

CLA Isomers in Milk Fat from Cows Fed Diets with High Levels of Unsaturated Fatty Acids

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Short description of the 2 studies

1st study: only grass feeding,
10 mixed milks per altitude (45 to 88 cows)

ALTITUDES

- Lowlands (600-650 m)
- Mountains (900-1210 m)
- Highlands (1275-2120 m)

2nd study: 10 individual milks per variant;
2 weeks feeding:

- Control: Basal diet: Hay ad libitum + 15 kg fodder beet
- Supplementation of 1 kg rapeseed
- Supplementation of 1 sunflowerseed
- Supplementation of 1.4 kg sunflowerseed
- Supplementation of 1kg linseed
- Supplementation of 1.4 kg linseed

Oilseed study: Levels of the most important unsaturated FAs in the 3 oilseeds (g / 100 g of fat)

Fatty acid	Rapeseed	Sunflowerseed	Linseed
Oleic acid (C18:1 cis 9)	54.67	15.20	17.55
Linoleic acid (C18:2 cis 9 cis 12)	17.95	53.62	14.21
alpha linolenic acid (C18:3 cis 9 cis 12 cis 15)	8.88	0.14	46.63

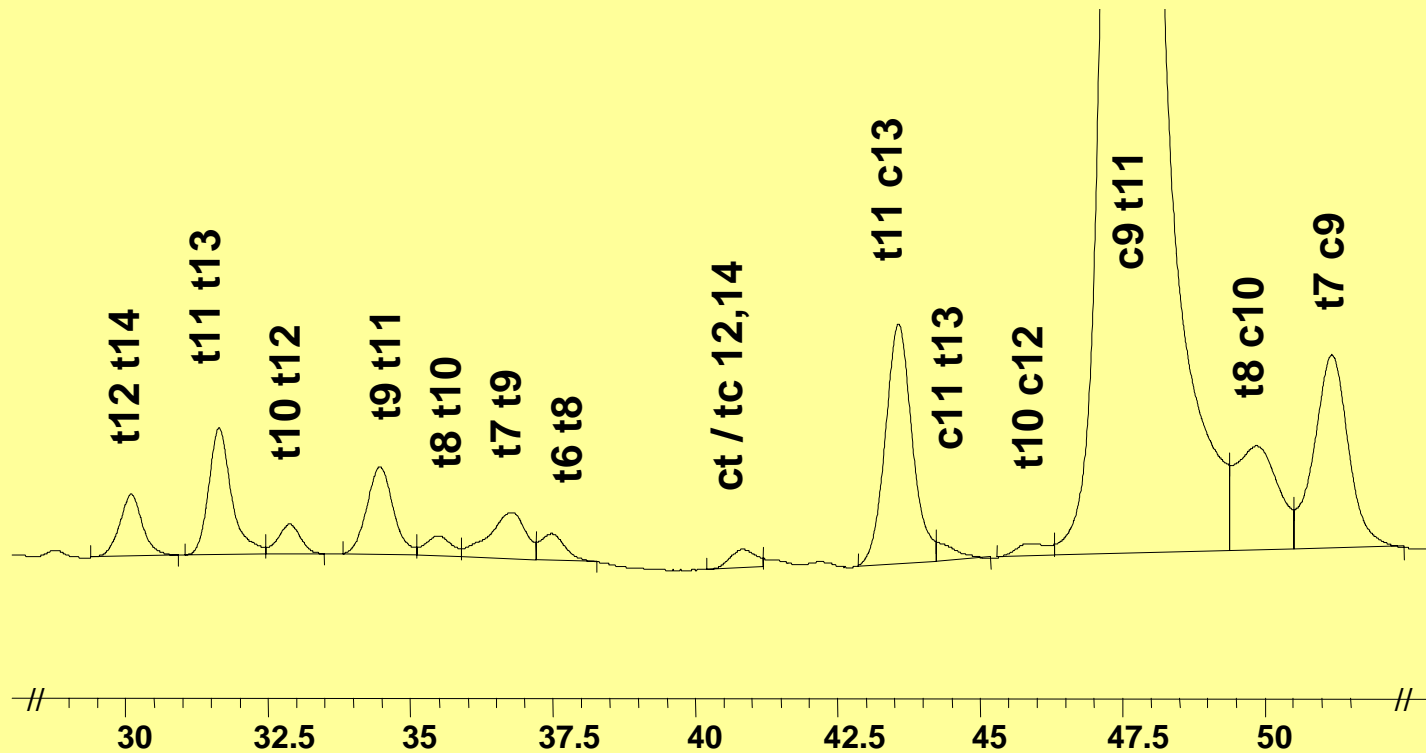
Oilseed study: Daily intake of unsaturated fatty acids (g day⁻¹ cow⁻¹)

	Oleic acid	Linoleic acid	α -Linolenic acid
RAP1	258	85	42
SUN1	80	281	1
SUN1.4	106	375	1
LIN1	59	48	157
LIN1.4	84	68	224

Ag⁺-HPLC Chromatogram of the CLA

trans, trans

trans, cis / cis, trans



Retention time (min)

CLA isomers analysed in milk fat

trans trans

t6 t8

t7 t9

t8 t10

t9 t11

t10 t12

t11 t13

t12 t14

cis trans / trans cis

t7 c9

t8 c10

c9 t11

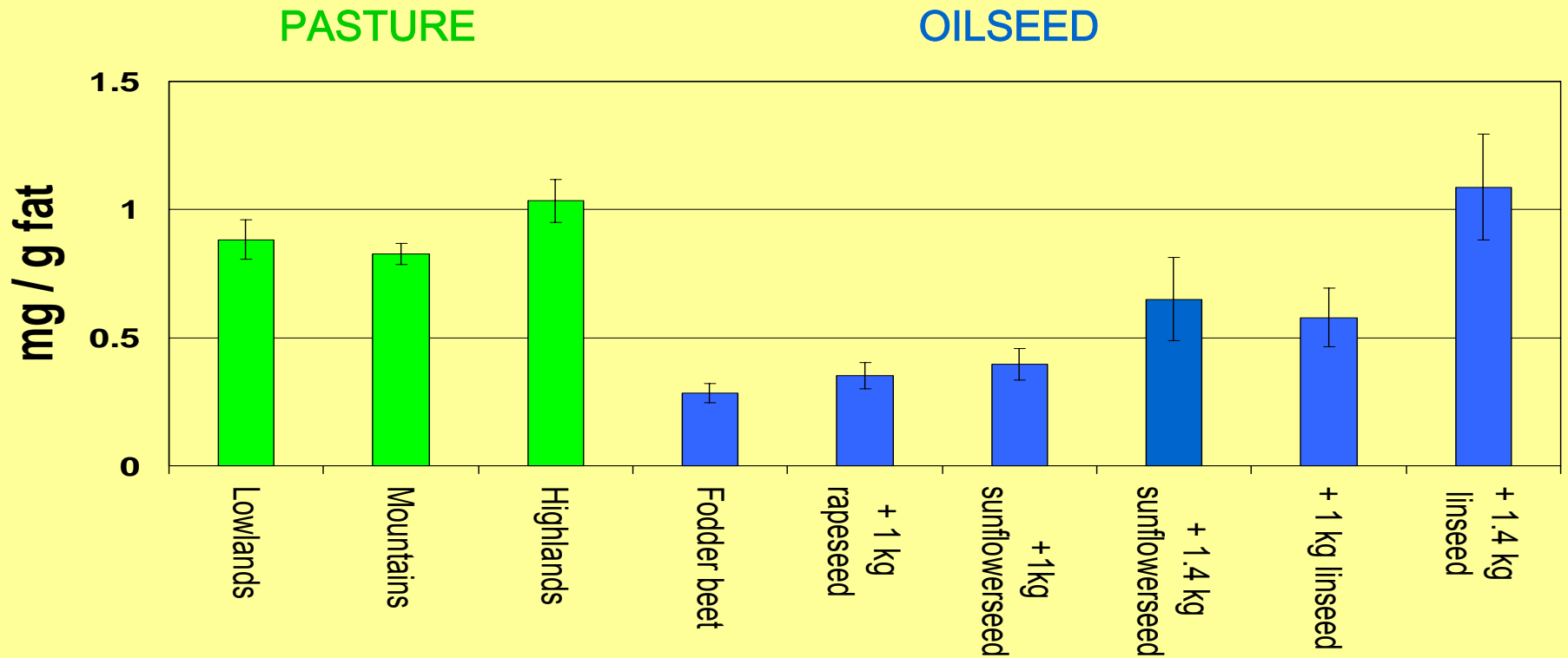
t10 c12

c11 t13

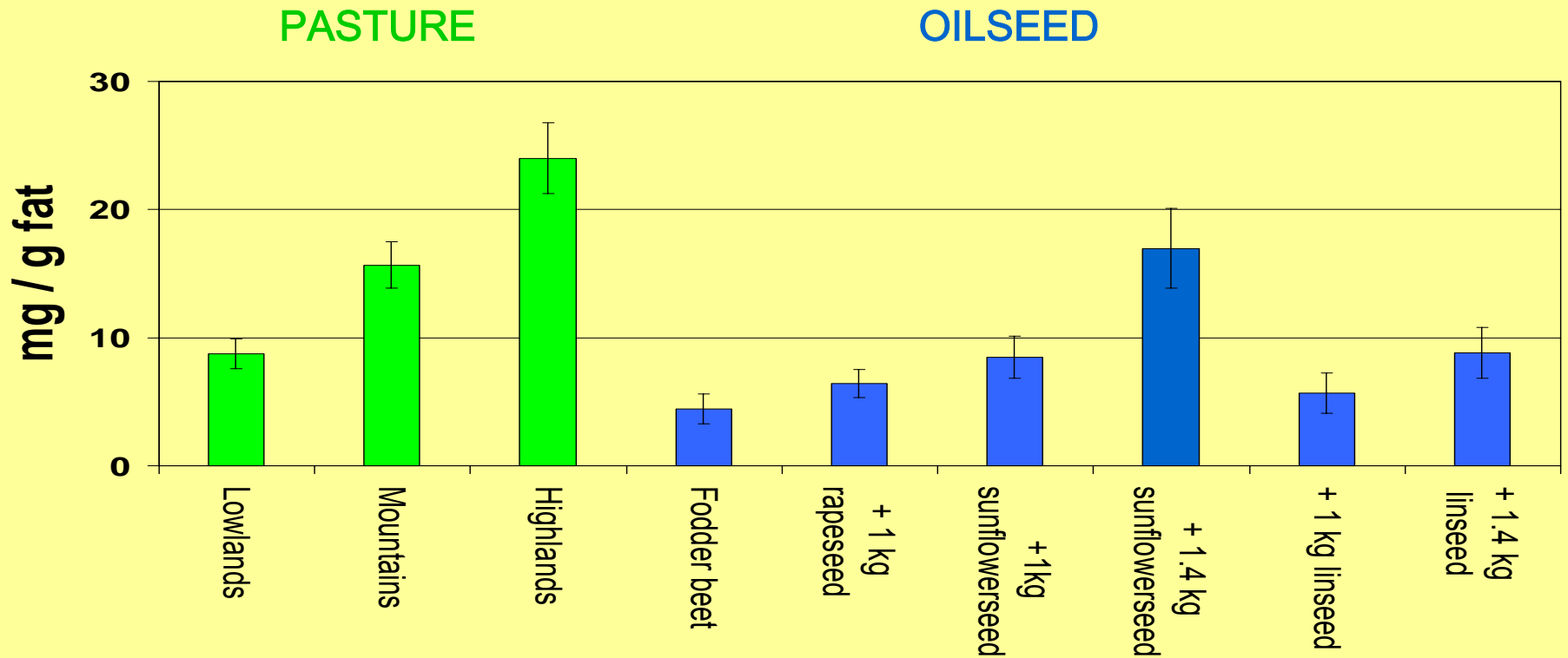
t11 c13

ct / tc 12,14

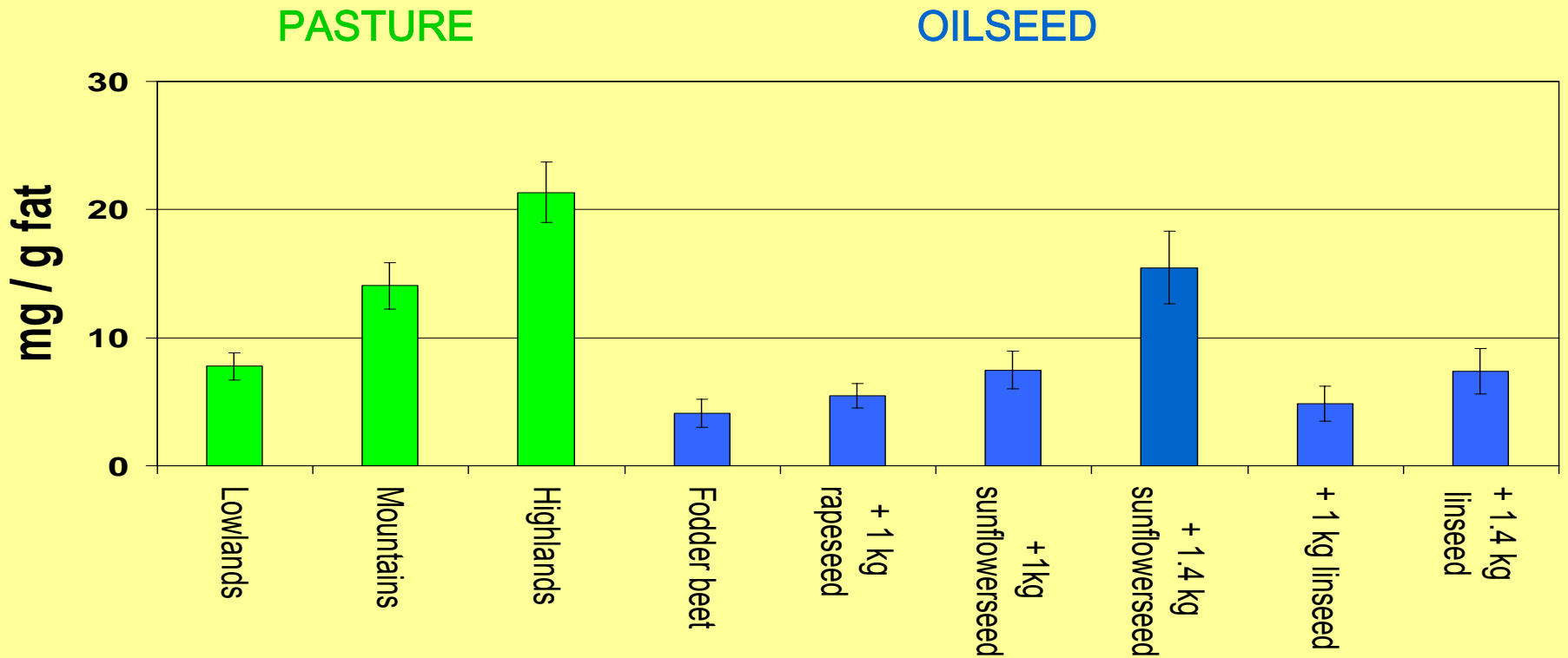
Sum of the trans, trans CLA



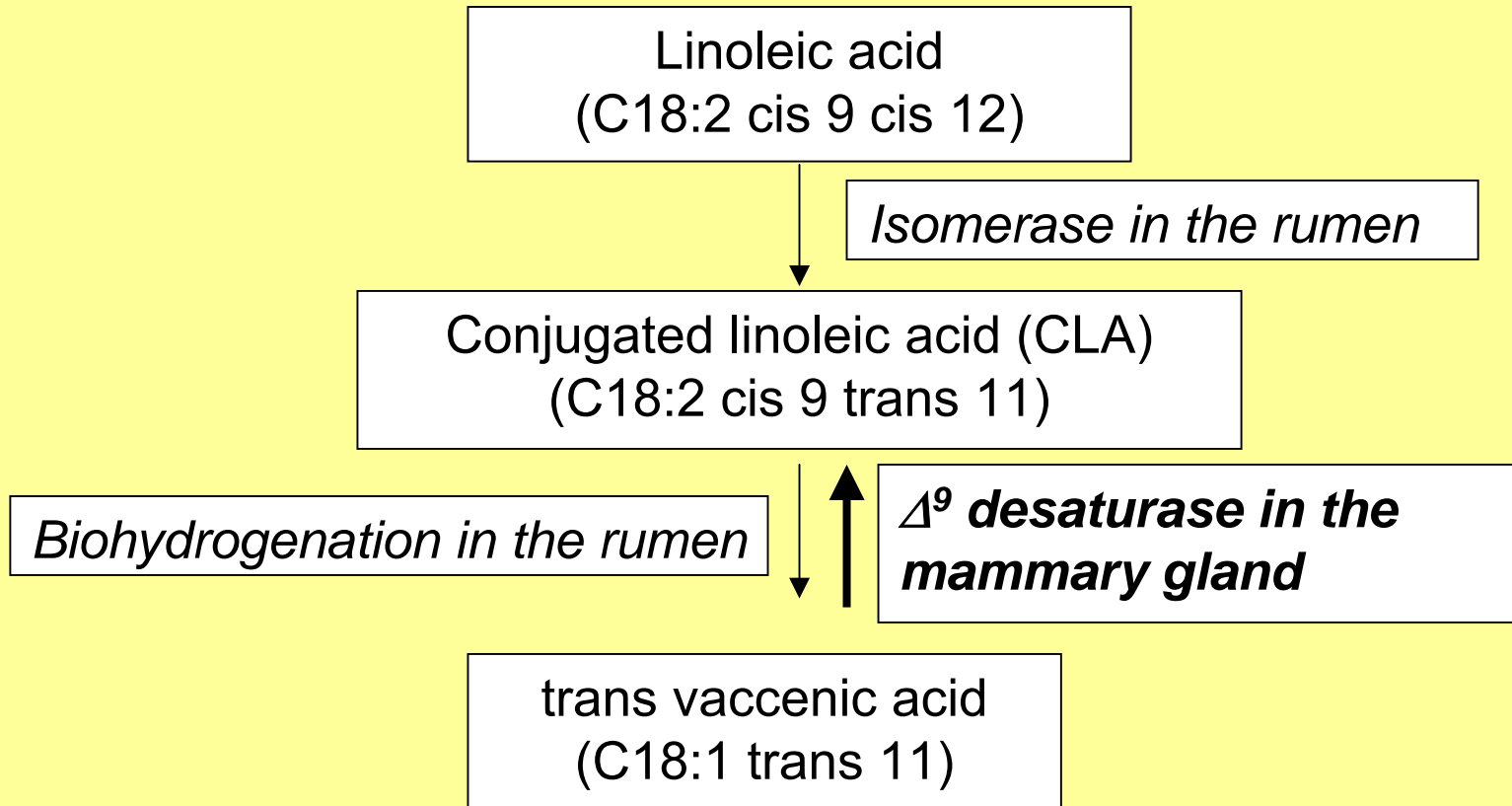
Sum of the cis, trans / trans, cis CLA



CLA cis 9, trans 11



Metabolic pathway for the formation of the CLA C18:2 cis 9, trans 11 from linoleic acid



Metabolic pathway for the formation of the CLA C18:2 cis 9, trans 11 from α -linolenic acid

α -Linolenic acid (C18:3 cis 9 cis 12 cis 15)

Isomerase in the rumen

C18:3 cis 9 trans 11 cis 15

Biohydrogenation in the rumen

C18:2 trans 11 cis 15

Biohydrogenation in the rumen

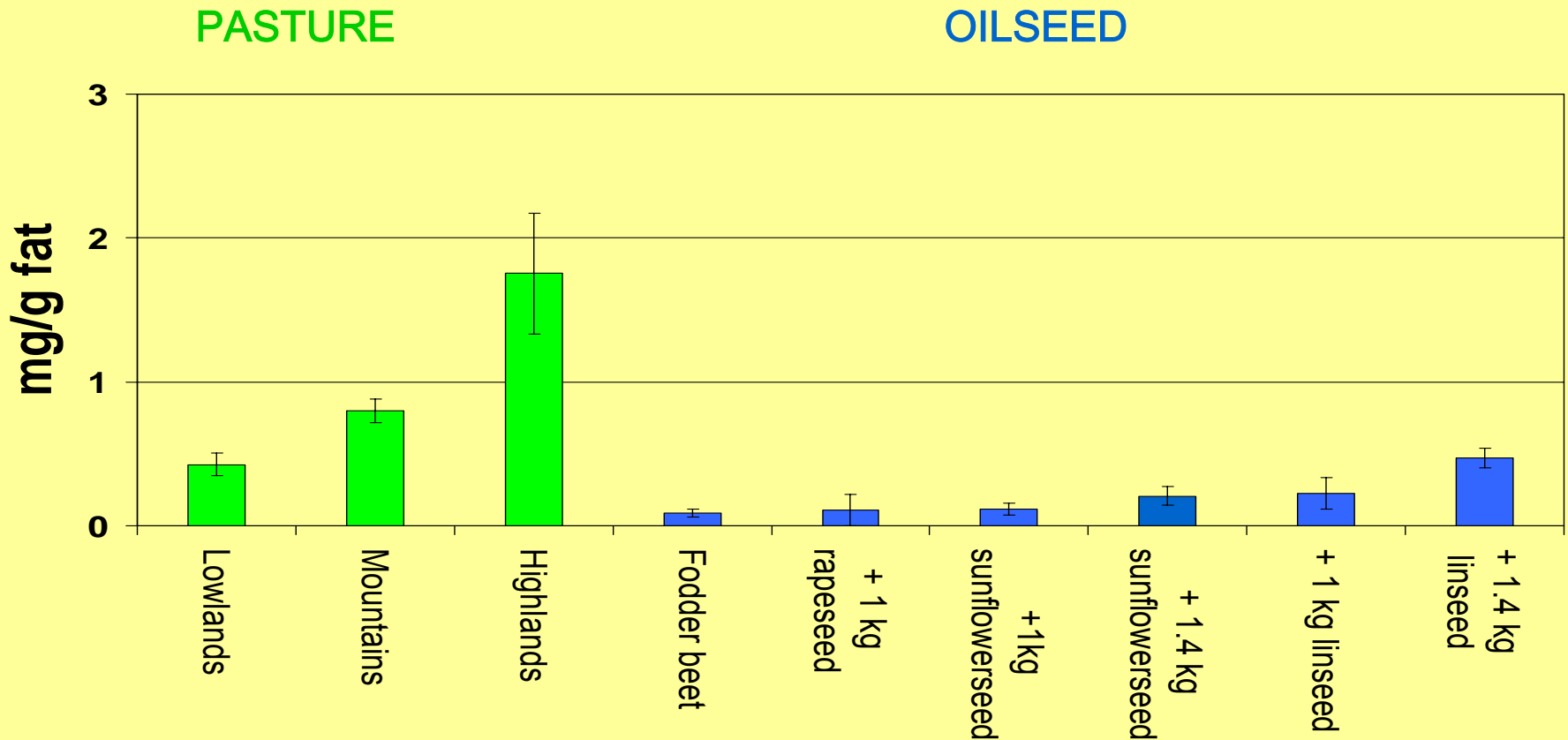
trans vaccenic acid
(C18:1 trans 11)

Δ^9 desaturase in the mammary gland

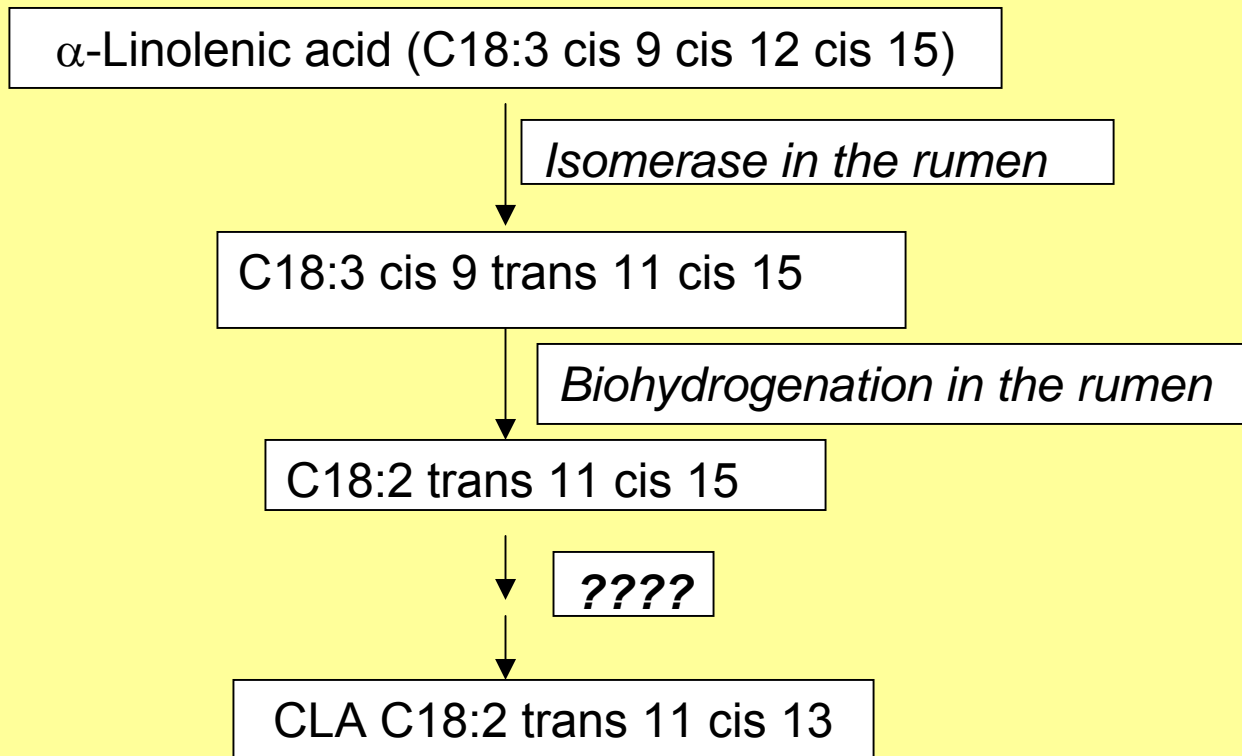
CLA C18:2 cis 9 trans 11

Ref.: Wilde and Dawson. *Biochem. J.* 98, 469-475 (1966); Griinari, Corl, Lacy, Chouinard, Nurmela and Bauman. *J. Nutr.* 130, 2285-2291 (2000).

CLA C18:2 trans 11, cis 13

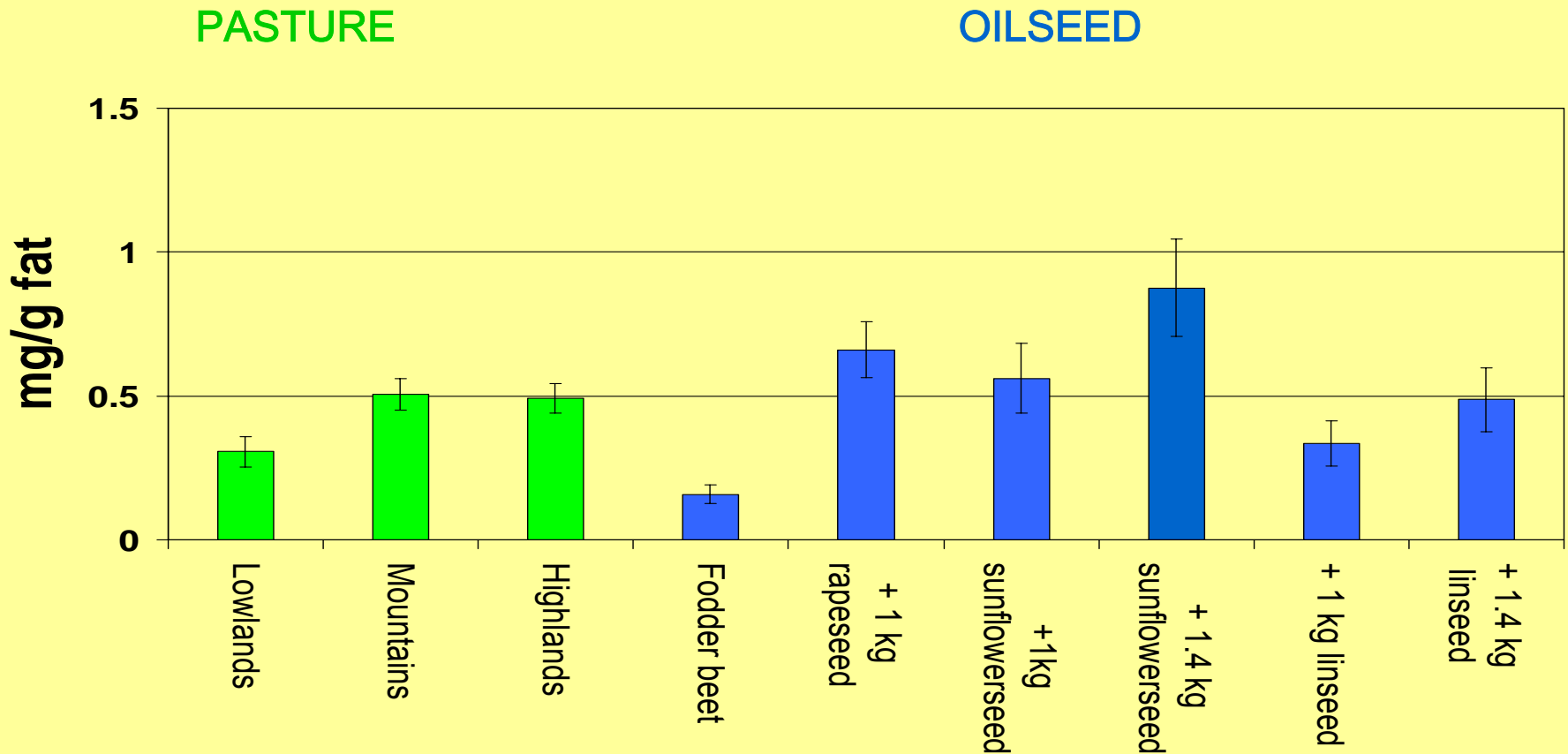


Metabolic pathway for the formation of the CLA C18:2 trans 11, cis 13 from α -linolenic acid

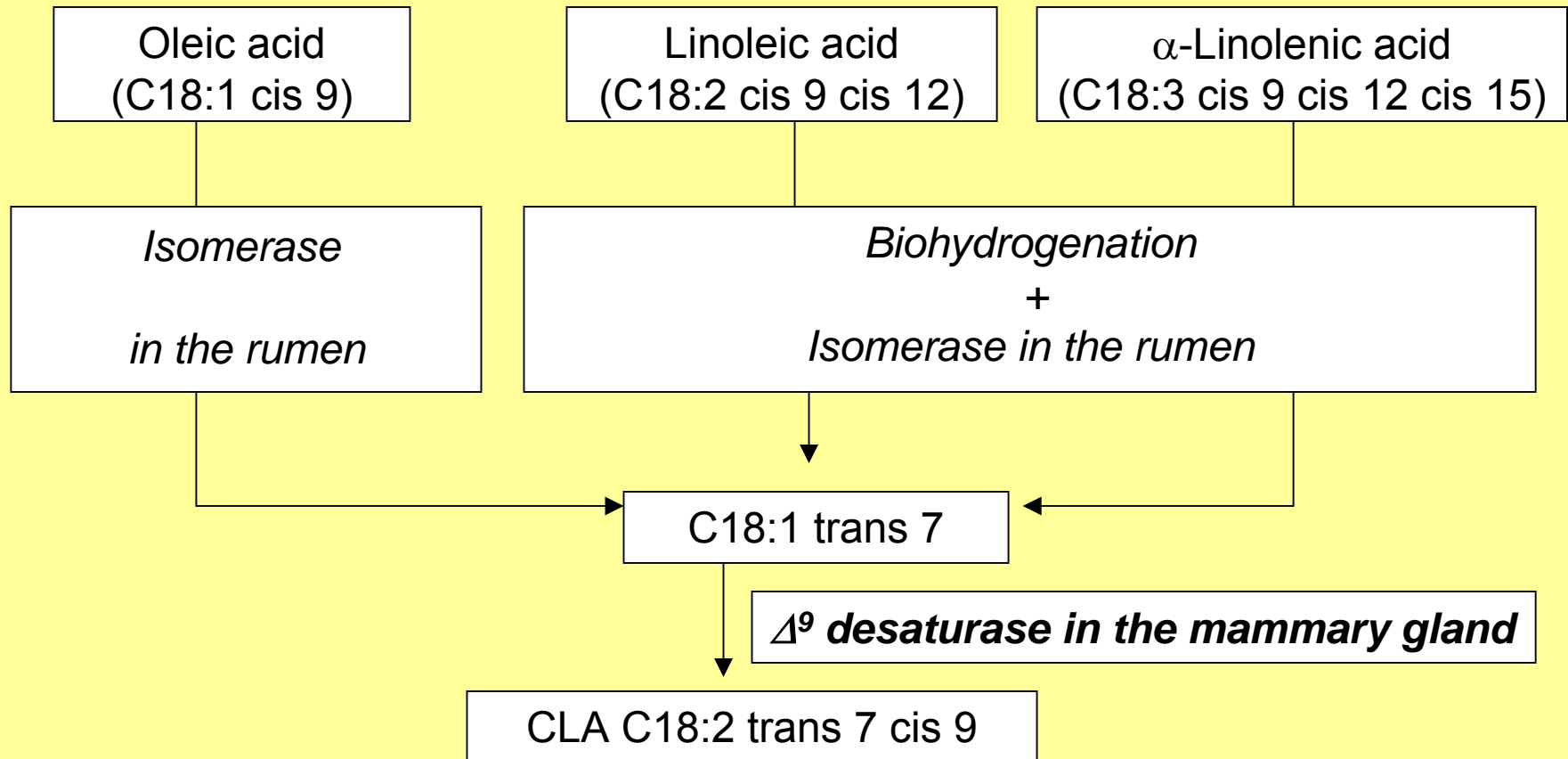


Ref. Wilde and Dawson. *Biochem. J.* 98, 469-475 (1966); Kraft, Collomb, Möckel, Sieber and Jahreis. *Lipids* 38, 657-664 (2003)

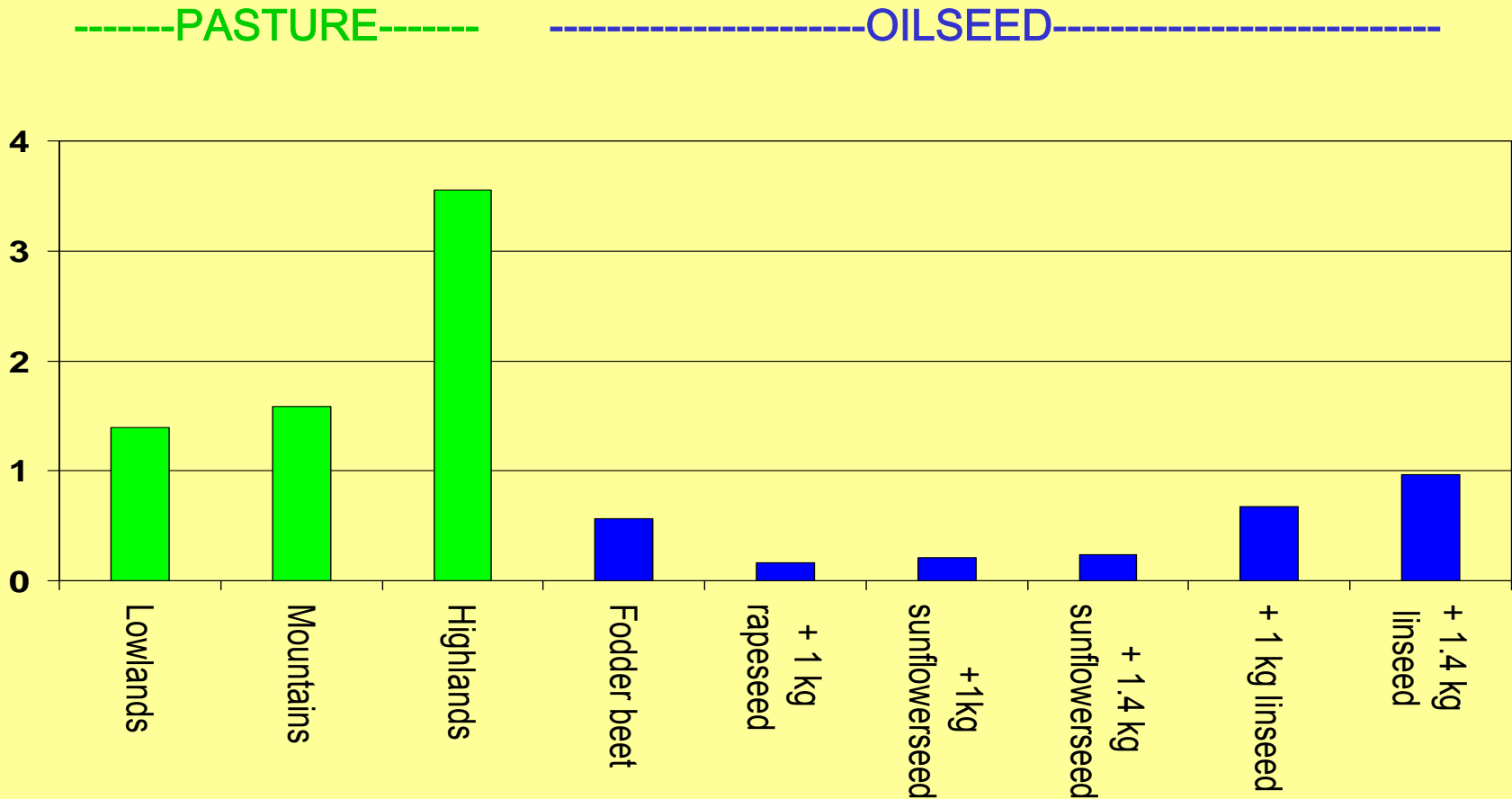
CLA C18:2 trans 7, cis 9



Metabolic pathway for the formation of the CLA C18:2 trans 7, cis 9



RELATION trans 11, cis 13 / trans 7, cis 9

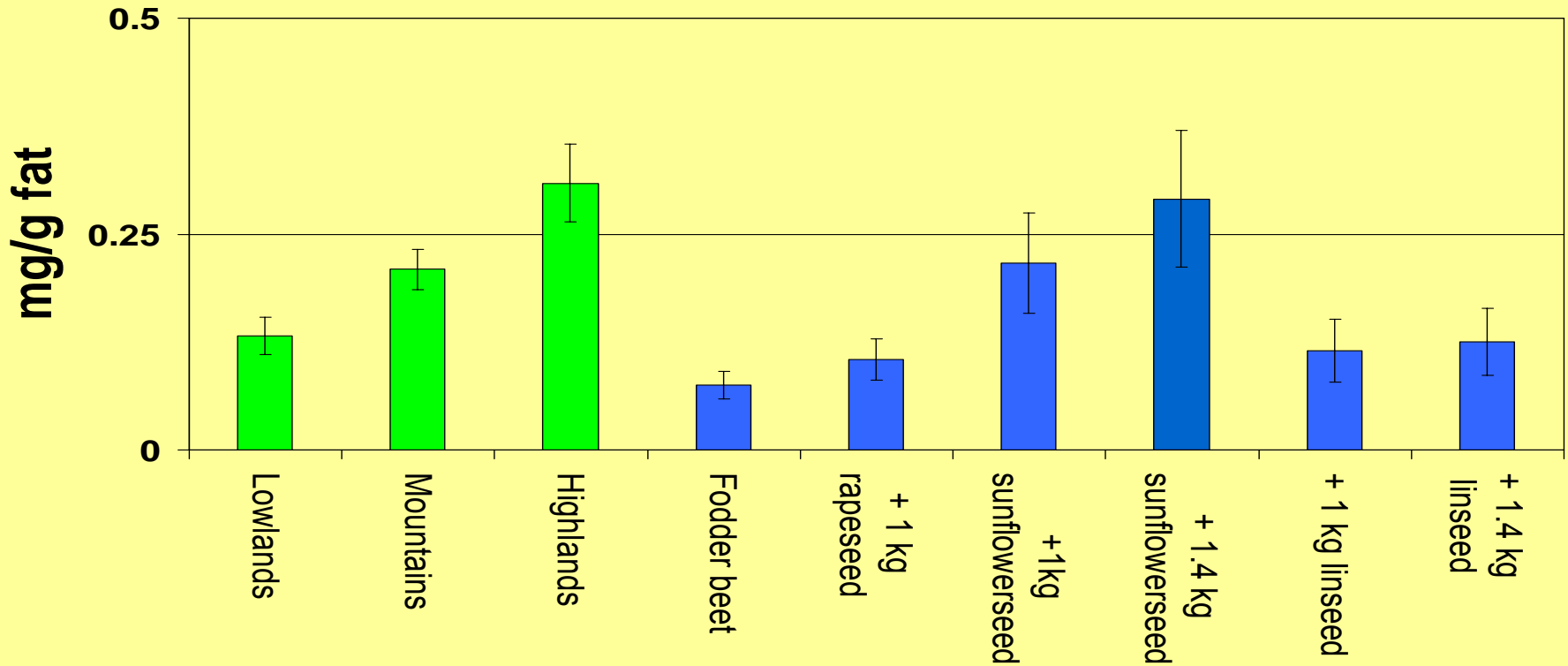


Ref. Kraft, Collomb, Möckel, Sieber and Jahreis. *Lipids* 38, 657-664 (2003)

CLA C18:2 trans 8, cis 10

PASTURE

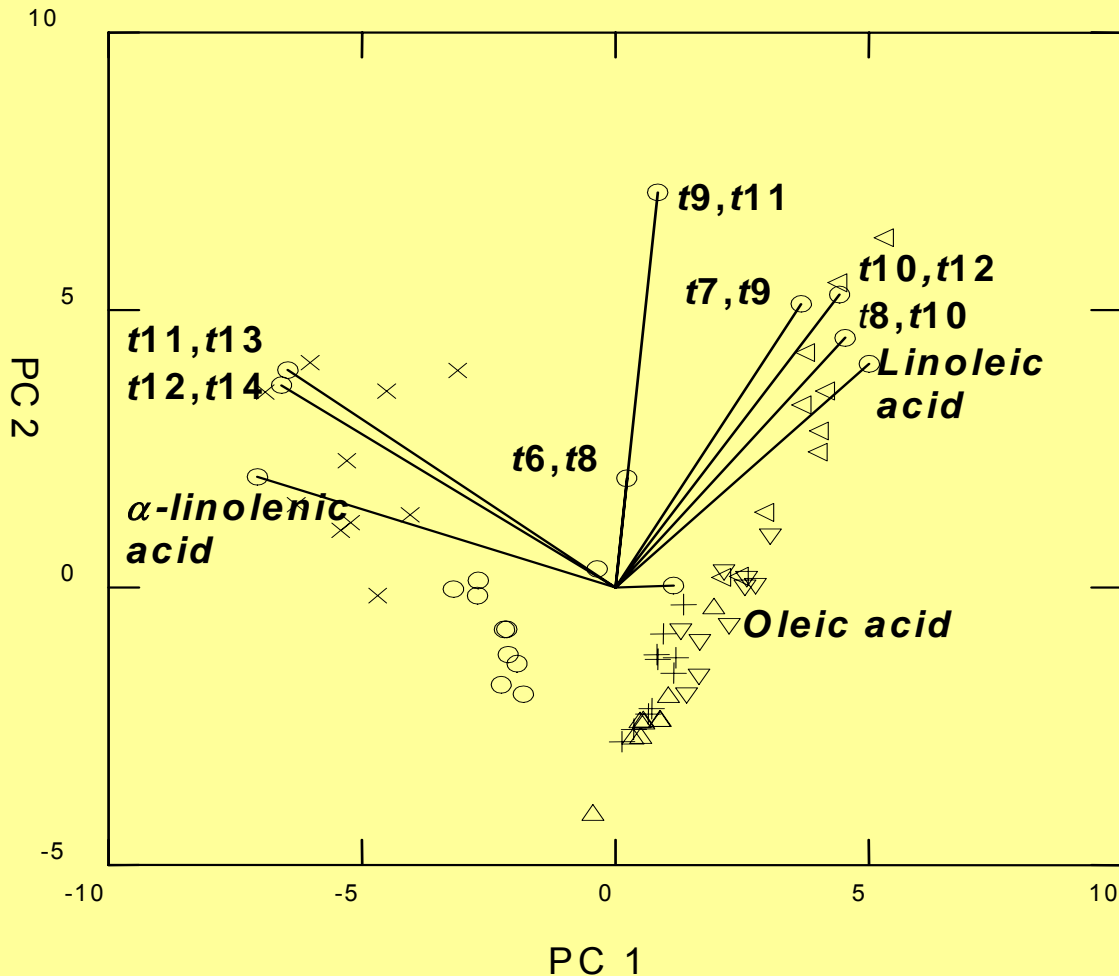
OILSEED



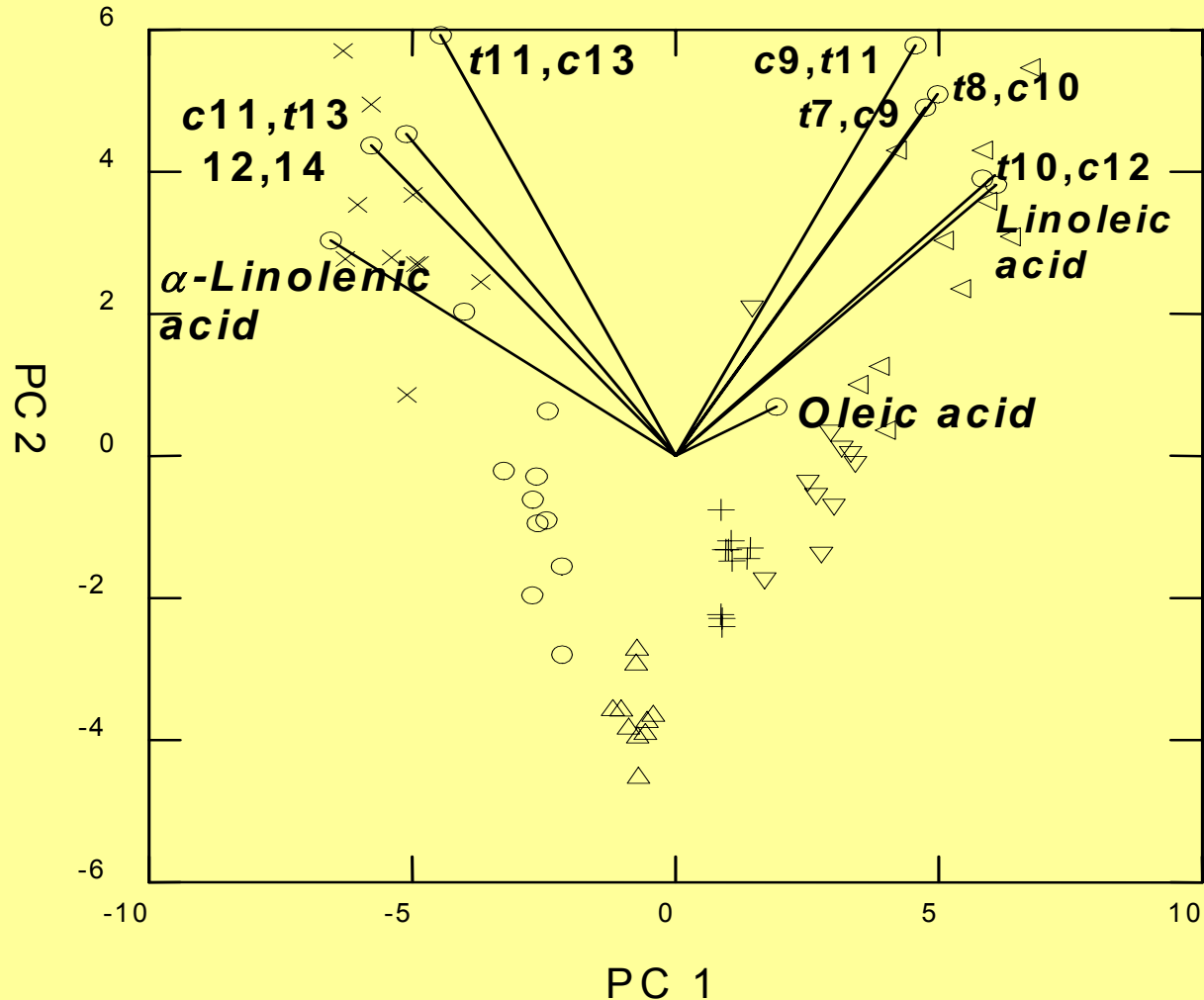
OILSEEDS STUDY: Positive correlation coefficients between the daily intake of UFA and the concentration of CLA in milk ($P < 0.001$)

Oleic acid	Linoleic acid	α -Linolenic acid
t7c9: 0.57	t10t12: 0.78	t12t14: 0.88
	t9t11: 0.58	t11t13: 0.89
	t8t10: 0.60	ct/tc12,14: 0.88
	t7t9: 0.47	t11c13: 0.76
	t10c12: 0.89	c11t13: 0.74
	c9t11: 0.81	
	t8c10: 0.85	
	t7c9: 0.74	

OILSEEDS STUDY: Principal component (PC) analysis of the daily intake of UFA and the *CLA* *tt* in milk. PC1 explains 39 % and PC2 28 % of the total variance



OILSEEDS STUDY: PC analysis of the daily intake of UFA and the **CLA *ct/tc* in milk. PC1 explains 46 % and PC2 35 % of the total variance**



CONCLUSION

- The concentrations of much isomers were highest in milk fat from highlands but those of only 3 isomers (CLA c9t11, t11c13 and t8c10) increased linearly with elevation. These 3 compounds (and particularly the CLA t11c13) could be interesting indicators for the origin of summer Alpine milk products
- CLA t7c9 was found in highest concentration in milk fat from cows fed a oleic acid-rich diet (RAPESEED)
- CLA t10t12, t9t11, t8t10, t7t9, t10c12, c9t11 and t8c10 were found in highest concentrations in milk fat from cows fed a linoleic acid-rich diet (SUNFLOWERSEED)
- CLA t12t14, t11t13, ct/tc 12,14, t11c13 and c11t13 were found in highest concentrations in milk fat from cows fed a α -linolenic acid-rich diet (LINSEED)