Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Economic Affairs DEA
Agroscope Liebefeld-Posieux Research Station ALP
Swiss Confederation

Conjugated linoleic acid and milk processing

Brita Rehberger (ALP)

Biofach 2007, Nürnberg, Germany
15.02.2007

Table of contents

- **EU-Project „Quality low input Food“**
  - Main Objectives and Background of our Study
    - *Conjugated linoleic acid (CLA)*
- **Results**
  - Impact of food processing on CLA content
  - 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

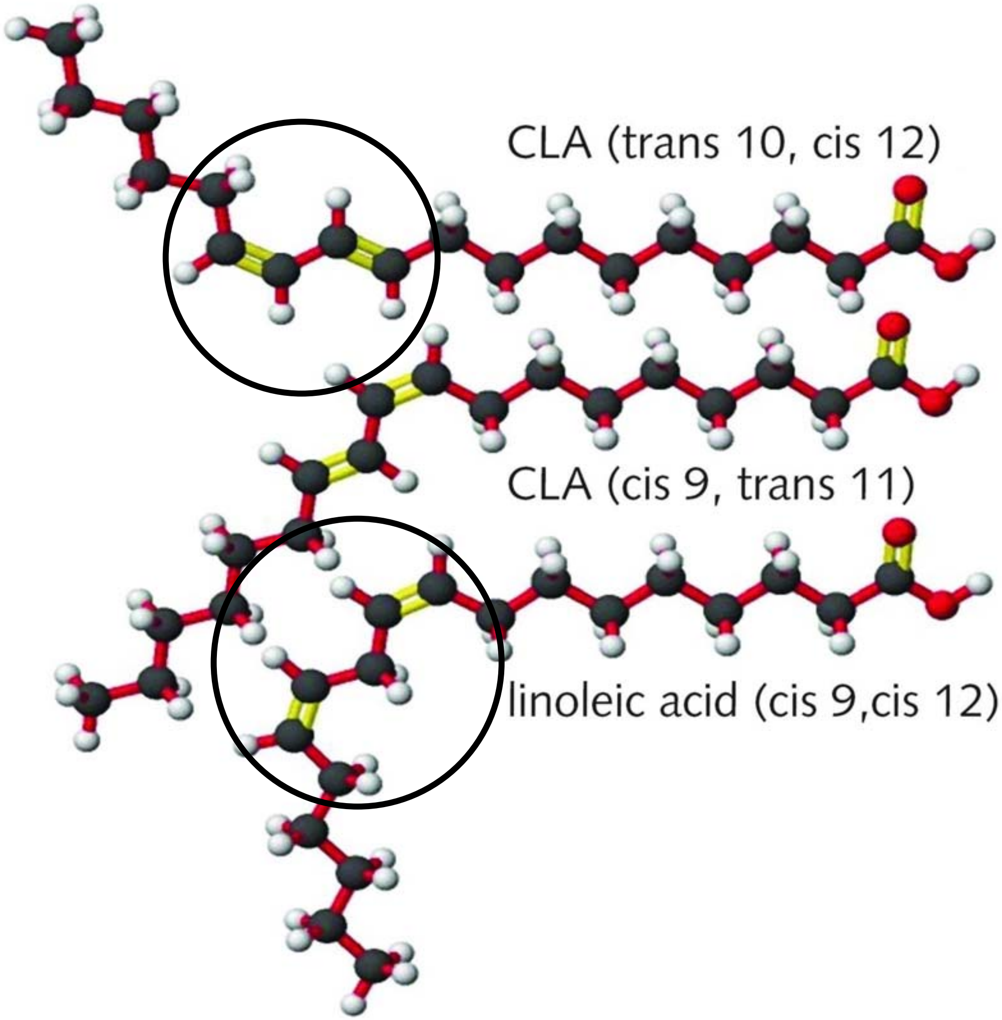
Background of our Study

- **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)

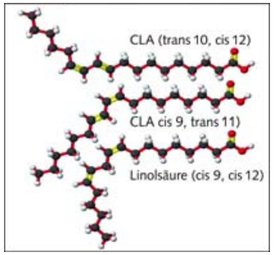
Results:

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

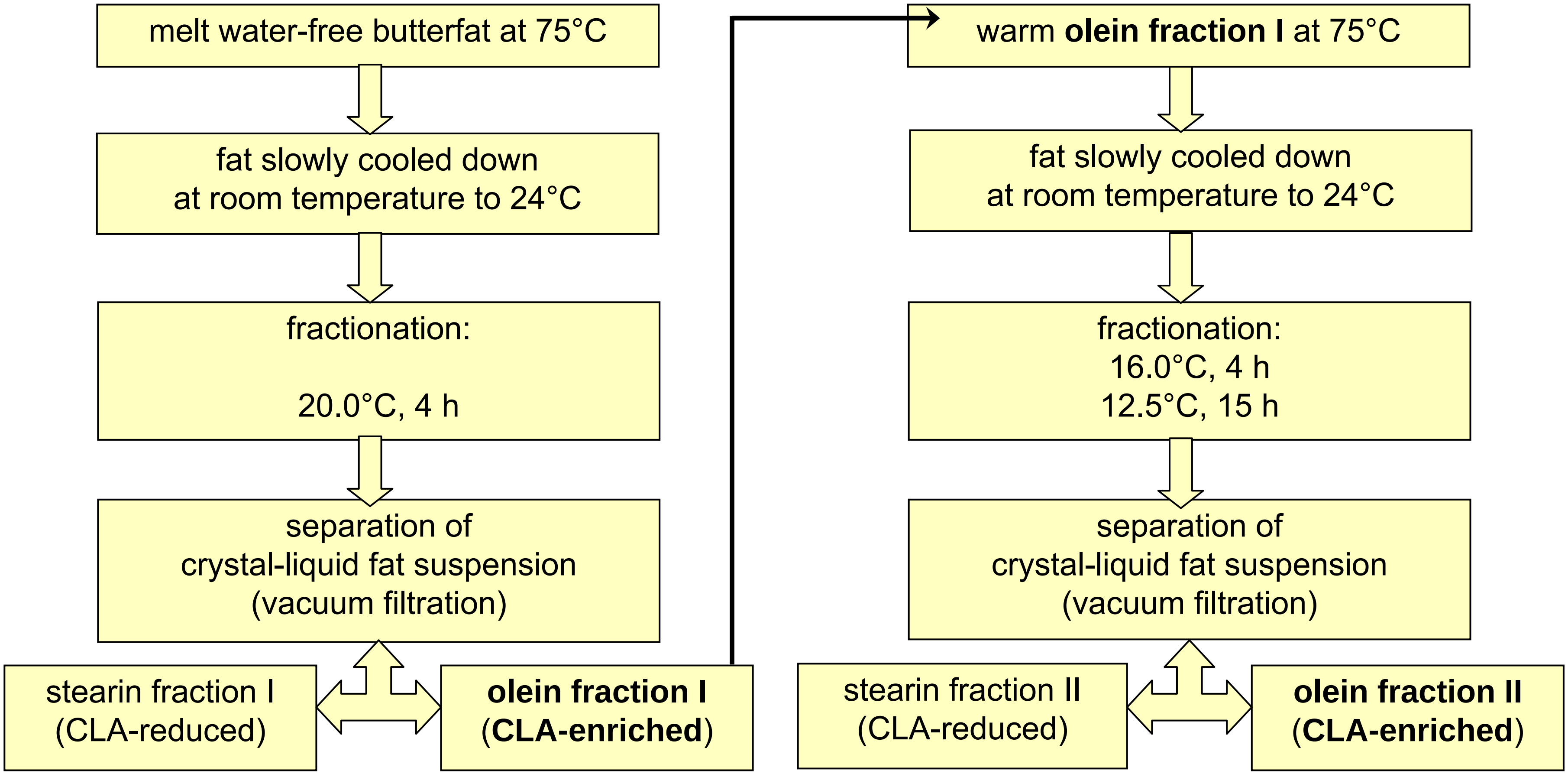
- Process produces two different products:
  - High-melting fraction: **stearin**
    (clear melting point at 41-48°C)

  - 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



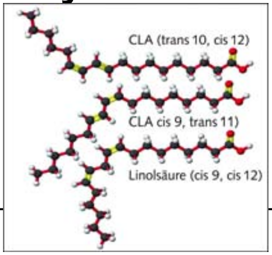
Results

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

Acknowledgement

We gratefully acknowledge financial participation from the European Community and co-funding by the Swiss State Secretariat for Education and Research

COMMUNITY RESEARCH

Dry fractionation process:

Thanks to all ALP colleagues, to Dr. Walter Bisig from the Swiss college of agriculture and to Margherita Vass from the Emmi AG

Emmi

University of Applied Sciences
Swiss College of Agriculture