

Improving the fatty acid composition of ruminant products

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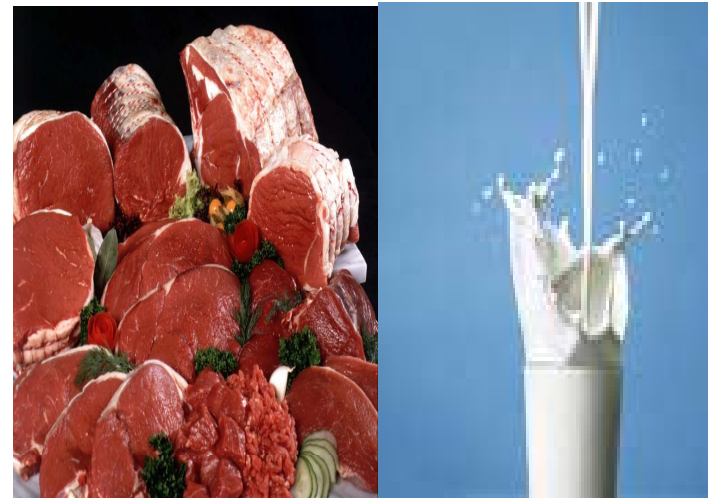
Quality Beef and Milk from Forage

Designing natural feed systems to produce quality beef and milk in a sustainable and efficient manner. Incorporating research on:



What is Quality?

- Consumer and quality
- Nutritional value and colour shelf life
- Payment for quality

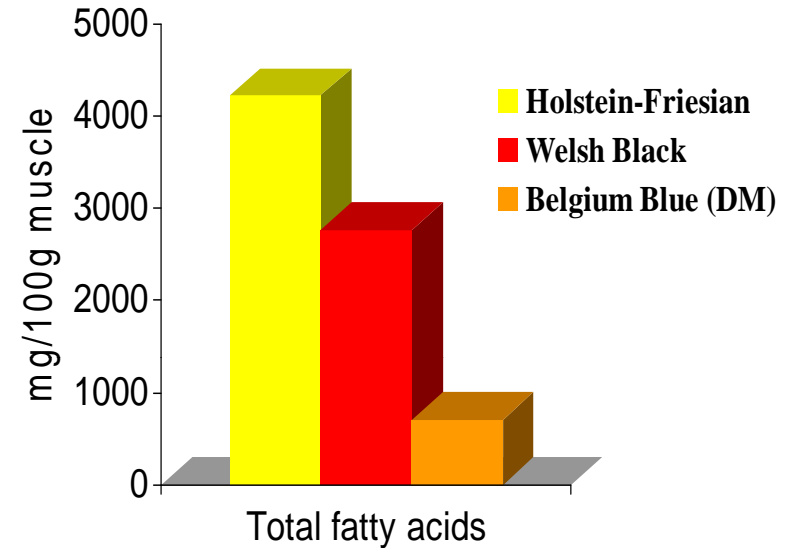
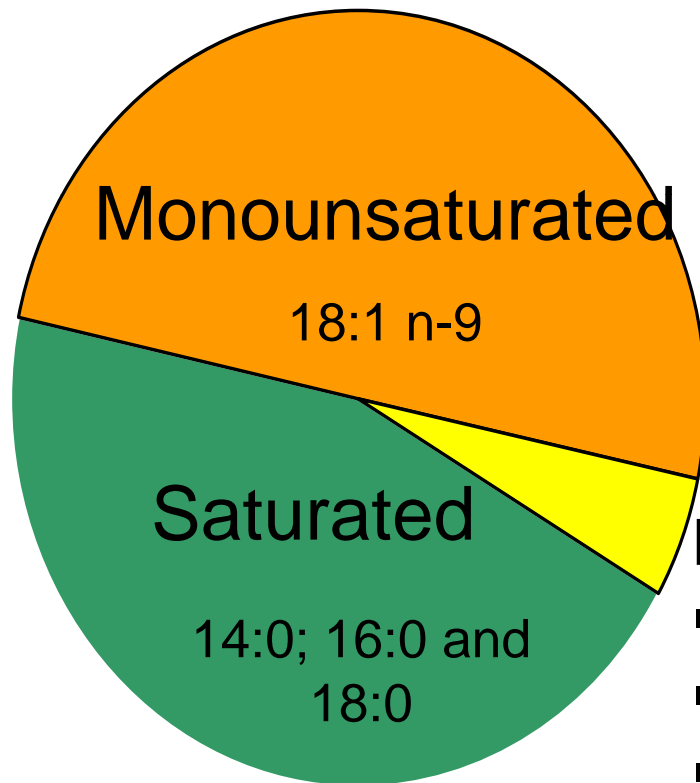


Consumer attitudes to ruminant products

- Price and a perception of product quality
- Food safety
 - Lifestyle
 - Animal welfare/exploitation
 - Health
 - Alternatives to animal products
 - Environmental impact
 - Recent food scares
- Production methods



Fatty acids in beef



Polyunsaturated fatty acids (PUFA)

- linoleic acid (18:2n-6)
- α -linolenic acid (18:3n-3)
- eicosapentaenoic acid (20:5n-3; EPA)
- docosahexaenoic acid (22:6n-3; DHA)

Omega-3 LC-PUFA deficiency and associated disorders

- Coronary heart disease and stroke
- EFA deficiency in infancy and associated retinal and brain damage
- Auto-immune disorders (e.g. lupus, and nephropathy)
- Crohn's disease
- Mild hypertension and Rheumatoid arthritis

Strategies

- Nutrition
 - Genetic (breeds : dairy v. beef)
 - Sex (Heifers v. Bulls v. Steers)

Sources of dietary fatty acids

- Forages

- Oils and oilseeds

rapeseed	C18:1 <i>n</i> -9 oleic acid
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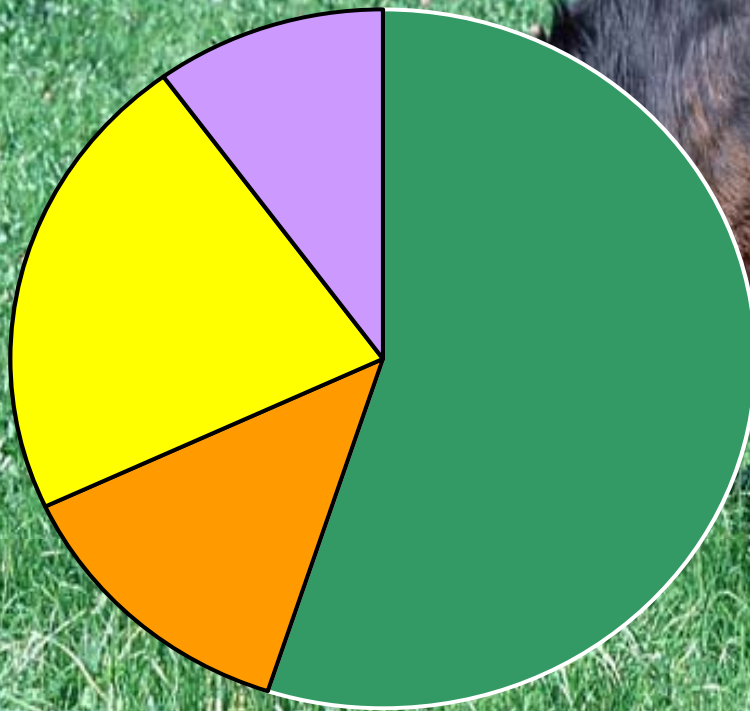
soybean	C18:2 <i>n</i> -6 linoleic acid
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linseed	C18:3 <i>n</i> -3 linolenic acid
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echium	C18:4 <i>n</i> -3 stearidonic acid
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- Fish oil and marine algae - long chain C20 EPA and DHA

Fatty acids in herbage



■ **linolenic acid**
(18:3n-3)

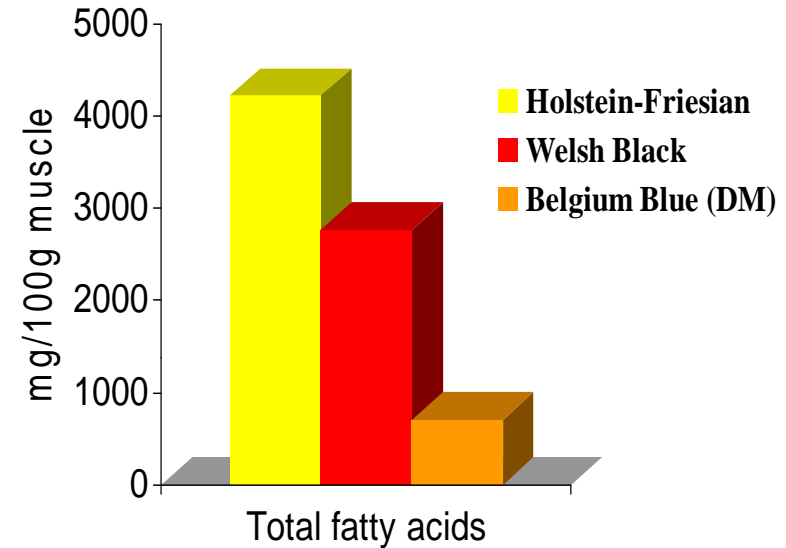
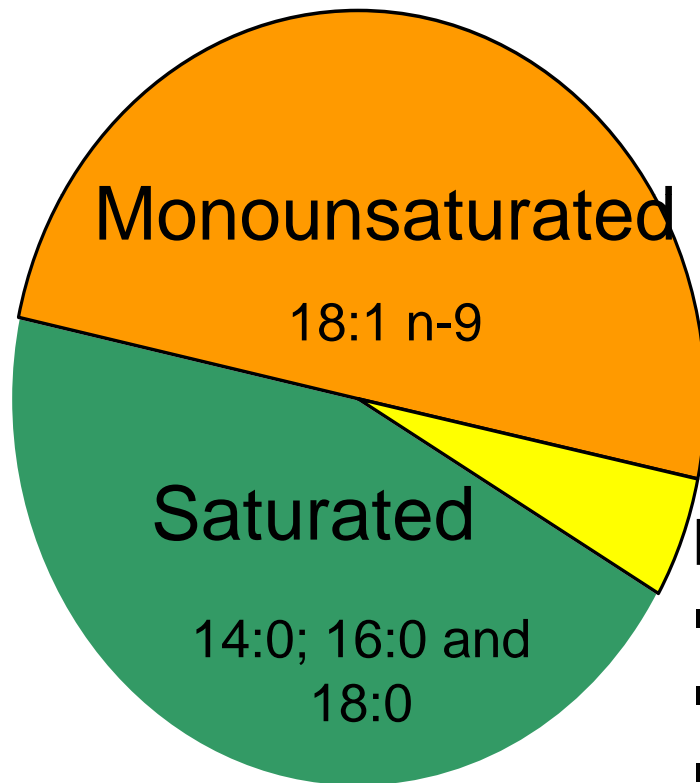
■ **linoleic acid**
(18:2n-6)

■ **palmitic acid**
(16:0)

■ **other**



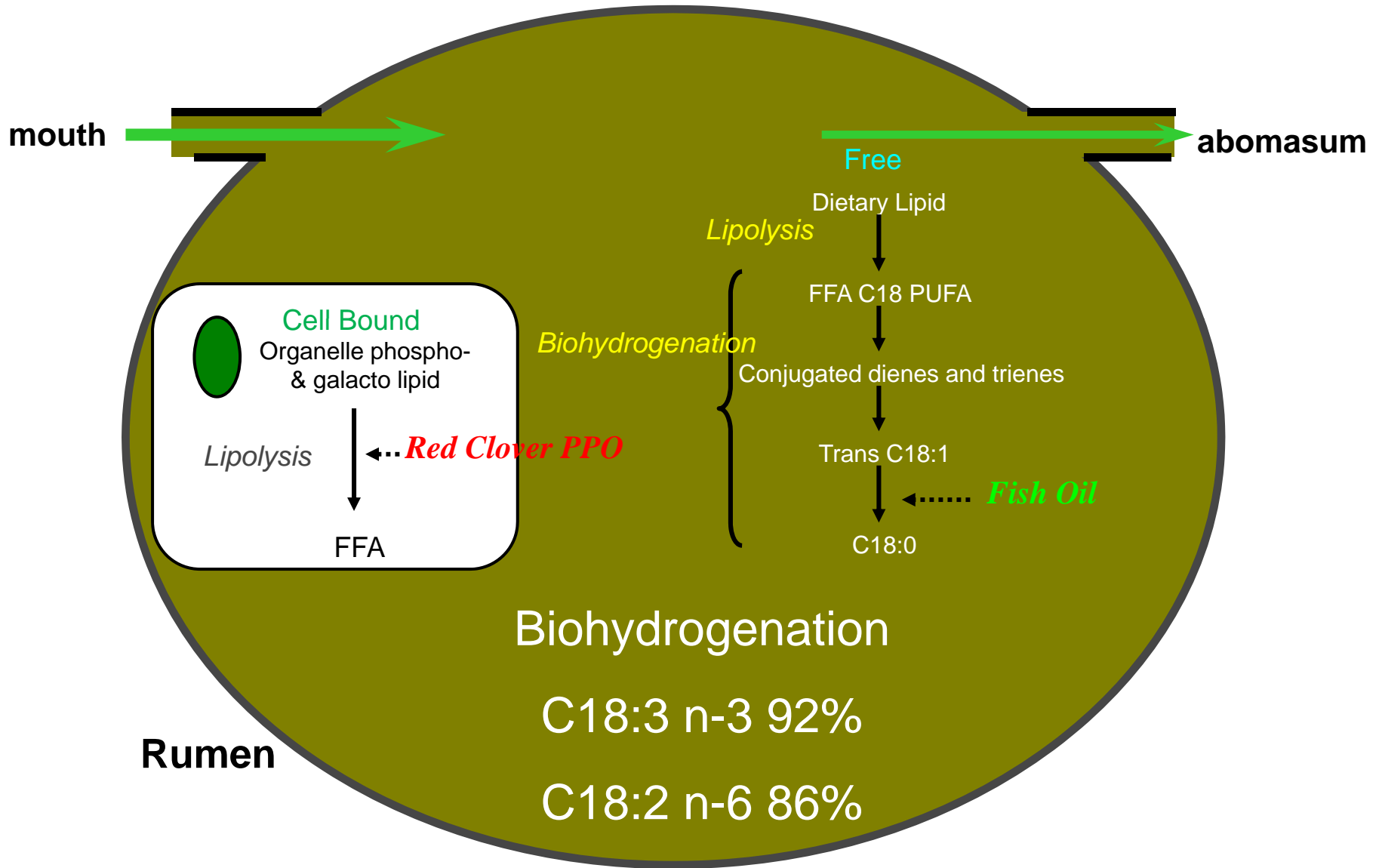
Fatty acids in beef



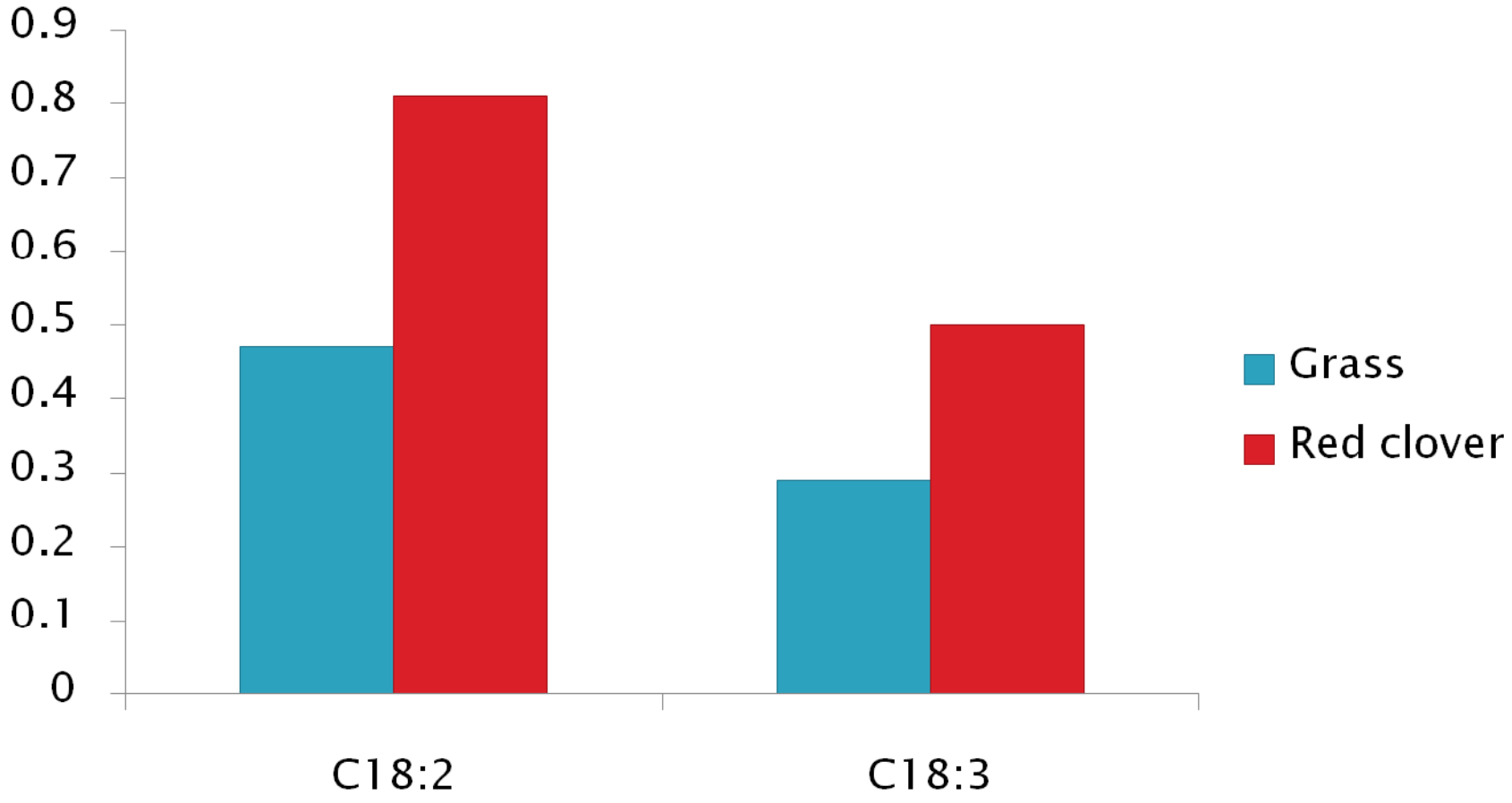
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Lipolysis and Biohydrogenation



Effect of red clover versus grass on milk (mg/ml) PUFA

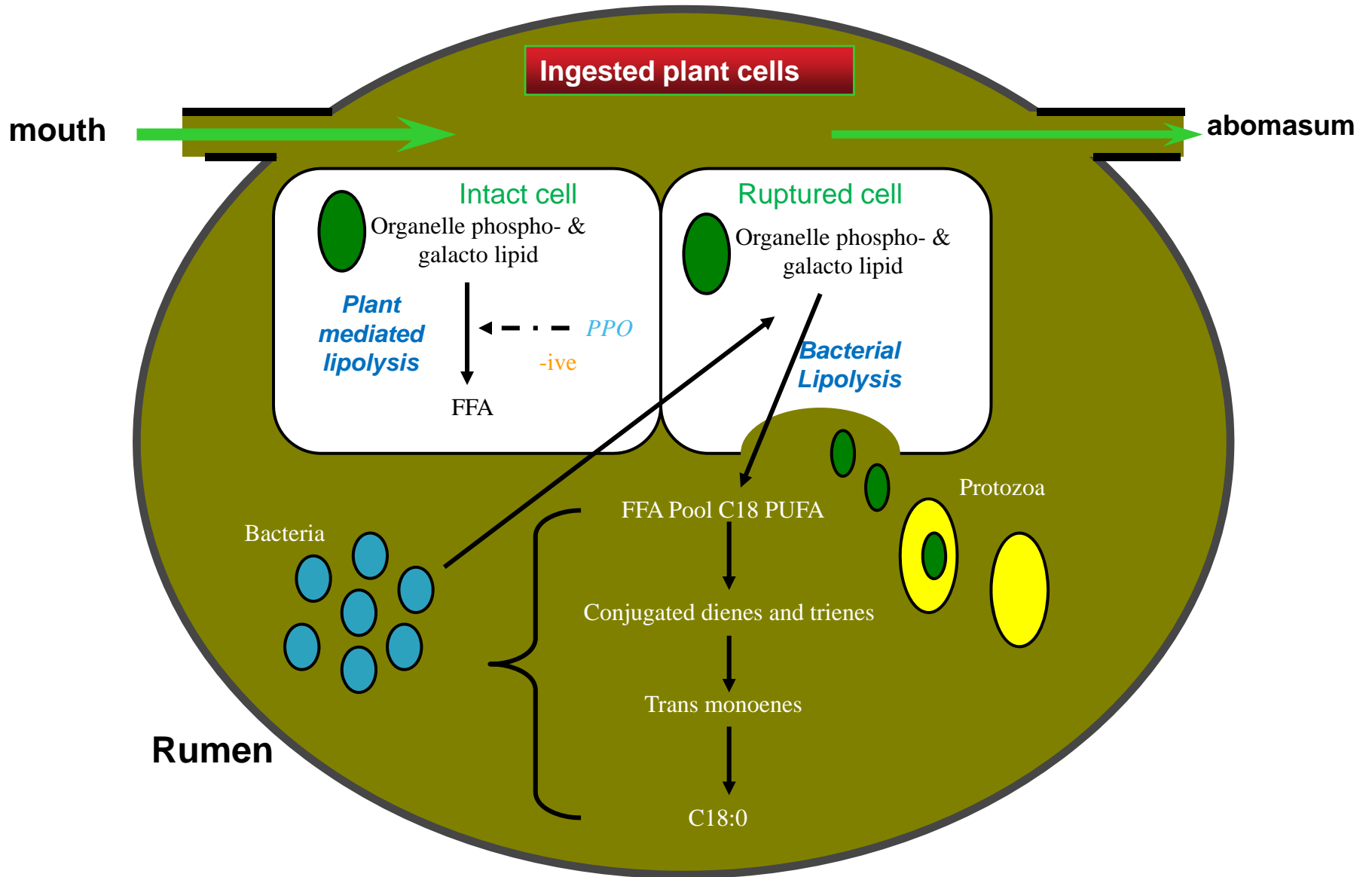


Polyphenol oxidase (PPO) in red clover

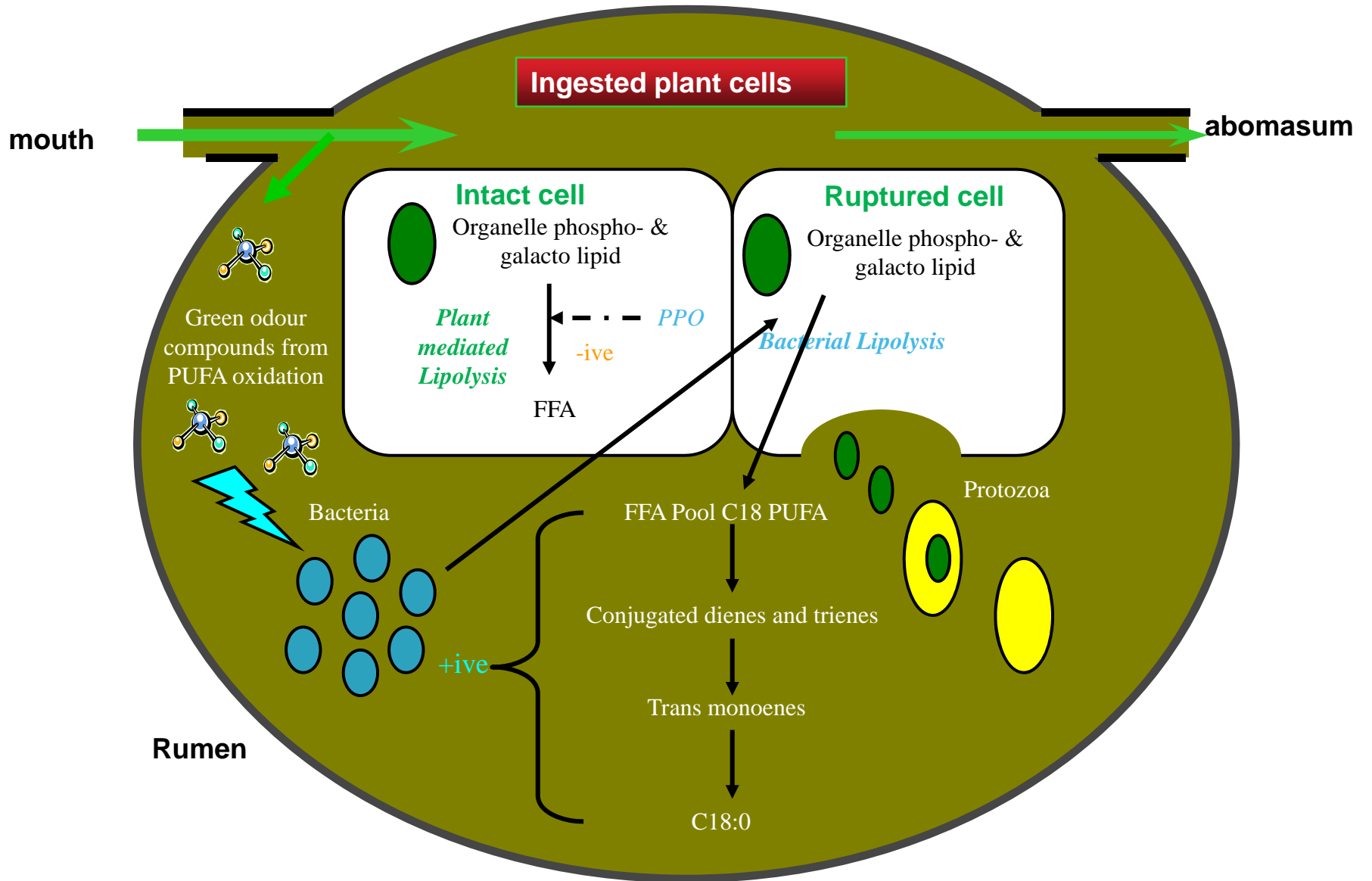


- Oxidises phenols to quinones in the presence of oxygen
- Quinones are very reactive
- Quinones bind to proteins to give protein-quinone complexes

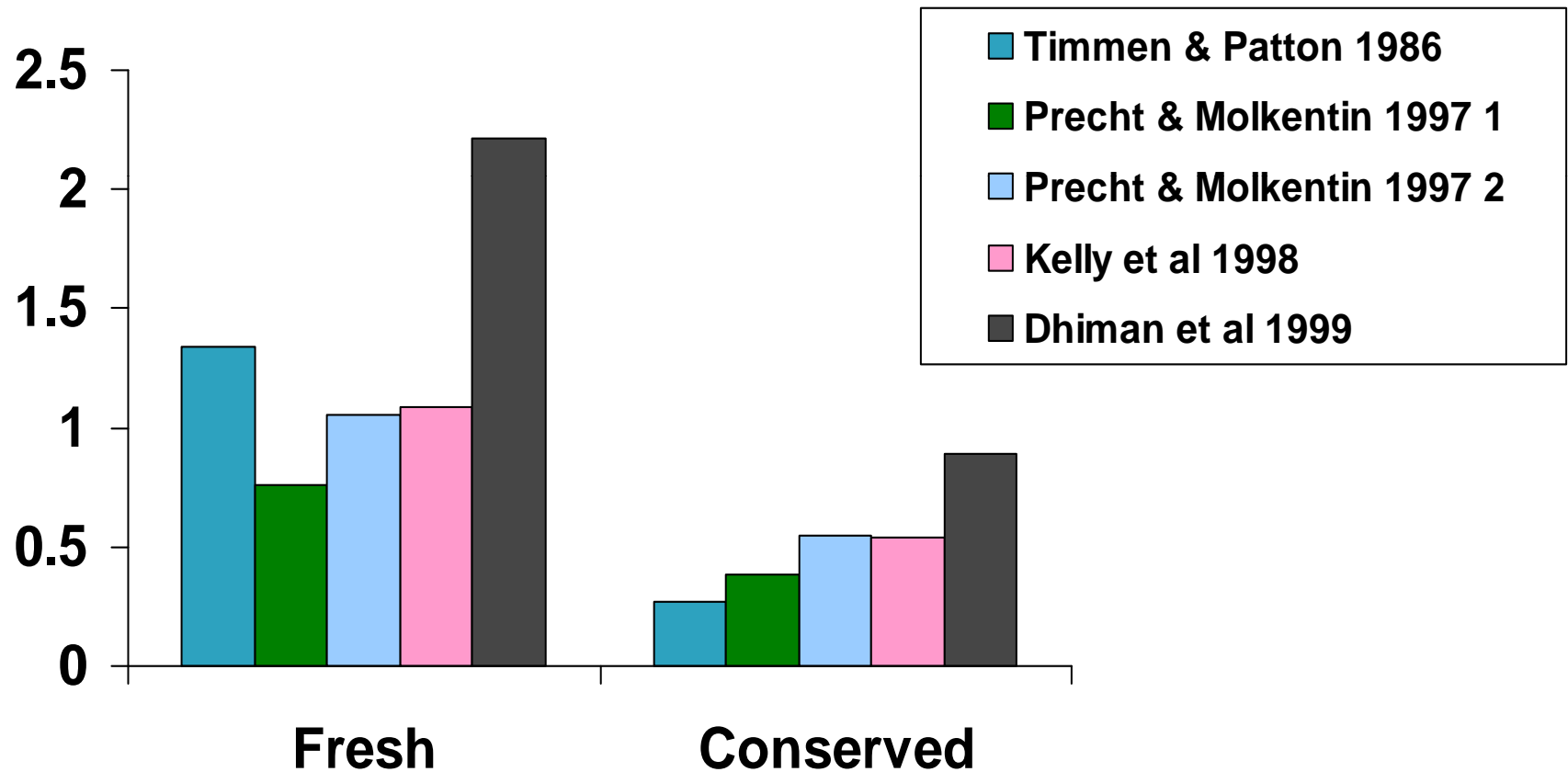
Plant:Microbe Interactions



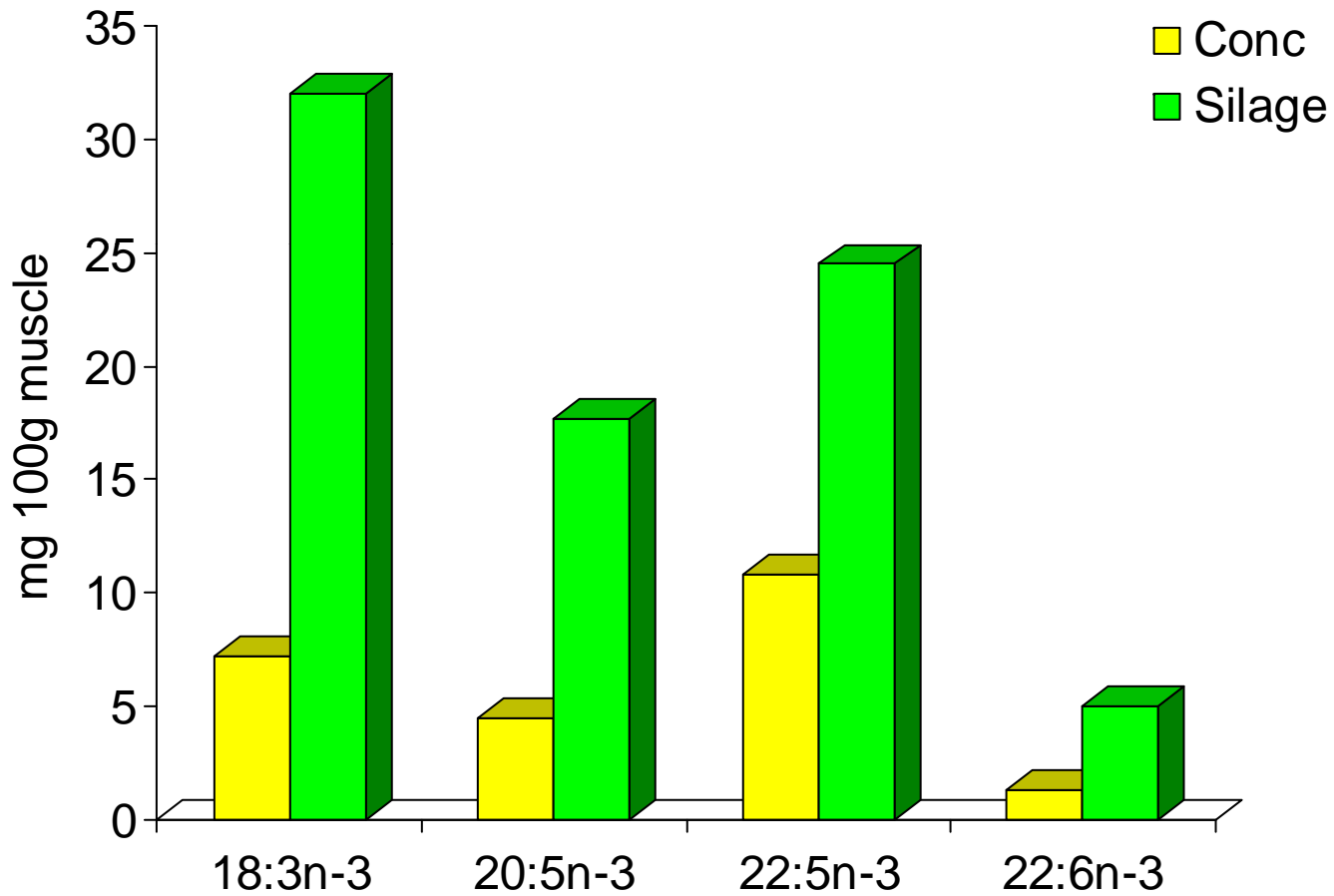
Green Odour



Conservation effect on CLA (g/100g) in milk fat



Effect of forage compared to concentrate feeding

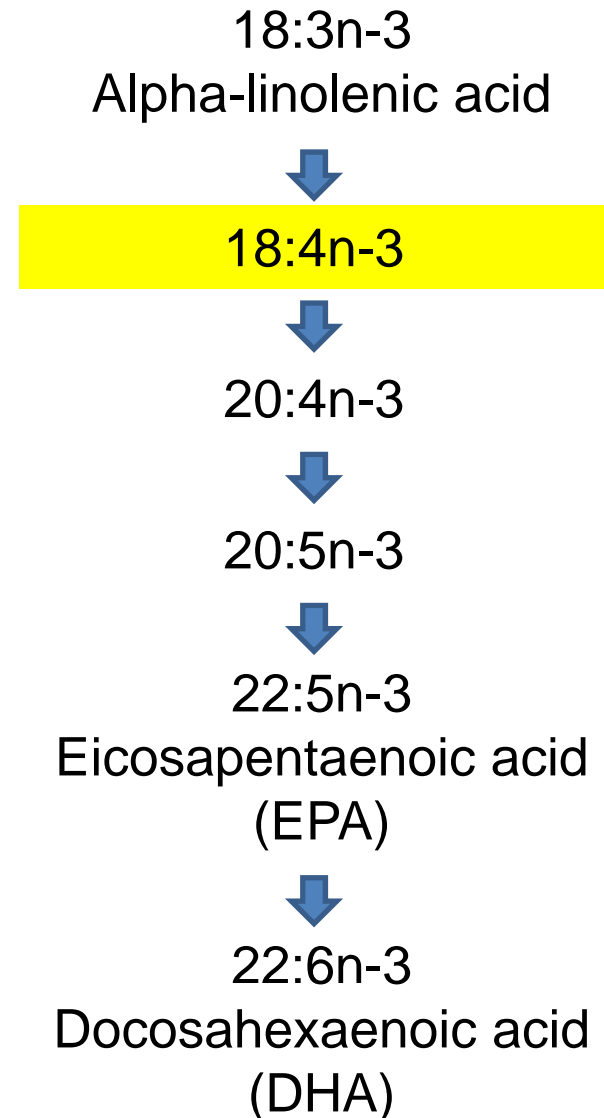


Chain Elongation

- Conversion of 18:3n-3 to 18:4n-3 is important (rate-limiting) for EPA and DHA synthesis
- 18:4n-3 is rich in Echium oil

➤ Trial

To assess effect of feeding plant oil rich in 18:4n-3 PUFA on the fatty acid composition of beef and meat quality in steers

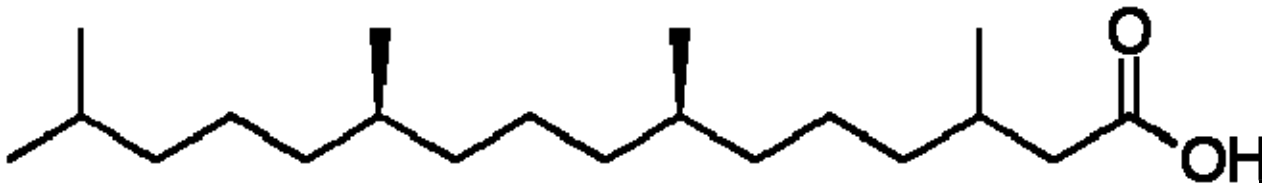


Fatty acid composition (mg/100 g muscle)

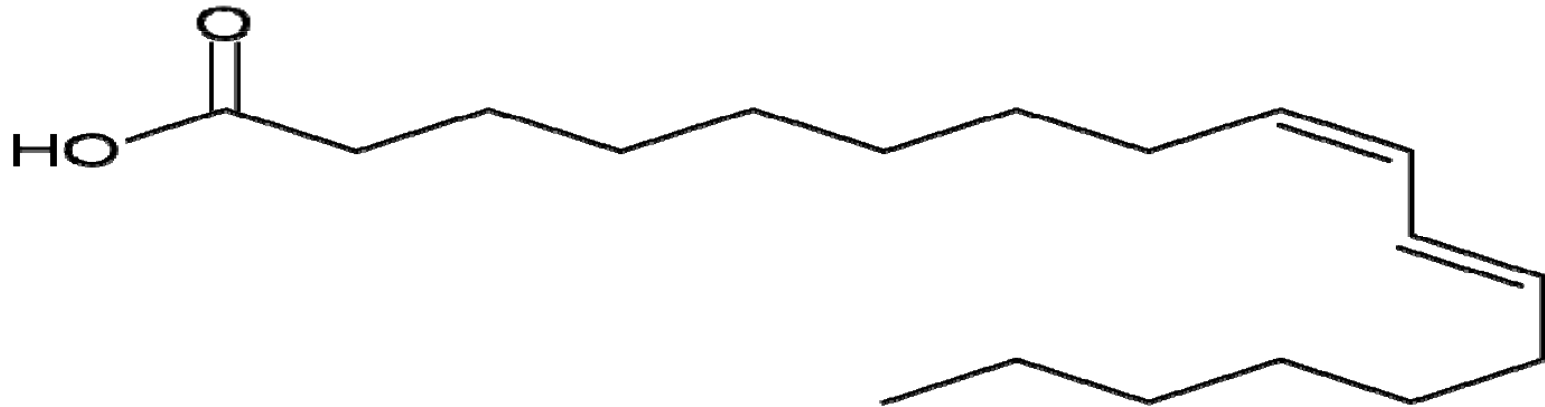
	GS	GS-LEO	GS-HEO	GS-LO	s.e.d.	P
Total fatty acids	3179	4090	4075	3385	601.7	NS
18:1 <i>trans</i> , total	42.0 ^a	77.1 ^b	122.6 ^c	79.1 ^b	13.85	<0.001
CLA (<i>cis</i> -9, <i>trans</i> -11)	9.7 ^a	15.5 ^a	25.0 ^b	15.2 ^a	3.01	<0.001
20:5 n -3 (EPA)	16.7	15.5	14.5	17.0	0.96	0.06
22:6 n -3 (DHA)	3.3	3.3	2.7	3.4	0.27	0.06
TBARS, day 10 (mg/kg muscle)	0.66	0.55	0.46	0.49	0.093	NS

- 1) grass silage *ad libitum* (GS),
- 2) grass silage *ad libitum* plus 1.5% Echium oil / silage DMI (GS-LEO)
- 3) grass silage *ad libitum* plus 3.0% Echium oil / silage DMI (GS-HEO)
- 4) grass silage *ad libitum* plus 3.0% linseed oil / silage DMI (GS-LO)

Interesting Unique Fatty Acids



Phytanic acid

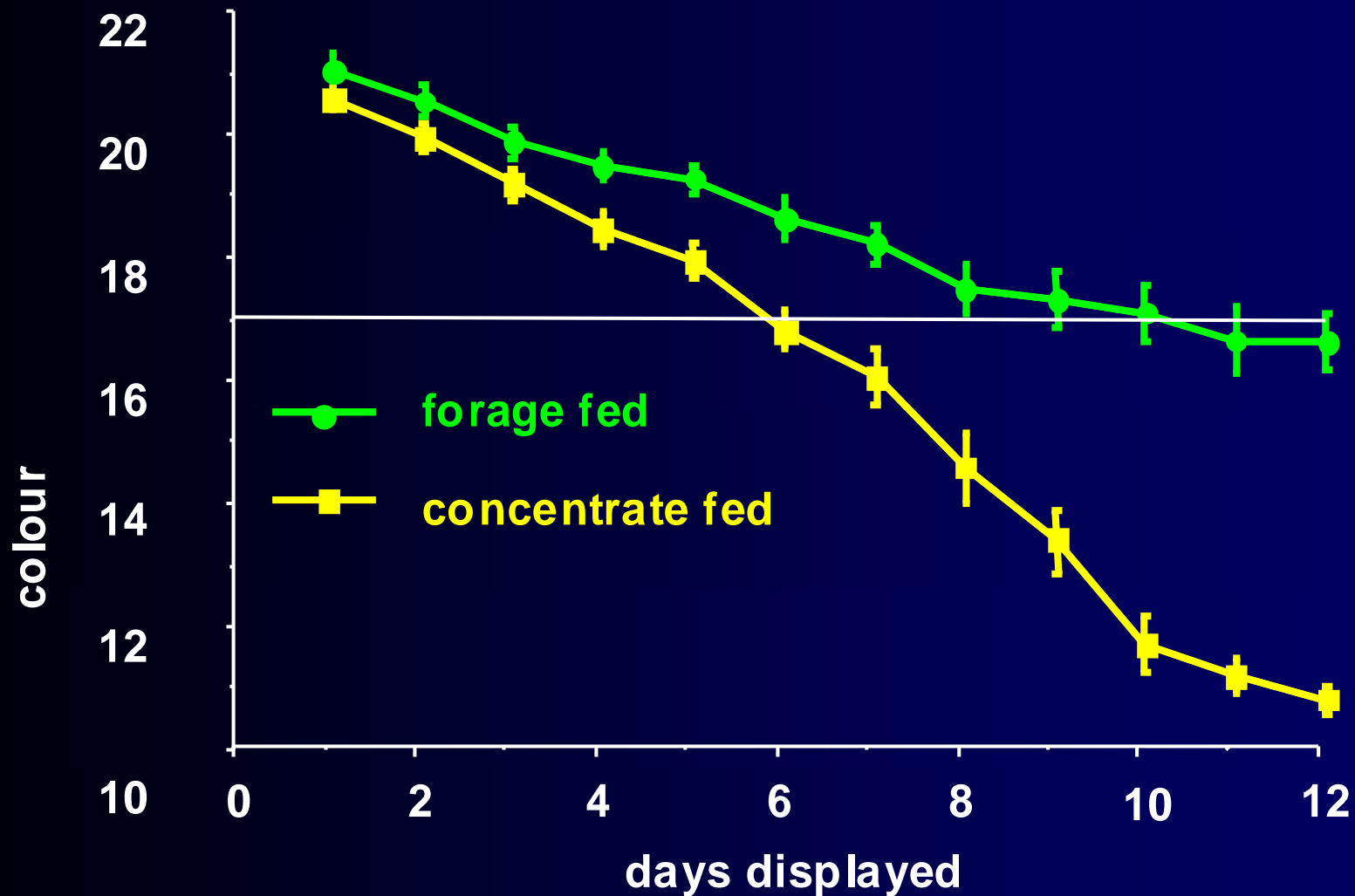


Rumenic acid (cis-9 trans-11 CLA)

Colour shelf life



Effect of diet on beef colour of 10d aged loin steaks during display in MAP



Loin steaks aged for 10d and displayed for 14d

Concentrate



Forage



The Eighth International Symposium
on
the Nutrition of Herbivores (ISNH8)
'Herbivores in a Changing World'

6th – 9th September 2011
Aberystwyth, Wales UK

www.isnh8.org