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Conjugated linoleic acid and milk processing

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  - CLA enrichment via fractionation

Main Objectives of our Study

I. **Composition**
   I. **Review** comparing impact of food processing on CLA content of dairy products
   II. **Product analysis** of butter to show impact

II. **Shelf Life**
   I. Evaluation of **methods** (chemical, sensory, holistic) Determination of secondary products of lipid oxidation
   II. **Shelf life analyses** to identify differences in product stability of different butter samples by evaluated methods

III. **Novel Processing Procedures**
   I. Novel **processing procedures** to maintain or increase the CLA content in dairy products

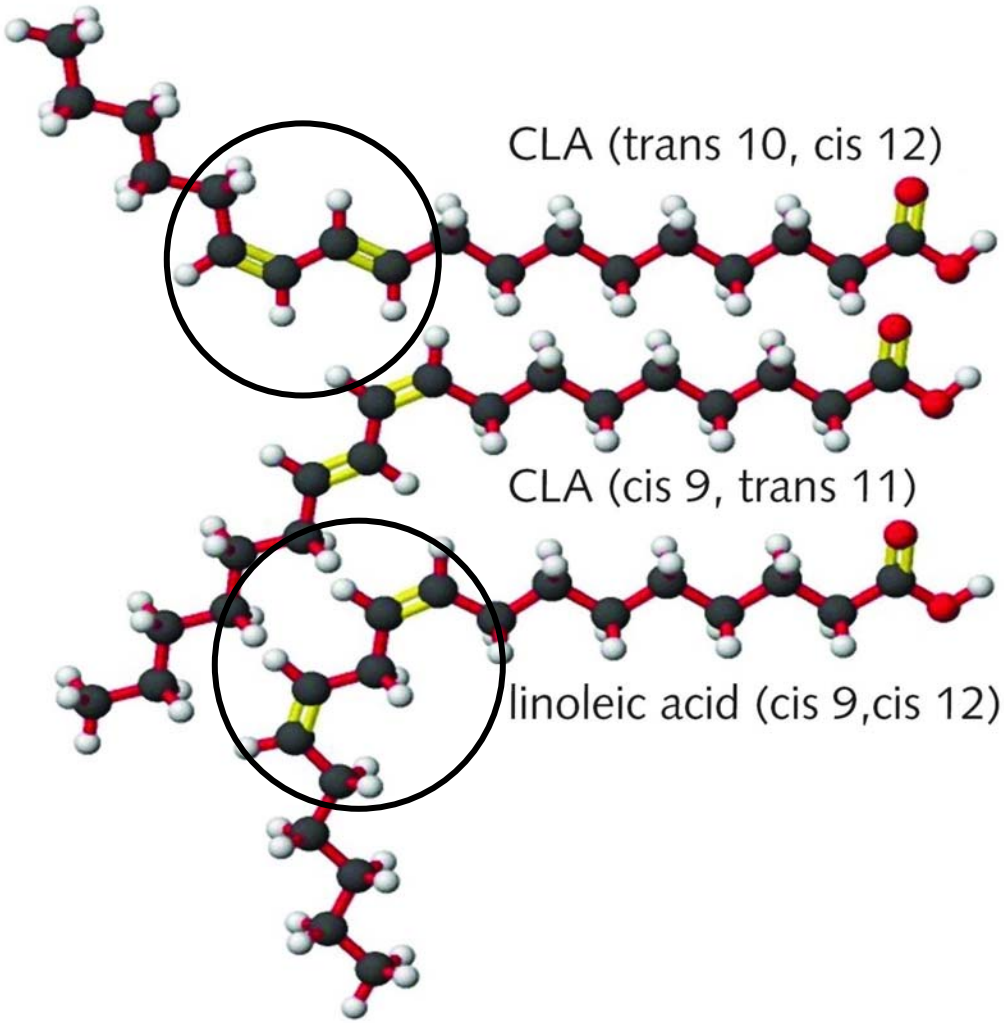
Background of our Study

- **Demand for foods with properties that promote human health is growing**
  - Development of new dairy products with a nutritional-physiological functionality

- **Recent studies indicate:**
  Conjugated linoleic acids (CLA) may have positive effects on human health (naturally present in fat of ruminants)

- **Aim of processing standards for organic foods:**
  Preserving or enhancing specific bio-active or functional components of raw material

Conjugated linoleic acid (CLA)



Conjugated linoleic acid (CLA)

- CLA are found in food of animal origins, in the fat of ruminants (i.e. meat, milk)
- Content of CLA is influenced by cow's ambient conditions (i.e. feed, breed, age, lactation period, altitude, seasonal influences)
- CLA exhibit several important health-promoting attributes (animal studies)

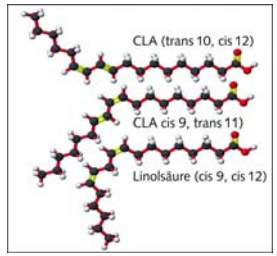
Results:

Does food processing influence the CLA content of the end product?

Literature research findings:

Overview of current knowledge

- Normal processing procedures for dairy products such as fermentation steps, heat treatments, storage and ripening **do not change** the content of CLA or the CLA isomer profile



Results:

Does food processing influence the CLA content of the end product?

Literature research findings:

Overview of current knowledge

- Organic dairy products show:
  - higher levels of CLA than standard products: Differences between 14% and 50%
  - higher contents of linolenic acid (+ ≈ 50%), trans-vaccenic acid (+ ≈ 50%), β-carotene (+76%) and α-tocopherol (+≈ 50%)

Results:

Does food processing influence the CLA content of the end product?

Own investigations:

- Butter making process (butter made from fermented cream of conventional and organic origin):
  → no significant influence on CLA content
- Significant differences in total CLA content between cream of organically produced milk and conventional milk

No.	Origin	CLA cream g/100 g fat	CLA butter g/100 g fat	Difference butter-cream g/100 g fat
∅	conventional	1.35^{ax}	1.31^{cx}	-0.04
∅	organic	1.54^{by}	1.48^{dy}	-0.06

n = 7 (conventional)
n = 5 (organic)
a, b and c, d: different letters in columns mean significant differences ($p < 0.005$).
x,y: different letters in rows mean significant differences ($p < 0.01$)

Results:

Does food processing influence the CLA content of the end product?

Literature research findings:

Procedures to enrich CLA in dairy products

- **Production**:
  Increase of CLA content through diet of dairy cattle
- **Microbiological** processes:
  CLA production in culture media by selected strains
  [e.g. bifidobacteria, propionibacteria]
- **Chemical** processes (not suitable for low input processing)
- **Physical** separation processes

Results:

Evaluation of a process for low-input CLA enrichment

- Evaluation of physical separation process to increase CLA content: **dry fractionation process**
  - Acceptation by international organic farming groups
  - Permission of application of CLA-rich fractions in organic products
- Collaboration with industry and an university of applied sciences
- Highland butter as a suitable raw material (high CLA content)

CLA content of highland butter

Dependent on altitude and feed:

- Decrease of saturated fatty acids and increase of MUFA, PUFA, CLA and ratio of ω3:ω6 FA

→ **nutritional-physiological advantages**

Higher CLA content is probably attributable to:

- grazing in natural pastures
- species-rich alpine meadows with secondary plant ingredients
- energy deficiencies and metabolism → mobilizing of body-fat

→ **further investigation required**

Fractionation

- **Definition:** Defined fractions can be extracted from the raw material fat by means of partial crystallisation at defined temperature intervals which indicate the melting point of the fraction

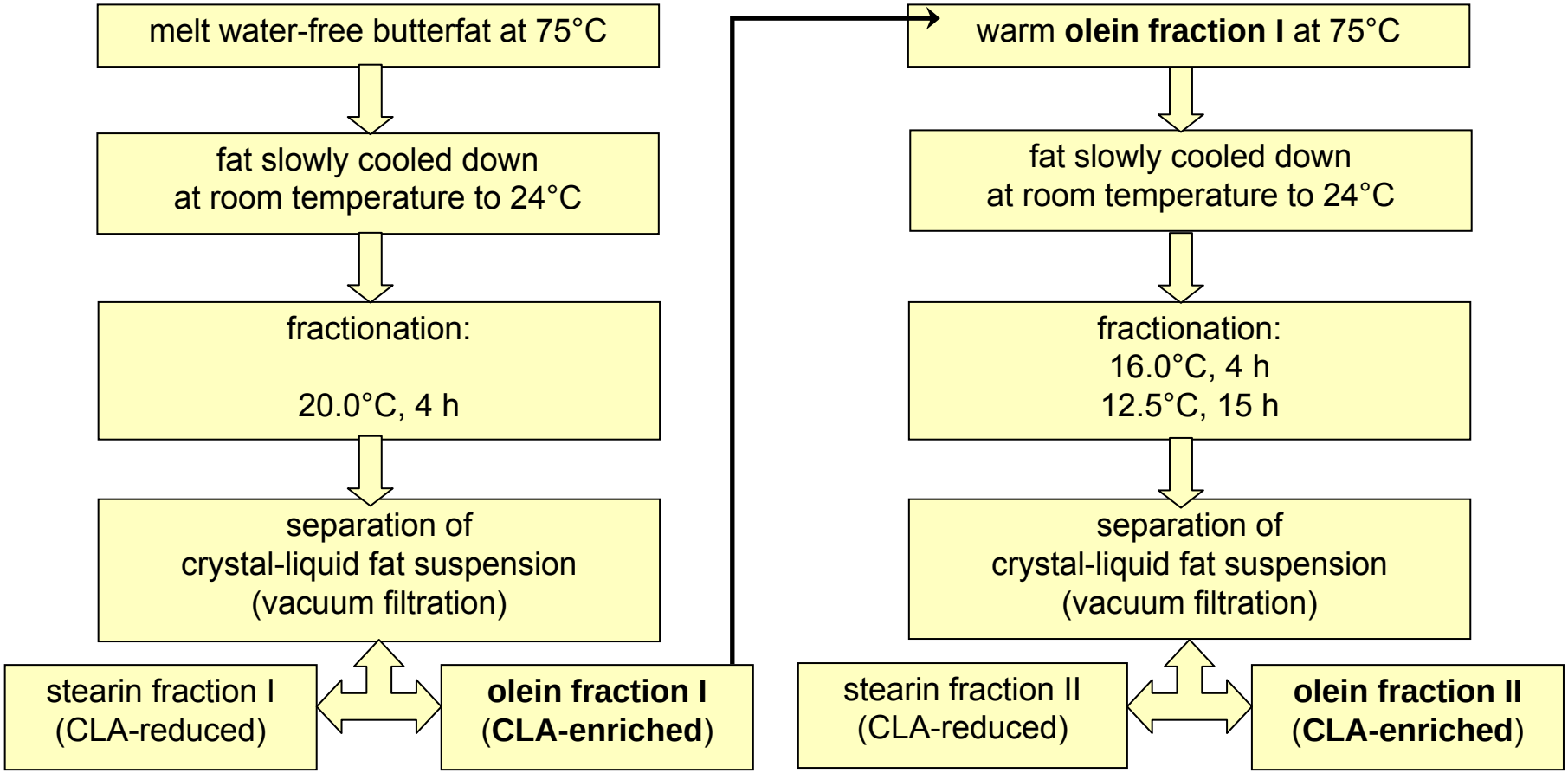
- Process produces two different products:
  - High-melting fraction: **stearin** (clear melting point at 41-48°C)

  - Low-melting fraction: **olein** (clear melting point at 15-30°C)

Process for CLA enrichment

- Evaluation of suitable fractionation conditions
    - by changing time, temperature and multiple fractionation
        - temperature range between 32°C and 9.5°C
        - crystallisation times between one and 20 hours
- Aim:
    - Obtainment of a higher CLA content in a fraction
    - Optimal Separation of the two fractions
    - Commercially interesting yield of the CLA rich fraction
- Determination of CLA content/isomers of olein and stearin fraction in laboratory ALP
    - Comparison against raw material

Evaluated process



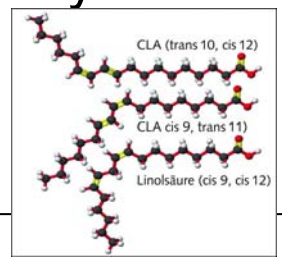
Results

product	[°C]	CLA content [mg/g fat]	
butterfat (reference)	**-**	**7.7**	
olein fraction I	20.0	8.6	
olein fraction II	12.5	**10.2**	**32.5 %**
alpine butter (reference)	**-**	**21.6**	
olein fraction I A	20.0	22.8	
olein fraction I B	20.0	22.7	
average increase of CLA content from reference to olein fraction I		**1.2**	
olein fraction II A1	12.5	25.1	
olein fraction II A2	12.5	24.5	
olein fraction II B1	12.5	25.1	
average increase of CLA content from olein fraction I to olein fraction II		**2.1**	**15.3 %**

Results

Tests conducted demonstrate:

- Selected physical separation process enables CLA enrichment
- CLA found in olein and stearin fraction
  - higher CLA content is found in olein fraction
- Anhydrous butterfat: CLA enrichment of 32.5 %
- Highland butter: CLA enrichment of 15.3 %
- CLA enrichment too minor to achieve decisive positive impact on human health
- High processing costs
  - industrial-volume CLA enrichment is too costly



Summary

- Normal processing procedures for dairy products **do not change** the content of CLA or the CLA isomer profile in fat
- During processing, CLA pass from raw material into final product (**proportionally** to content and CLA isomer profile in fat)
- Organic dairy products show **higher levels** of CLA than standard products
- Enrichment of CLA by low-input processes is **possible but limited** (industrial-volume is too costly)

Summary

- Enrichment of CLA by diet of cattle (and altitude) has an influence on **quality** of milk products
  - Butter: nutritional-physiological advantage; softer texture
- **Methods** to determine secondary products of fat oxidation (and shelf-life) are established

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COMMUNITY RESEARCH

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