Influence of standardization of cheesemilk lactose on the flavor and texture of reduced-fat and low-fat Gouda cheese during ripening

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Introduction

- **Defects associated with reduced/low fat cheeses:**
  - Texture
  - Acidity
- **Whey dilution step during Gouda cheese manufacture is used to control acidity**
  - Replacement of whey with water.
  - Reduction of lactose and lactate content.
  - High variability (water added, temperature, time, stirring rate)
- **Standardizing lactose content in cheesemilk as an alternative to control pH and acidity.**
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Introduction

- Ultrafiltration (UF) Skim Milk

\[
\text{UF} \quad \downarrow
\]

Retentate (Casein)  Permeate (Lactose)

\[
\text{Retentate (Casein)} + \left( \text{Permeate (Lactose)} + \text{RO Water} \right) = \text{Cheesemilk (Standardized Lactose to Casein Ratio)}
\]

Varying proportions
Introduction

High Acidity

Low pH

Low INSOL Ca
Introduction

Low Acidity

High pH

High INSOL Ca
Introduction

Water Dilution → Low INSOL Ca
Hypothesis

1. Standardization of lactose to casein in cheesemilk influences the acidity and pH of cheese.
2. Lactose standardization reduces levels of insoluble calcium, leading to changes in texture and melting properties of cheese.

Objective

To compare the effect of lactose standardization in cheesemilk versus whey dilution during cheese manufacture on the properties of reduced-fat and low-fat Gouda cheese.
### Cheese Manufacture

- **Reduced-Fat Cheese (RF)**
  - **WD 30**
    - Normal cheesemilk
    - Casein to Lactose ratio: ~1.8
  - **WD 15**
    - Normal cheesemilk
    - Casein to Lactose ratio: ~1.8
  - **UF**
    - Standardized cheesemilk
    - Casein to Lactose ratio: ~1.1

- **Low-Fat Cheese (LF)**
  - Whey Dilution 30%
  - Whey Dilution 15%
  - No Dilution

- **Whey Dilution**
  - 30%
  - 15%
  - No Dilution

- **Casein to Lactose ratio**
  - ~1.8
  - ~1.1

- 250 Kg (550 lb) scale
- Stirred milled curd direct salting process.
- Stored at 10°C (50°F) for 2 wk and at 5°C (~42°F) for 22 wk (total ripening of 6 mo).
- 4 independent replicates.
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No changes in composition between treatments.
A significant increase in pH was found on UF cheeses in RF and LF cheeses.
Lactic acid was considerably lower in UF cheeses, when compared to WD cheeses.
Residual lactose and galactose 1 d

Reduced Fat

Low Fat

Lactose and Galactose (mg/100 g)

Lactose

Galactose

Cheeses

Cheeses
Residual lactose and galactose content was considerably lower in UF cheeses.

A high variation on residual lactose and galactose was found on WD cheeses.
Buffering capacity of cheese

- Determines texture and functionality of cheese
- Highly influenced by pH and acidity
- Estimated to determine the proportion of insoluble calcium (Hassan et al., 2004)
• UF cheeses exhibited a lower proportion of insoluble Ca
• No changes were observed during 8 wk of ripening.
Cheese hardness

- Texture Profile Analysis (TPA)
- Two-bite compression test on cheeses cylinders at 30% their original size.
Cheese hardness

Reduced Fat

Low Fat

• UF cheeses exhibited a softer texture than WD cheeses.
Melting point

- Determination of temperature at melting point on cheese discs (50 mm diameter, 3 mm thickness) using a rheometer.
- Heating from 5 to 85°C at 1°C/min.
• UF cheeses exhibited a lower melting point than WD cheeses.
Proteolysis

Reduced Fat

- Proteolysis expressed as pH 4.6 soluble-N showed no differences between WD and UF Cheeses.
Sensory Analysis at 6 mo: Texture

Reduced Fat

- UF cheeses were found to be softer.
- RF-UF cheese presented a lower chewiness.
Sensory Analysis at 6 mo: Basic taste

- Salty and Acid were lower in UF cheeses.
- RF-UF presented a higher intensity of bitterness.
Sensory Analysis at 6 mo: Flavors

- UF cheeses were less astringent than WD cheeses
Conclusions

• Lactose standardization led to a higher pH due to a lower content of lactic acid.

• Lactose standardization significantly decrease residual lactose and galactose of UF cheeses, when compared to WD.

• INSOL Ca was lower on UF cheeses, leading to a softer texture and a lower melting temperature.

• Sensory analysis showed lower acidity and astringency on UF cheeses.
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Influence of varying Lactose:Casein contents on the flavor and texture of reduced-fat and low-fat Gouda cheese during ripening

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Addition of water during processing

Before Cheese manufacture
Addition of water during processing

During Cheese manufacture