

Omega-6 Fatty Acids

What, Why, Where and How?

Peter Lapinskas

www.lapinskas.com

A Fitter Future for Fats

Leatherhead Food RA

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What, Why, Where and How?

- **What** are Omega-6 fatty acids?
- **Why** are they important?
- **Where** are they found?
- **How** can they be used?

Fat is bad for you!

are
Fat ~~is~~ bad for you!
↑
Some types of

may be

~~are~~

~~Fat is bad for you!~~

Some types of



Some types of fat may
be bad for you

on the other hand.....

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be bad for you

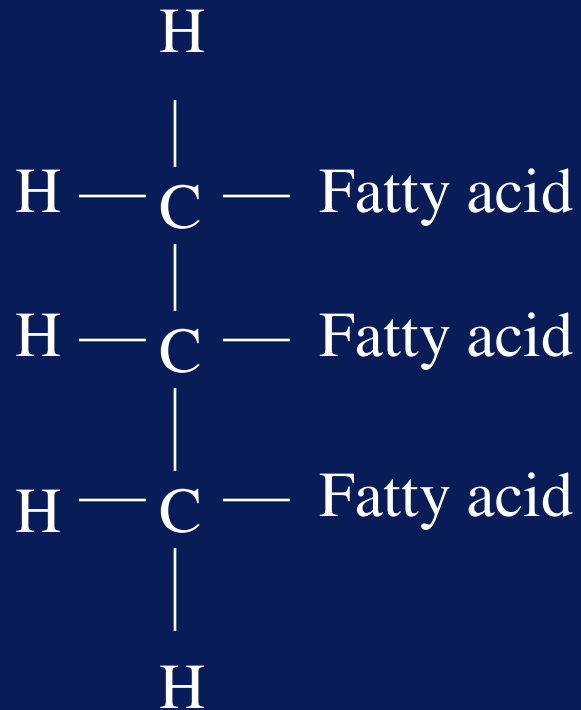
on the other hand.....

Some types of fat are
essential for human health

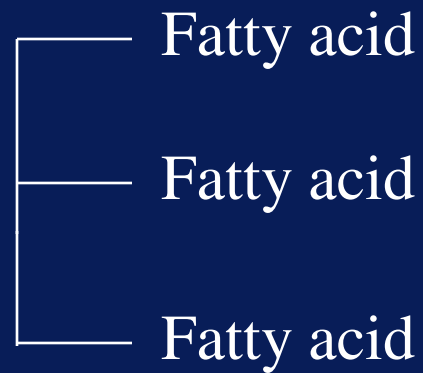
Fats and Fatty acids

- Fats and oils are made of triglycerides (98%+)
- Each triglyceride molecule contains 3 fatty acids
- There are a range of different fatty acids
- The mix of fatty acids determines the properties of the fat or oil
- Therefore will discuss fatty acids rather than fat

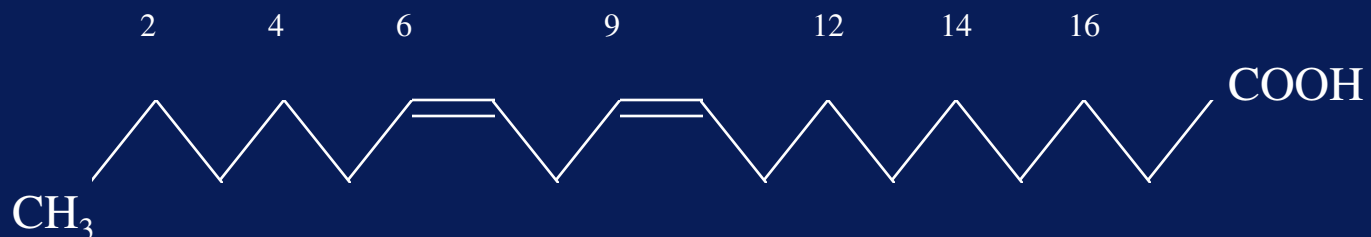
Structure of a Triglyceride



Structure of a Triglyceride



Structure of a Fatty Acid



Linoleic acid

cis, cis 9,12 octadecadienoic acid

An omega-6 fatty acid

Omega-6 Fatty Acid Functions

- Membrane structure - fluidity, receptors, enzymes and channels
- Skin permeability
- Cholesterol movement - ω -6 fatty acid esters are more soluble
- Precursors for regulatory molecules
 - Control of inflammation
 - Platelet aggregation
 - Vasoconstriction/dilation

Omega-6 Pathway

Common in
healthy diet

Linoleic acid (18:2)

desaturation

γ -Linolenic acid (18:3)

elongation

Dihomo- γ -linolenic acid (20:3)

desaturation

Arachidonic acid (20:4)

Some available
from meat and eggs

Omega-6 Pathway

Linoleic acid (18:2)



γ -Linolenic acid (18:3)

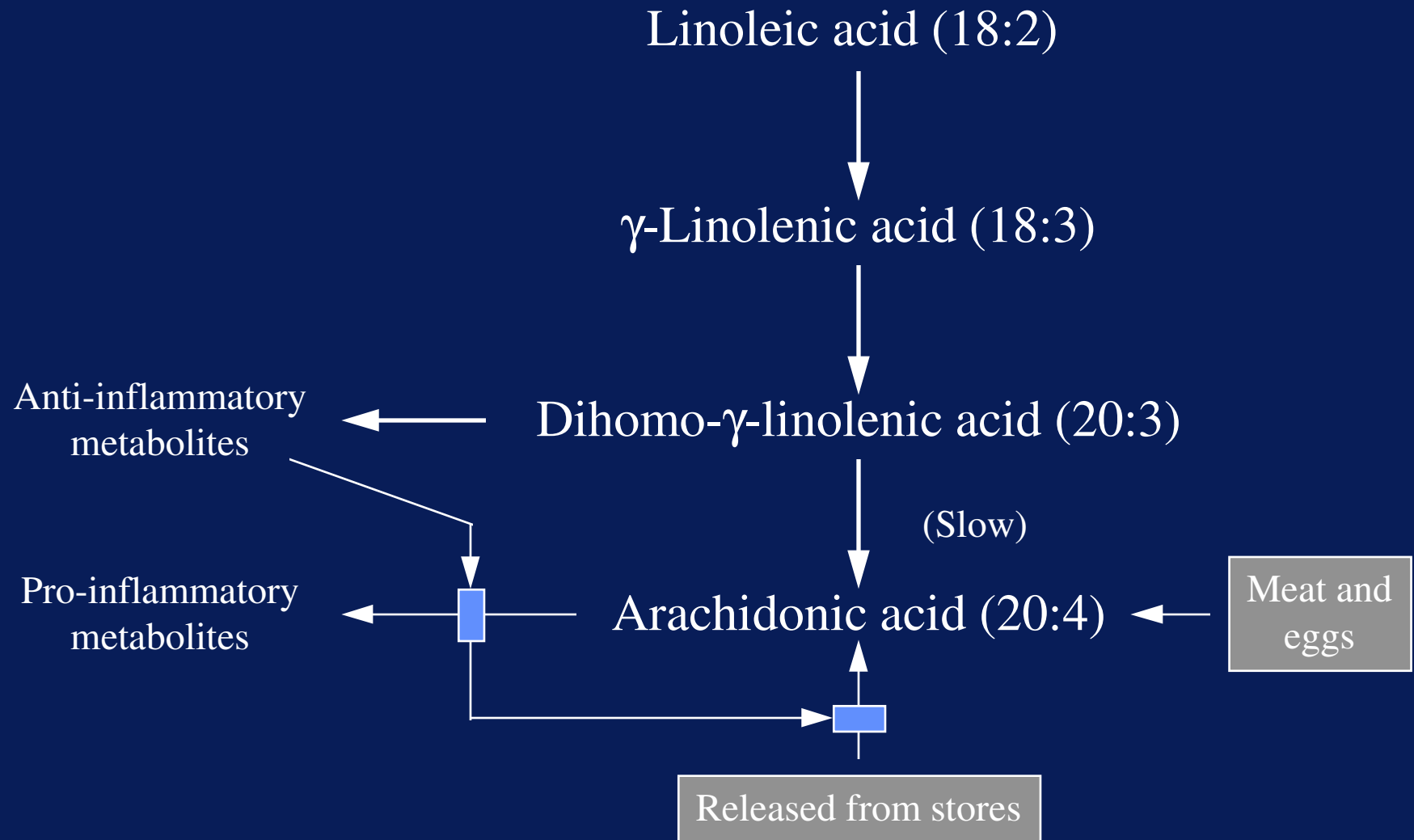


Dihomo- γ -linolenic acid (20:3)



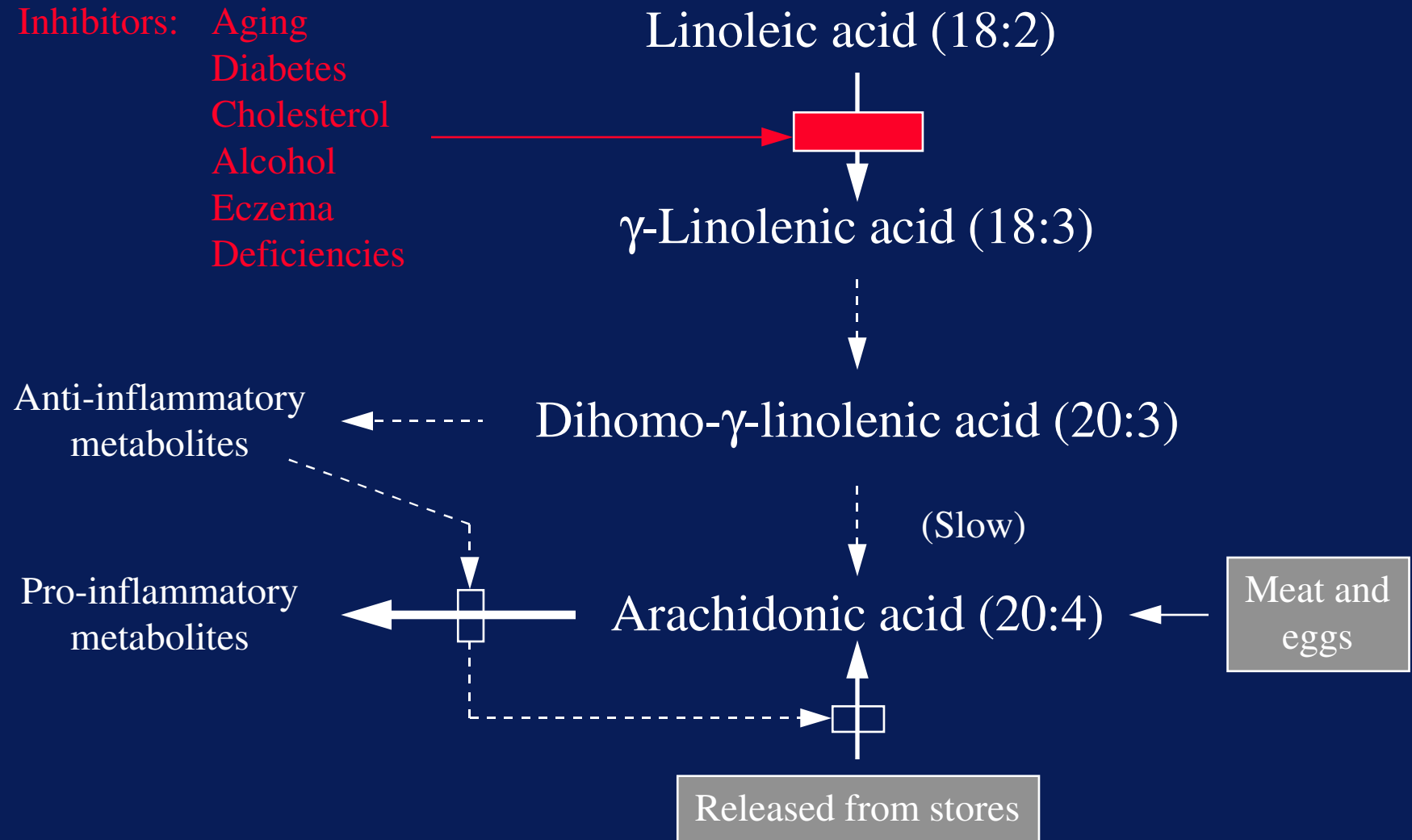
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Omega-6 Pathway

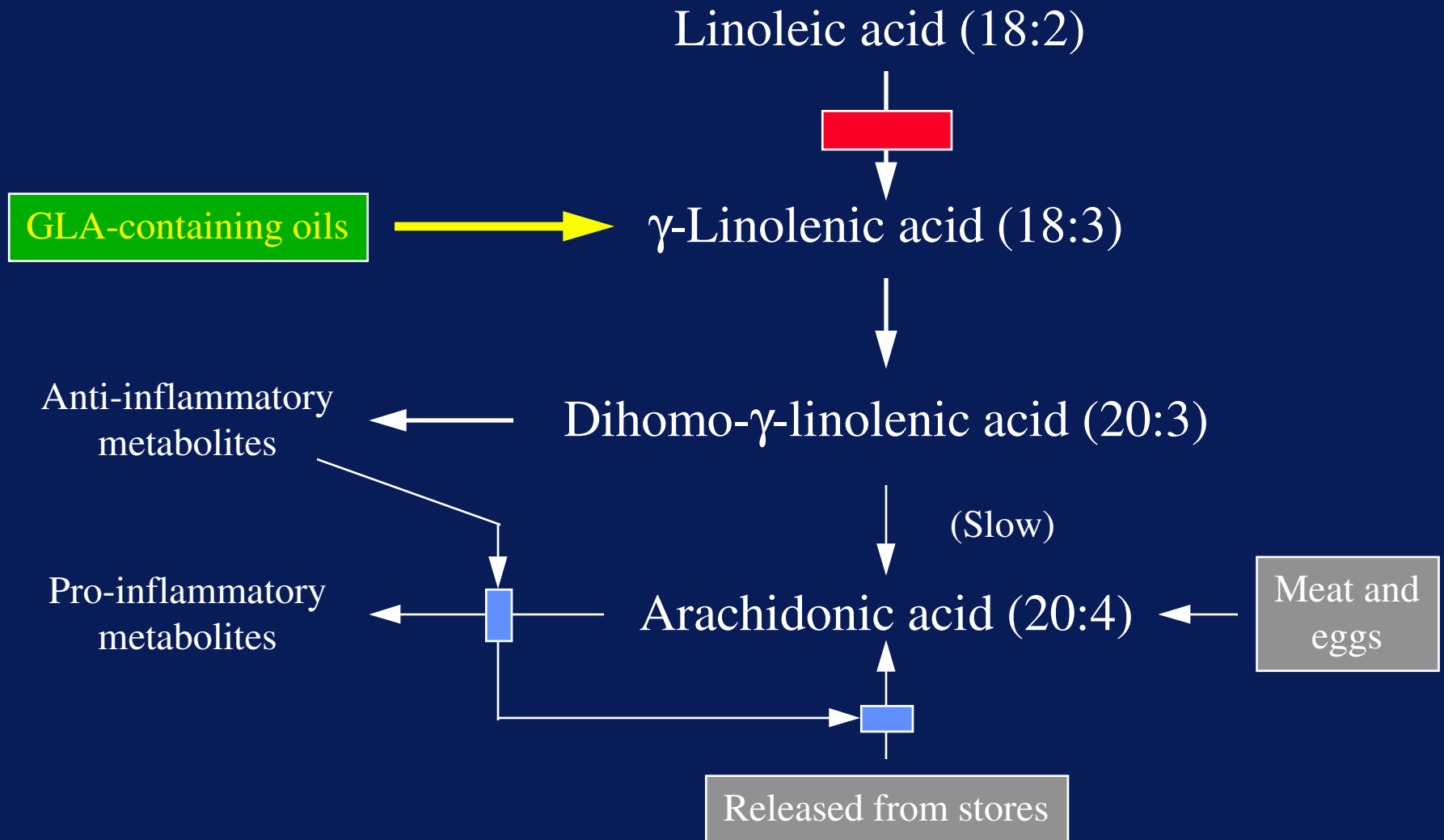


Omega-6 Pathway

Inhibitors: Aging
Diabetes
Cholesterol
Alcohol
Eczema
Deficiencies



Omega-6 Pathway



Oils Containing GLA

- Evening Primrose (*Oenothera* spp.)
- Borage (*Borago officinalis*)
- Blackcurrant (*Ribes nigrum*)
- Hemp (*Cannabis sativa*)
- Fungi (e.g. *Mucor javanicus*)
- Others

Fatty acid profiles (%)

	Linoleic	GLA	ALA	Stearidonic	Erusic
Evening primrose	68 - 75	8 - 15	0	0	0
Borage	35 - 40	18 - 25	0 - 1	<1	2 - 3
Blackcurrant	45 - 55	12 - 18	12 - 15	2 - 4	0
Hemp	50 - 60	1 - 3	15 - 25	0 - 2	0
<i>Mucor</i>	10	19	0	0	0
<i>Echium</i>	16	12	28	14	<1

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GLA Oils Market

- Mostly healthfood with some pharmaceutical
- No reliable volume data because of commercial secrecy
- Best guesses
 - Evening primrose 1,000 - 1,500 t/a
 - Borage 500 - 750 t/a
 - Remainder 200 - 400 t/a

Evening primrose market

- 90% from China
- Unstable production leading to large price swings
- £3 - £15 per kg over a 5 - 7 year cycle
- Currently in surplus, prices at bottom of range
- Some production in Holland, Poland, New Zealand and USA

Evening primrose market

- ‘Cold’ press vs. solvent extraction
- Use of press cake
- New developments:
 - New Chinese joint ventures
 - High GLA varieties

Borage market

- Mostly sold as seed
- Main producers: UK, Holland, Canada and New Zealand
- Chinese can't compete
- Canadian yields unstable - unbalances price
- New Zealand is 6 months out of phase
- Price swings much less than EP
 - £2.20 - £4.50 per kg for seed, not cyclical

Concentrated GLA oils

- Processes available for concentrating GLA to various levels up to 95%
- Evening primrose and borage are best starting materials
- Not yet commercialised
- Savings on capsule numbers can offset cost of concentration

Other GLA oils

- Blackcurrant
 - By-product of juice and jam manufacture
 - Mostly UK, some European
 - Prices vary according to availability
- Hemp
 - Was held back by drug issues
 - Approved varieties now available
 - Major use as fibre, biofuel, animal feed - GLA content not being significantly exploited

Potential new uses

- Alternative presentations
 - Currently soft gel capsules
 - Sachets, oil sprays?
- New products
 - Salad oils
 - Spreads (butter, margarine)
- Requirements
 - Avoid high (>100C) temperatures
 - Protect from oxygen

Oxidation

- GLA oils sensitive to oxygen
- Produce off flavours - go rancid
- Three stage process:
 - 1) Formation of peroxides
 - 2) Breakdown into aldehydes and other SOP's
 - 3) Polymerisation

Measurement of oxidation

- Peroxide value - measures current oxidation
- Anisidine value - measures historic oxidation
- Polymerisation not normally measured
- Need both PV and AnV to assess an oil batch
- Can use Totox number where:

$$\text{Totox} = \text{AnV} + (2 \times \text{PV})$$

Control of oxidation

- Use of inert blanket gas (e.g. Nitrogen)
- Avoid metal ions, by use of stainless steel or inert linings
- Add antioxidants (e.g. Vitamin E)
- Crude evening primrose oil contains high level of endogenous antioxidants

Conclusions

- Omega-6 fatty acids are key in human nutrition
- Many people suffer from functional deficiency
- Supplementation with GLA can alleviate this deficiency
- GLA products sold in healthfood market - well understood by consumers
- Time may be ripe to extend this market with a wider range of products