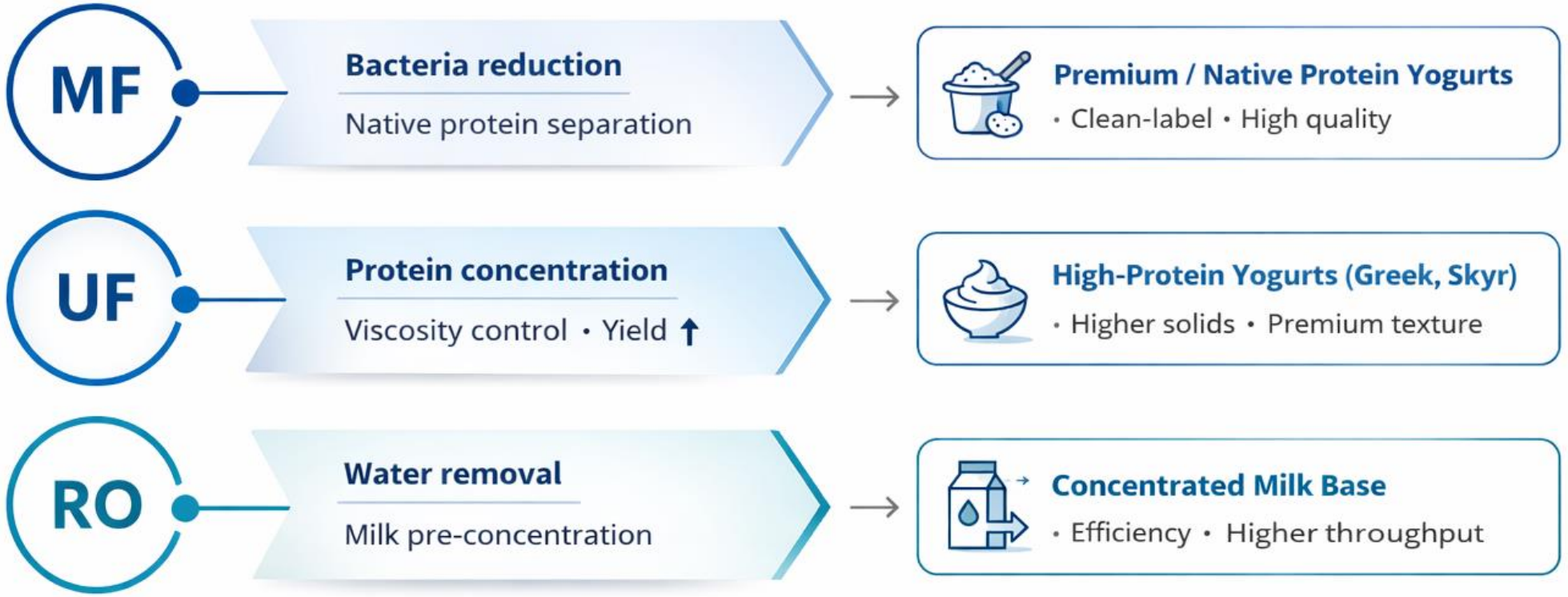
A2/SPECIALISED PRODUCTS
- A2: Easier to digest
- Grass Fed:
- Lactose intolerant clientele
- Regenerative:

Health-driven formulation is redefining dairy product to a functional nutrition platform.

Innovations & trends

Membrane strategy in Fermented dairy processing



Membrane selection is now a key driver of product positioning, plant economics and sustainability.

Key takeaways

Fermentation is controlled protein transformation
Texture, viscosity and flavor are engineered outcomes.

Process defines product identity
Small parameter shifts create completely different products.

Equipment drives positioning

Membranes, mixing systems and cooling strategy are product differentiation tools, not just utilities.

Health-driven yogurt is a formulation platform
Innovation now happens at the intersection of microbiology and processing.

Fermented dairy is a value-creation category
Offers Premium positioning, functional claims and strong margins

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