Yoghurt

Production Technology Principles

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March 2/2017

Define the Product

- Choose the yoghurt type
- Stirred type
- Set type
- Fat content
- Shelf life
- Package
- The type determines the process design

Yoghurt Types

Set

The yoghurt is filled as a liquid at pH6.7

Fermentation takes place in the cup

The timing of the process is critical to its success

Stirred

The yoghurt is filled as a viscous solid at pH4.3

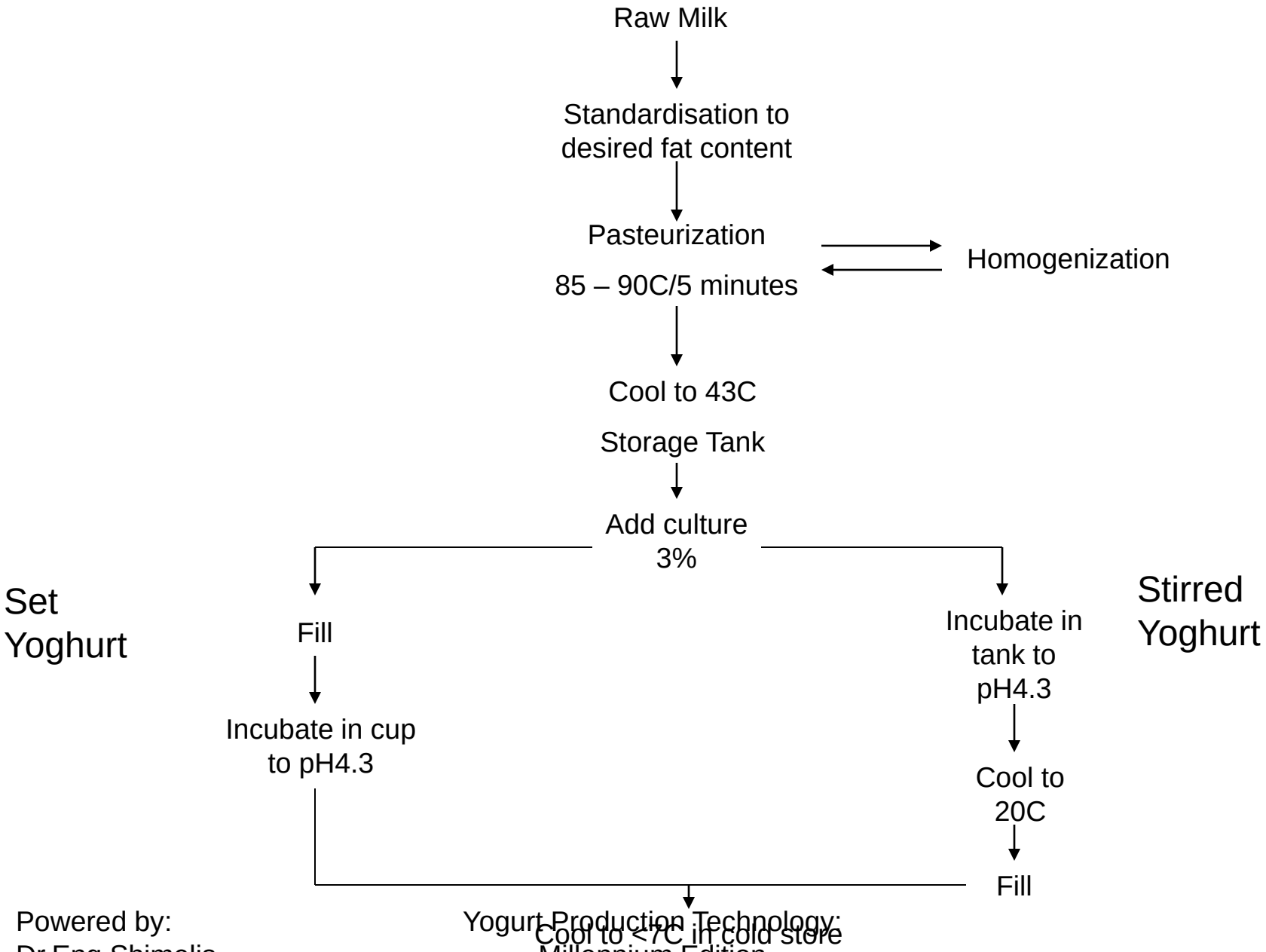
Fermentation takes place in a tank

The timing of the process is less critical

For Yoghurt Manufacture Use a High Temperature and Long Holding Time

- Produce a relatively sterile and conducive environment for the starter culture
- Competitor organisms are destroyed
- Denature and coagulate whey proteins to enhance the viscosity and texture

- The mix is then homogenized using high pressures of 2000-2500 psi.
- Besides thoroughly mixing the stabilizers and other ingredients, homogenization also prevents creaming and wheying off during incubation and storage
- Stability, consistency and body are enhanced by homogenization – improved viscosity
- Once the homogenized mix has cooled to an optimum growth temperature, the yoghurt starter culture is added.


Raw Milk
Standardisation to desired fat content
Pasteurization
85 – 90C/5 minutes
Homogenization
Cool to 43C
Storage Tank
Add culture 3%
Set Yoghurt
Fill
Incubate in cup to pH4.3
Stirred Yoghurt
Incubate in tank to pH4.3
Cool to 20C
Fill
Cool to <7C in cold store

Pasteurisation

- The higher the temperature and the longer the holding time, the better the viscosity of the final product
- Batch 85^{o}C for 20 minutes
- HTST 80 $^{o}C^{+}$ for 3 to 5 minutes
- Homogenisation pressure 150 bar

Starter Cultures

- Streptococcus thermophilus
- Lactobacillus bulgaricus
- They have a symbiotic relationship
- There are ‘designed’ cultures for specific yoghurt types

- Although they can grow independently, the rate of acid production is much higher when used together than either of the two organisms grown individually.
- ST grows faster and produces both acid and carbon dioxide. The formate and carbon dioxide produced stimulates LB growth.
- On the other hand, the proteolytic activity of LB produces stimulatory peptides and amino acids for use by ST.
- These microorganisms are ultimately responsible for the formation of typical yogurt flavour and texture.
- The yogurt mixture coagulates during fermentation due to the drop in pH.
- The streptococci are responsible for the initial pH drop of the yogurt mix to approximately 5.0.
- The lactobacilli are responsible for a further decrease to pH 4.0

- A ratio of 1:1, ST to LB, inoculation is added to the jacketed fermentation tank.
- A temperature of 43° C is maintained for 4-6 h under quiescent (no agitation) conditions.
- This temperature is a compromise between the optimums for the two micoorganisms (ST 39° C; LB 45° C).
- The titratable acidity is carefully monitored until the TA is **0.85 to 0.90%.** At this time the jacket is replaced with cool water and agitation begins, both of which stop the fermentation.
- The coagulated product is cooled to 5-22° C, depending on the product.
- Fruit (sterile) and flavour may be incorporated at this time, then packaged.
- The product is now cooled and stored at refrigeration temperatures (5° C) to slow down the physical, chemical and microbiological degradation

Fermentation Products Contributing to Flavour

- lactic acid
- acetaldehyde
- acetic acid
- diacetyl

Yoghurt Beverages

- Drinking yogurt is essentially stirred yogurt which has a total solids content not exceeding 11% and which has undergone homogenization to further reduce the viscosity
- Flavouring and colouring are invariably added
- Heat treatment may be applied to extend the storage life
- HTST pasteurization with sanitary processing will give a shelf life of several weeks at 2-4°C
- UHT process with aseptic packaging will give a shelf life of 8 months at room temperature

Culture Range for East Africa

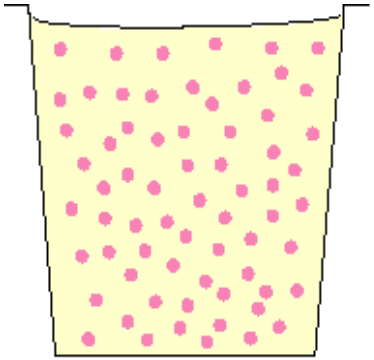
Type of technology	PH Time Temperature	Technological characteristics	Yo-Mix LYO
SET & DRINKING YOGHURT	**4,6-4,5 5-6h 40-43°C**	- Smooth texture - Stable taste during storage - Creamy products	**401** **421**
STIRRED YOGHURT	**4,6-4,5 5-6h 40-43°C**	- Thick and smooth texture - Low post-acidification - Creamy products - No syneresis	**401** **421**
STIRRED YOGHURT Thick texture and mild taste	**4,6-4,5 6-7h 40-43°C**	- Very thick and smooth texture - No post-acidification even with slow cooling	**495** **496**
PROBIOTIC YOGHURT with high texture	**4,6-4,5 5-7h 37-43°C**	- Creamy product - Very thick and smooth texture - No post-acidification even with slow cooling - No syneresis - Guaranty of 10E6 "probiotic strain" in the yogurt	**205** **207**

205,207 = *S. thermophilus, L.bulgaricus, L. acidophilus, Bifidobacterium lactis*

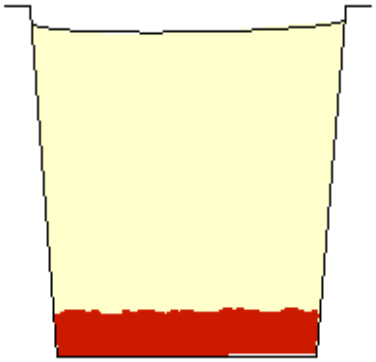
Stabiliser Range for East Africa

STABILISER LIST PROPOSAL		DVI LYO		
Products	Stabiliser	units	Dosage	Comment
Yoghurt	Grindsted SB 258 A	modified starch, gelatine	0.6-1.0%	Cheapest solution
	Grindsted Pectin SY 200	pectin	0.07-0.15	more expensive
Long-life yoghurt	Grindsted SB 254	modified starch, gelatine	1.0-1.2	good
	Grindsted SB 264	modified starch, gelatine, pectin	2.2-2.6	expensive, but very good
Yoghurt - to consider	Grindsted SB 251	gelatine, modified starch, starch, pectin	0.5-0.8	get tested

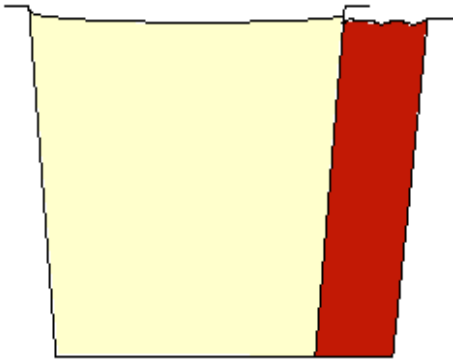
Three Major Fruit Yoghurt Types



Stirred with fruit dispersed



Fruit at the bottom



Fruit in a separate compartment

Fruit Flavoured Yoghurts

- Do not contain any fruit
- Contain fruit flavours and colours
- Flavours can be synthetic, nature identical, natural
- Synthetic is the cheapest

Real Fruit for Yoghurt

- The processor can prepare own fruit
- Boil equal weights of fruit and sugar
- This is a cheap and convenient method

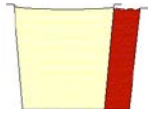
or

- The processor can buy processed fruit that contains stabiliser, flavour and colour
- Commercial fruit has to be bought as a sterilized product – very expensive

Functional Requirements for Yoghurt Fruit Preparations

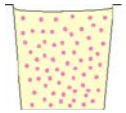
Requirements for Fruit On Bottom Yoghurt

- No interfacial interaction (gelation, syneresis, protein aggregation)
- No colour migration from fruit to white base



Rrequirements for Twin Pot Yoghurt

- Non gelling properties
- Good suspension properties
- High degree of fruit identity and flavour release
- High yield value (flotation control)



Requirements for Stirred yoghurt

- No interaction with white mass (fish eyes, syneresis)
- Good suspension properties and pourable texture
- Texturing effect of the yoghurt is in some cases desirable

Commercial Fruit Preparations

- Low viscosity during hot processing
- High ability to regain texture after pumping (thixotropic properties)
- Wide pH tolerance
- Good organoleptic properties, viscosity
- Excellent flavour release
- Superior transparency
- **Results: Increased product appeal**

Pectins – What they do for your Yoghurt

- Broad calcium, pH and Brix tolerance
- Process flexibility
- Excellent for Fruit On Bottom yoghurt
- Excellent yield properties
- Low viscosity during processing
- Needs calcium saturation
- Strong carry-through-effect in the white mass
- Nice creamy mouthfeel with no syneresis
- Low viscosity in low solids formulation (< 55% SS)

Choosing a Stabilizer: Your Target

Good suspension of fruit particles

- Good viscosity at processing temperatures and also at refrigeration temperatures
- No syneresis – holds the water in
- Good mouthfeel
- Does not leave an aftertaste or sense of particles
- Smooth, creamy
- Stable texture throughout the shelf life
- Does not interact with the yoghurt white mass
- No gelation
- Large formulation tolerance
- Tolerant to various fat contents

Process Control of the Yoghurt

- From the time of inoculation, must do pH or acidity tests frequently throughout the fermentation process
- Normal time for fermentation is 4.5 hours
- Tests become more frequent as the fermentation proceeds

Inoculation Time 0
30 minutes
1 hour
1.5 hours
2.0 hours
3.0 hours
3.0^{+} hours every 15 minutes

Cultures

- The ideal yoghurt culture has a composition of 50% S. thermophilus and 50% L. bulgaricus
- As the lactic acid concentration increases the S. thermophilus which is less tolerant of high acidity declines and is taken over by the L. bulgaricus which is the primary acid producer
- If using mother culture then should microscopically examine the culture to verify that the relative 50% proportion is maintained

Filling Stirred Yoghurt

- Cool to approximately 20°C
- Cooling can be either in a jacketed tank or in a plate cooler
- Transfer cups to cold store for final cooling

Filling Set Yoghurt

- ☑ Fill at 43ºC
- ☑ Must finish filling by pH6.0
- ☑ Transfer filled cups to incubator set at 45ºC
- ☑ Monitor the acidity and pH frequently until pH4.6
- ☑ Transfer to refrigerator at pH4.6
- ☑ Adjust the process timing so that the final pH at <10ºC will be pH4.3

Product Assessment

- Viscosity measurement: pipette, Bostwick viscometer, penetrometer etc
- Texture
- Taste
- After taste
- Syneresis
- Colour seepage between layers
- Colour reduction
- Shelf life

Changes in Bacteria Population During Shelf Life

- The initial count on Day 1 should be approximately 10^7 to 10^8 per ml
- The number of organisms declines during the shelf life
- Coliforms decline during shelf life because coliforms do not tolerate the high acidity
- Yeasts and Moulds increase during shelf life
- The main spoilage organisms are yeasts and moulds

Recommended pectin dosages and application areas for GRINDSTED® Pectin YF range

Product	Usage level [%]	mg Ca^{2+}/ g GRINDSTED® Pectin YF	Application areas
GRINDSTED ® Pectin YF 310	0.5-0.9%	25-40 brix ~ 55 mg/g 55 brix ~ 25 mg/g	Excellent for stirred yoghurts and fruit on the bottom.
GRINDSTED ® Pectin YF 450	0.4-0.6%	5-15 mg/g	Perfect for stirred yoghurts, giving high fruit identity and high yield stress values.
GRINDSTED ® Pectin YF 738	1-2%	0 mg/g	Dual function pectin, creating viscosity in fruit prep. and acidified white base.

Yoghurt Fruit - Market potentials

	Potential	Market Share in %
LE Pectin	1500 MT	10
Carrageenan	200 MT	0
LBG, Xanthan, Guar, Alginate and HE Pectin	300 MT	5
Blends	?	0
Flavouring	350 Mio DKK	< 1

Vanilla Fruit preparation for All Types of Yoghurt

1)	Dry blend pectin and sugar **I** and dissolve the blend in hot water **I** (80°C), using a high-speed mixer
2)	Mix fruit, sugar **II,** and water **II** and bring the blend to the boil
3)	Add 1) to 2) agitating continuously
4)	Add the calcium as a calcium slurry (calcium lactate dissolved in water)
5)	Evaporate until the desired soluble solids is reached
6)	Add preservatives
7)	Adjust pH with sodium citrate solution
8)	Add the flavourings
9)	Cool to filling temperature and fill