Effect of pasture age on milk composition in organic production

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Introduction

- Silage with high legume content tend to increase the milk proportion of poly-unsaturated fatty acid (PUFA)(Dewhurst et al. 2003; Vanhatalo et al 2007; Steinshamn & Thuen, 2008)

- Red clover-grass silage increases PUFA and alpha-linolenic acid (ALA) in milk compared to white clover-grass silage (Dewhurst et al. 2003; Steinshamn & Thuen 2008)

- Known plant-related properties of legumes
  - Rumen passage rate (Dewhurst et al 2003)
  - Polyphenol oxidase activity (Lee et al. 2008)

Introduction

- Red clover-grass forage increases the milk content of phytoestrogens compared to white clover-grass forage (Steinshamn et al. 2008; Andersen et al. 2009)

- Only few studies with dairy cows grazing red clover containing pastures have been carried out

Objective

Examine the effect of pasture age (i.e. botanical composition)

- on milk FA pattern and milk content of vitamins and phytoestrogens

- milk lipids susceptibility to photo-oxidation

Hypothesis

Short term, red clover containing pastures increases the milk:

- fat proportion of ALA
- fat susceptibility to photo-oxidation
- content of phytoestrogens

Compared to long term, white clover containing pastures

Material and Methods

Treatment = Pasture type

Short-term pasture (SP)	Long-term pasture (LP)
1. production year	6. production year
✓Red clover ✓Timothy ✓Meadow fescue	✓White clover ✓Red clover ✓Timothy ✓Meadow fescue ✓Smooth meadow grass ✓Perennial ryegrass

Pasture management

- Organically managed
- Fertilization: No
- Grazing management:
  - 4 paddocks
  - rotationally grazed
  - fresh stripes twice daily
  - allowance app. 20 kg DM/cow/day
  - Paddocks were topped after each grazing

Animals and pre-exp. diet

- Animal Production Centre, Ås, Norway
- 16 Norwegian Red dairy cows
  - Average days in milk was 80
  - Average body weight of 597 kg
  - Average milk yield of 30.7 kg/day
- Pre experimental feeding:
  Grass-clover silage *ad libitum* +
  5.9 kg DM/day concentrate

Grazing and experimental periods

- Grazing *ad libitum* day and night
- Additional barley (2.7 kg DM/day)
- Experimental periods
  - 3: June, July, September
  - 3 weeks each
    - 14 days adaptation
    - 7 days measurement and sample collection

Samples and recordings

- Sample collection
    - Feed samples (4 days)
    - Milk samples (4 consecutive milkings)

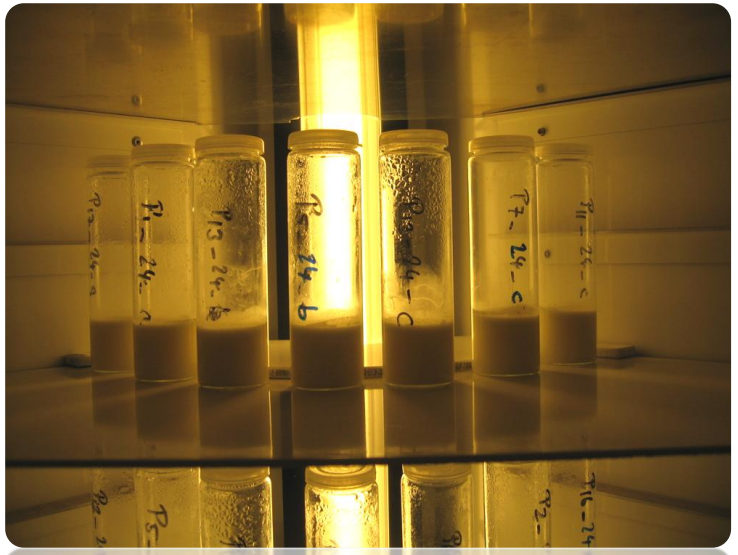
- Botanical composition (dry-weight-rank method)

Milk analysis

- FA by gas chromatography
- Vitamins by HPLC
- Phytoestrogens by LC-MS/MS
- Lipid oxidation in light exposure experiment

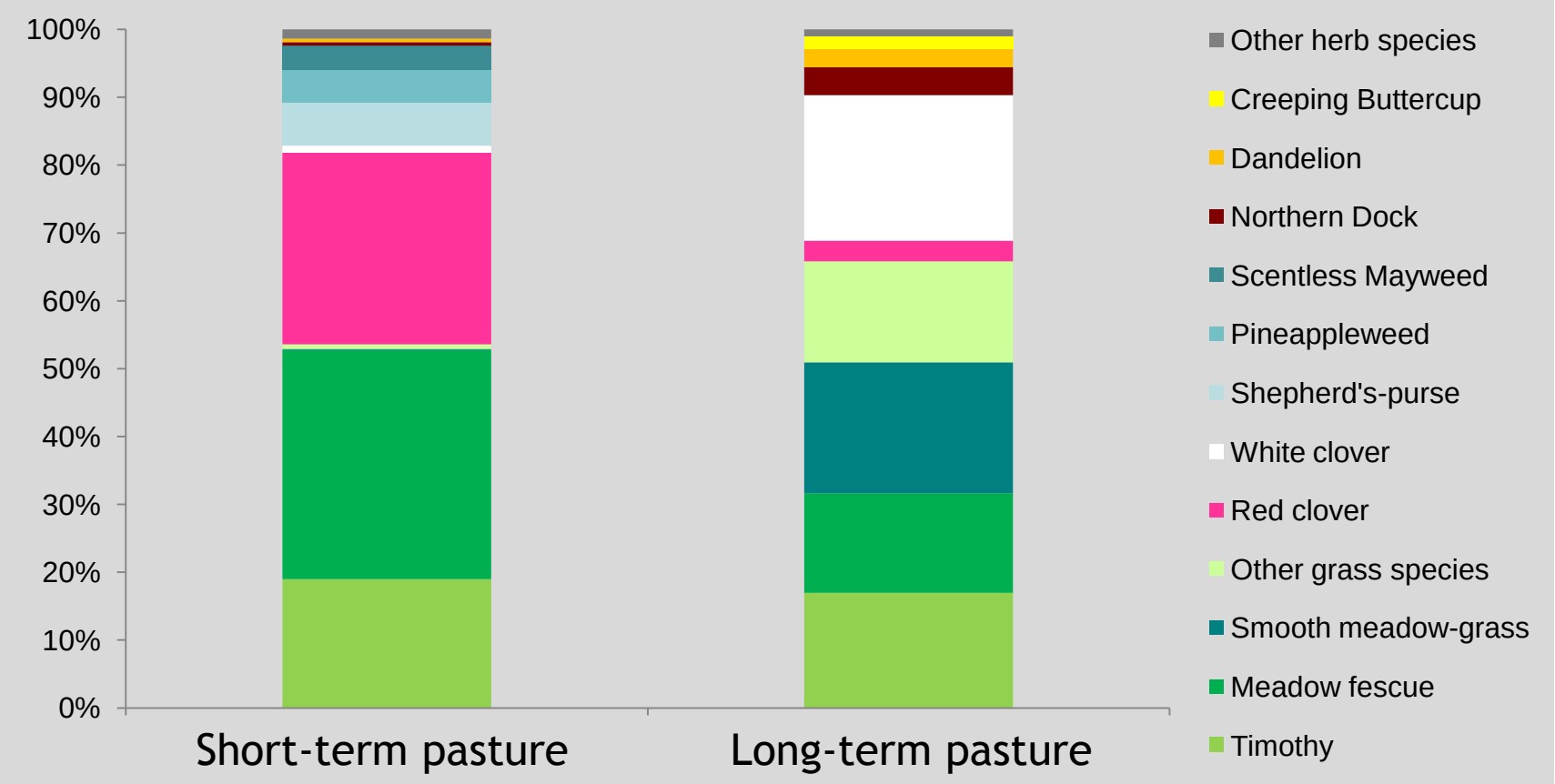
Light exposure experiment

- 0, 24 or 48 h
- Two parallels
- Concentration of hydroperoxides
- Fluorescence spectroscopy, excitation 382 nm



Results

Pasture botanical composition



Herbage chemical composition

No difference in:

- Crude protein content
- Fibre content
- Energy value
- Vitamin and carotenoid content

Herbage FA content, g/kg DM

	Short-term pasture	Long-term pasture
Total FA	2.37	1.68
C16:0	0.33	0.28
C18:1c9	0.06	0.06
C18:2c9,c12	0.40	0.32
C18:3c9,c12,c15, ALA	1.39	0.87

Feed intake, milk yield and composition

No difference in

- Forage intake
- Milk yield
- Milk content of fat, protein, lactose, urea or FFA

Milk FA composition, g/100 g FAME

	Short-term pasture	Long-term pasture	Sign.
C12:0	3.73	3.81	NS
C14:0	12.24	12.55	NS
C16:0	27.82	30.90	*
C18:0	11.39	9.93	*
C18:1c9	19.74	18.76	NS
C18:1t11	4.67	4.04	(*)
C18:2c9,c12	1.09	1.00	NS
C18:2c9t11	2.01	1.85	NS
C18:2t10c12	0.11	0.12	NS
C18:3c9,c12,c15, ALA	0.97	0.99	NS
SFA	66.7	68.4	NS
MUFA	28.4	27.0	NS
PUFA	5.0	4.7	NS
n-6/n-3 FA	2.00	1.89	NS

Milk vitamin content

	Short-term pasture	Long-term pasture	Sign.
α-tocopherol, mg/L	1.51	1.32	NS
β-carotene, mg/L	0.25	0.24	NS
Retinol, mg/L	0.52	0.45	NS

Milk phytoestrogen content, µg/L

	Short-term pasture	Long-term pasture	Sign.
Lignans			
Secoisolariciresin	6.3	6.0	NS
Mateiresinol	1.3	1.4	NS
Enterodiol	1.6	1.0	NS
Enterolactone	172.3	120.9	(*)

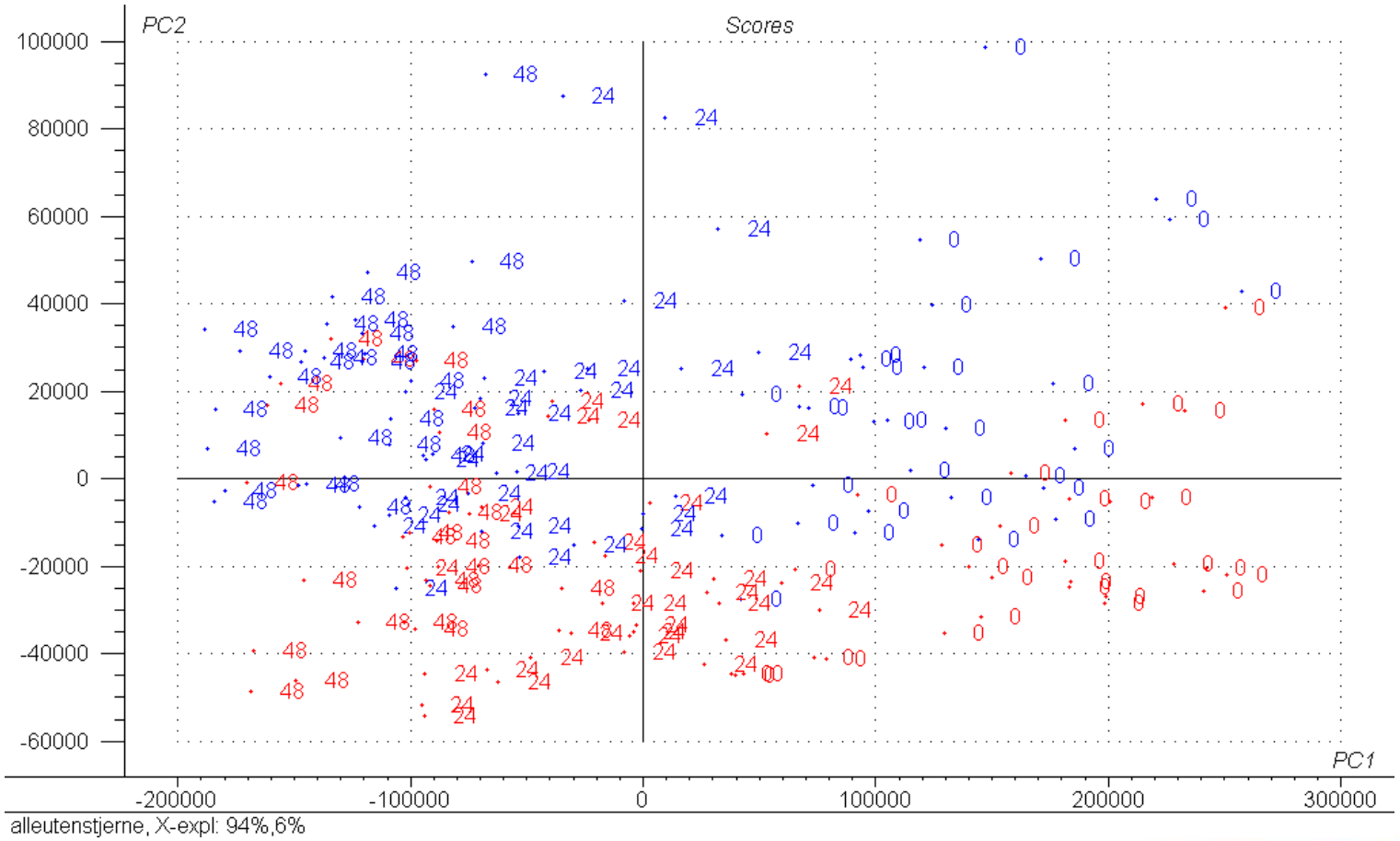
Milk phytoestrogen content, µg/L

	Short-term pasture	Long-term pasture	Sign.
Isoflavonoids			
Formononetin	49.4	5.5	(*)
Daidzein	39.6	4.0	NS
Equol	1230.8	88.0	*
Genistein	15.5	2.6	*
Prunetin	0.8	1.1	NS
Biochanin A	16.2	1.2	*
Coumestan			
Coumesterol	0.1	0.9	*

Light exposure experiment: Hydroperoxides

	Short-term pasture	Long-term pasture	Sign.
Hydroperoxides after 48 t, abs. 500 nm	0.47	0.46	**NS**

Light exposure experiment: PCA score plot of fluoroscence spectra



Conclusions

- Pasture type had only small effect on FA composition
- Short-term pasture (SP) with red clover did not lead to higher risk of milk fat oxidation compared to grazing long-term pasture (LP)
- Grazing SP compared to LP increased the concentrations of phytoestrogens in milk

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Thank you for your attention