

A young boy with dark skin and short hair is looking towards the camera with a slight smile. He is wearing a white shirt. In front of him is a white plate filled with various fruits, including several green apples, a few red apples, and a bunch of yellow bananas. The background is slightly blurred, showing what appears to be a window or a wall with some texture.

Nutritional knowledge

Fat

Nigeria, March 2005

Presentation

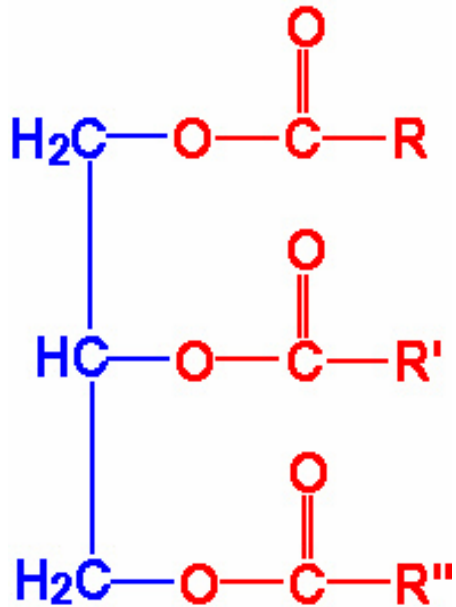
- Chemical structure
- Different fatty acid groups
- Essential fatty acids: LA & ALA
- Function
- Sources & quality
- Digestion & absorption
- Requirements
- Cow's milk & fat
- GMO
- Check your knowledge

The key lines

- **Fat** is an important source of energy
- **Fat** = lipids
- **Fat** supplies the fat soluble vitamins A, D, E and K

Chemical structure

- Fat = tri-glyceride = glycerol + 3 fatty acids



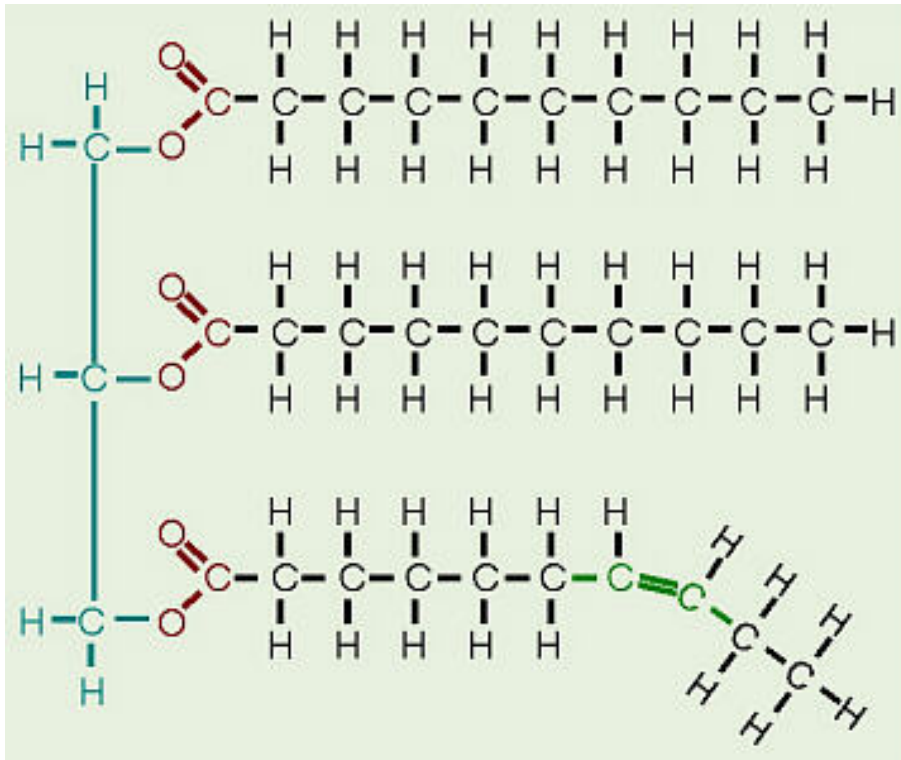
Fat contains

C = carbon

H = hydrogen

O = oxygen

Fatty acids: saturated & unsaturated



Saturated fatty acid =
no double bond

Unsaturated fatty =
1 or more double bonds

Fatty acids vary in chain length & degree of unsaturation

Important fatty acids: classification

- Saturated fatty acids = **SAFAs**
 - no double bonds
- Cis-mono-unsaturated fatty acids = **MUFAs**
 - 1 double bond
- Cis-poly-unsaturated fatty acids = **PUFAs**
 - 2 or more double bonds
 - n-6 fatty acids (incl. LA & AA)
 - n-3 fatty acids (incl. ALA & DHA)

AA & DHA: LCPUFAs

SAFAs = saturated fatty acids

- Butyric acid C 4 : 0
- Caprylic acid C 8 : 0
- Caproic acid C 10 : 0
- Lauric acid C 12 : 0
- Myristic acid C 14 : 0
- Palmitic acid C 16 : 0
- Stearic acid C 18 : 0

Chain length varies from 8 to 18 carbon atoms; 0 = 0

double bonds between C-atoms

MUFAs = mono-unsaturated fatty acids

- Oleic acid C 18 : 1 ω -9
- Myristoleic acid C 14 : 1 ω -7
- Palmitoleic acid C 16 : 1 ω -7
- Vaccenic acid C 18 : 1 ω -7
- Eicosenoic acid C 20 : 1 ω -9
- Erucic acid C 22 : 1 ω -9

1 = 1 double bond between C-atoms

ω -sign (omega) indicates position of double bond
(calculated from methyl-end)

n-6 Cis poly-unsaturated fatty acids (PUFAs)

- **Linoleic acid (LA)** C 18 : 2 ω -6
 - Essential fatty acid
- γ -Linolenic acid (GLA) C 18 : 3 ω -6
- Dihomo γ -linolenic acid C 20 : 3 ω -6
- **Arachidonic acid (AA)** C 20 : 4 ω -6
- Adrenic acid C 22 : 4 ω -6
- Docosapentaenoic acid C 22 : 5 ω -6

>1 double bonds between de C-atoms

ω -sign (omega) indicates position of double bond = 6

n-3 Cis poly-unsaturated fatty acids (PUFAs)

- **α -Linolenic acid (ALA)** C 18 : 3 ω -3
 - Essential fatty acid
- Eicosapentaenoic acid (EPA) C 20 : 5 ω -3
- Docosapentaenoic acid C 22 : 5 ω -3
- **Docosahexaenoic acid (DHA)** C 22 : 6 ω -3

>1 double bonds between C-atoms

ω -sign (omega) indicates position of double bond = 3

Essential fatty acids: LA & ALA

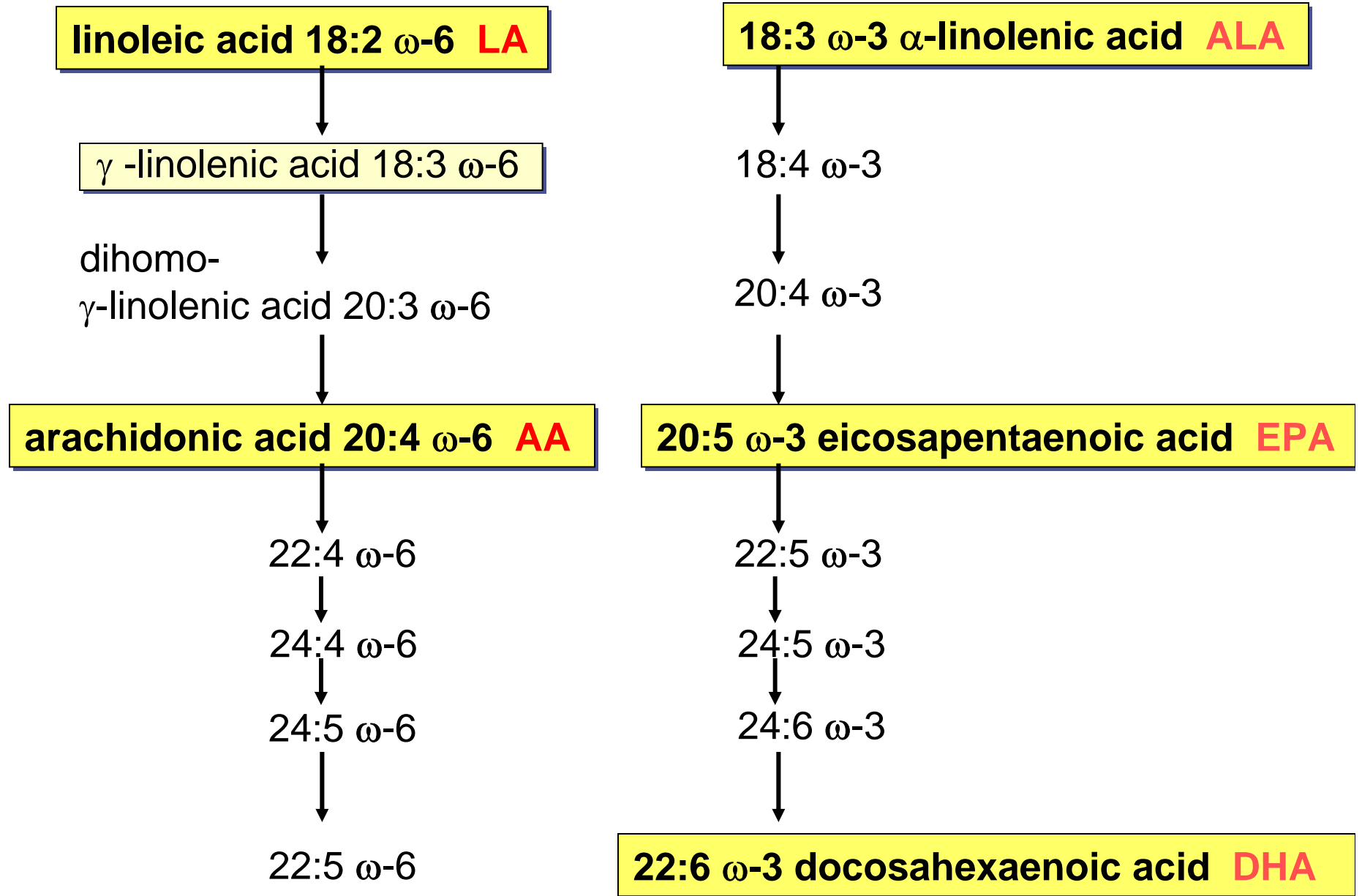
- Linoleic acid (LA) C 18 : 2 ω -6 =
precursor for AA
- α -Linolenic acid (ALA) C 18 : 3 ω -3 =
precursor for DHA

LA & ALA → AA & DHA

By the help of enzymes

- LA (parent of the ω -6 family) → via GLA (γ -linolenic acid = gamma-linolenic acid) → AA (arachidonic acid)
- ALA (parent of the ω -3 family) → via EPA (eicosapentaenoic acid) → DHA (docosahexaenoic acid)
- AA & DHA: LCPUFAs (Long Chain Poly Unsaturated Fatty Acids)
- AA & DHA: important role in brain development

The conversion of PUFA's (LA & ALA) into LCPUFA's: DHA & AA

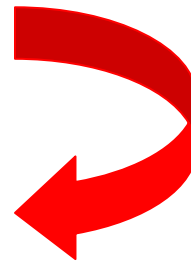


Good ratio LA/ALA important

- Both families use same enzymes for conversion = competition!
- LA/ALA ratio important to produce required amount of AA & DHA
- High LA/ALA ratio can inhibit conversion of ALA to DHA
- Low LA/ALA ratio can inhibit conversion of LA to AA

Modern Western diet

- Low in ALA
- High in total fat, saturated fat, LA and trans fatty acids (bad fat)



- Chronic diseases: heart disease, cancer

Function of fat

- Major source of energy for the body
 - 1 g → 9 kcal (38 kJ)
- Provides essential fatty acids LA & ALA (cannot be synthesised by the body itself)
- LA & ALA important as precursors for AA & DHA
- (Essential) fatty acids:
 - Structural components of all tissues
 - Crucial for cell function
 - *Brain*: rich in AA & DHA (brain development!)
- Supports absorption of fat-soluble vitamins A, D, E, K & carotenoids

Sources & quality

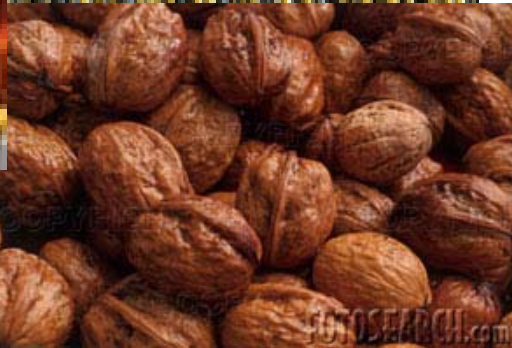
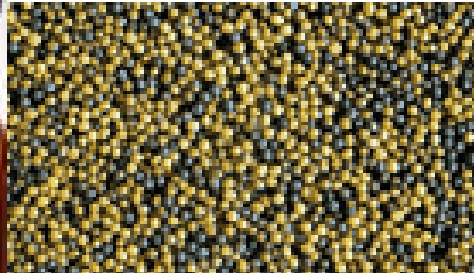
Animal fat

- Higher melting point and solid (hard) at room temperature
- Contains mainly *saturated fatty acids*
- Exception: fish oil (rich in poly-unsaturated fatty acids)

Plant fat (oils)

- Lower melting point and liquid at room temperature
- Rich in *unsaturated fatty acids*
- Exceptions: *coconut oil, palm oil, palm kernel oil* (rich in saturated fatty acids)

Animal fat & vegetable oils: different sources, different quality

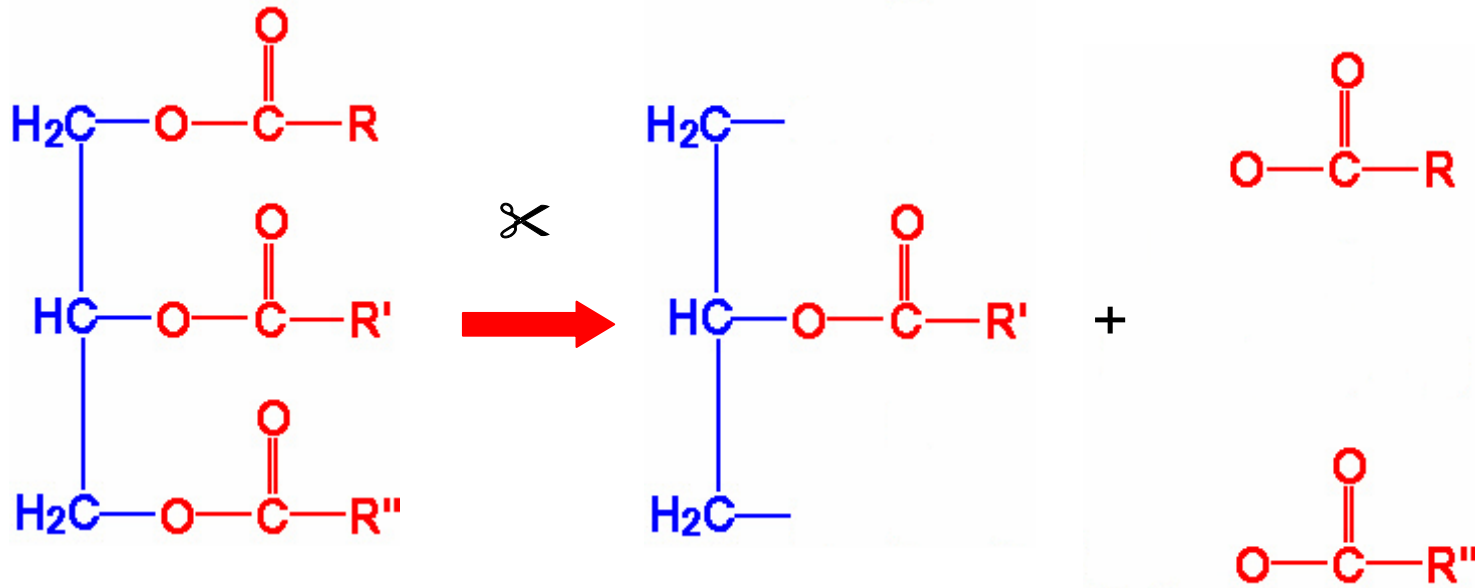


Milk & fatty acids

Cow's milk

- Milk fat
- Mainly SAFAs & MUFAs + little PUFAs

Digestion & absorption



Tri-glyceride → mono-glyceride and 1 fatty acid + 2 free fatty acids

Digestion

- Fat is hydrolysed (digested / cleaved) by particular fat-cleaving enzymes
- Place of action: small intestine
- Enzymes cleave fat (tri-glyceride) in its smaller units:
 - Mono-glyceride and 1 fatty acid + 2 free fatty acids

Absorption

- Small units: absorbed by small finger-like projections (villi), lining the intestinal wall

Fatty acids are

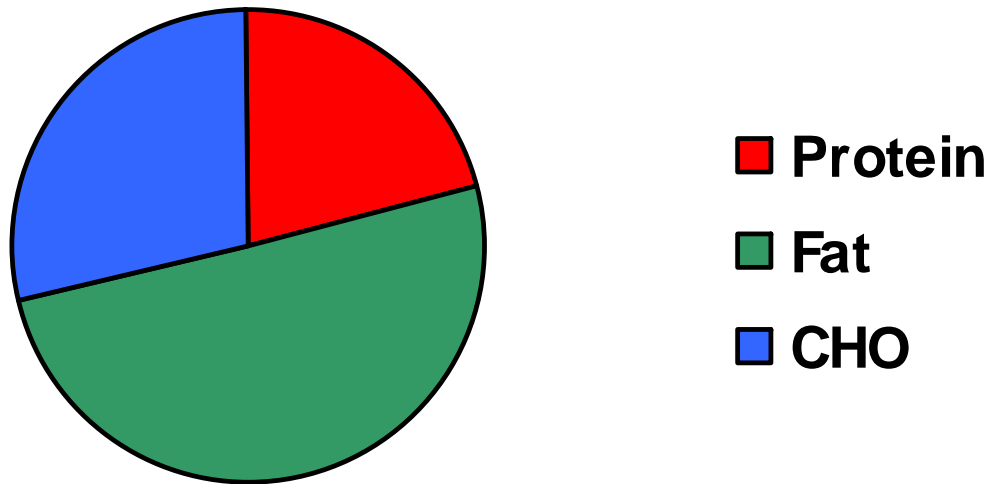
- Stored in the adipose tissue
- Used for energy in the cells
- Used in the cells as a structure of membranes (tissue, cell layer)

Fat requirements

- Requirement depends on age, gender
- Every country: own, local nutrient recommendations
 - Internationally: US/Canadian Dietary Reference Intakes (DRIs)

**Cow's milk:
3.7 g fat per 100 ml**

**Standard cow's milk:
macro-nutrients in Energy%**



Fatty acids in cow's milk fat

SAFAs	62%	myristic, palmitic, stearic acid
MUFAs	30%	oleic acid
PUFAs	4%	LA, ALA, AA, EPA & DHA present in small amounts / traces
Remainder	4%	e.g. trans fatty acids (vaccenic acid)

Non-GMO = no genetically modified organisms

- Since consumer and customer acceptance of GMO products and ingredients is lacking, Friesland Foods does not use GMO ingredients in their products
- Friesland Foods strictly adheres to national laws and regulations regarding the admission and labelling of GMOs in every country they operate