Raw Materials and Processes in Oleochemistry

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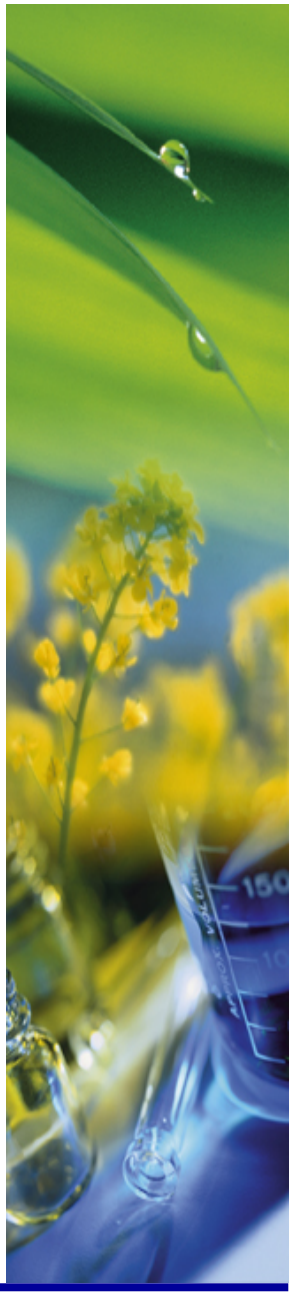
carechemicals

cognis

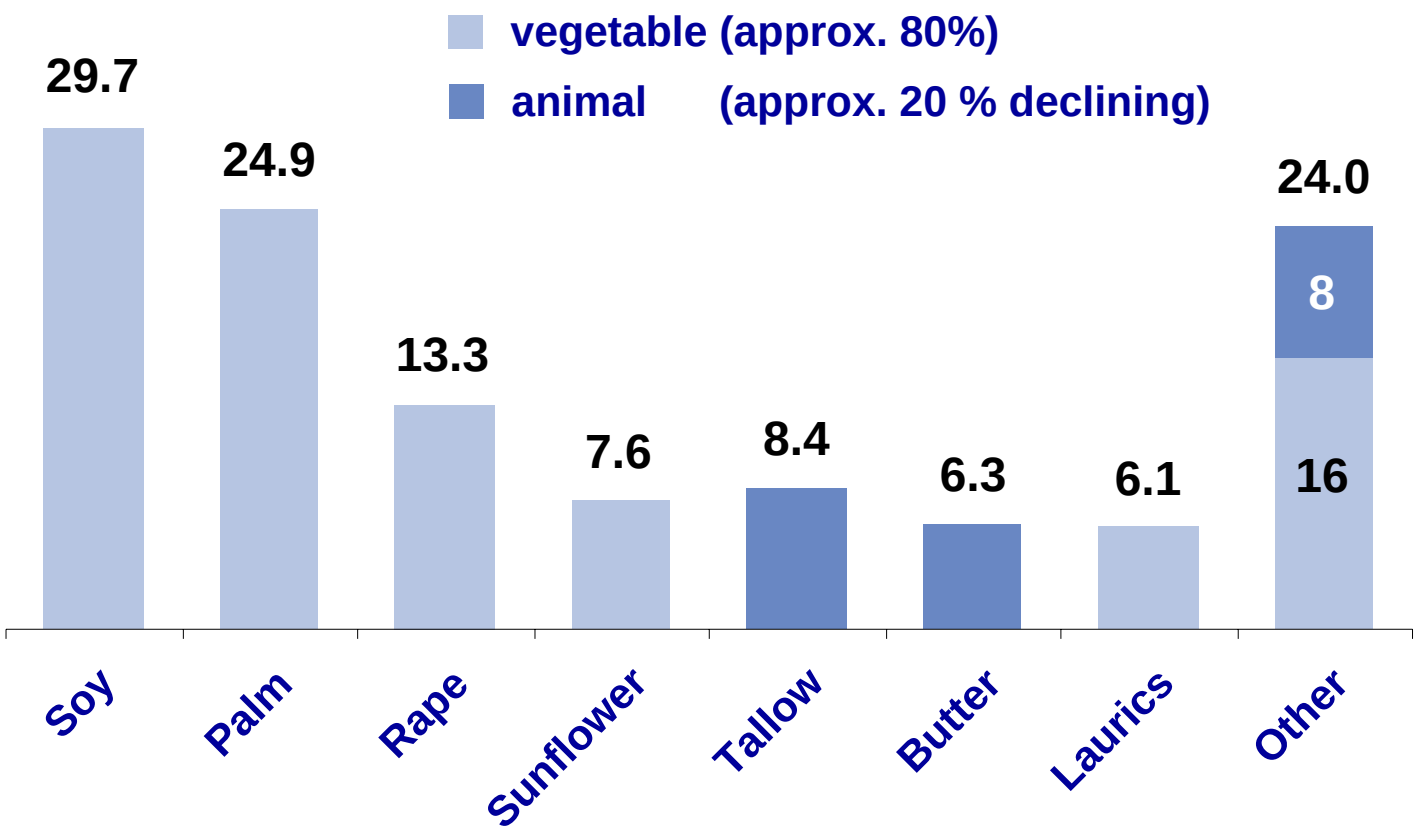
Contents

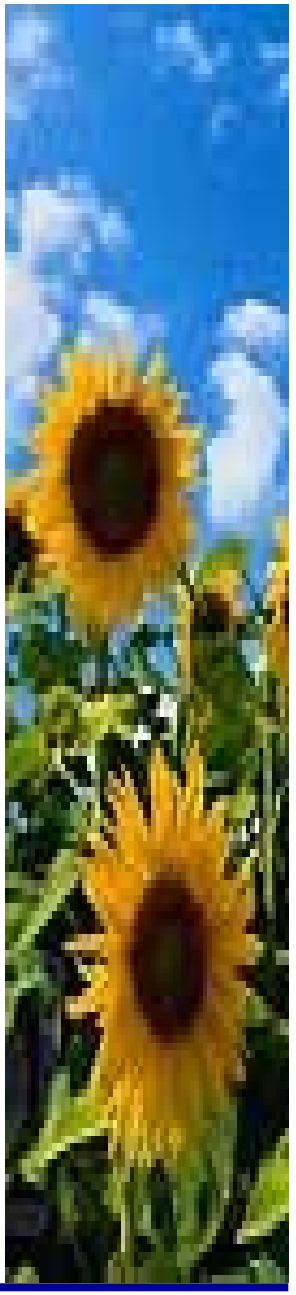
- Raw Materials
- Basic Oleochemical Transformations
- Oleochemical Products
- Summary



Raw Materials

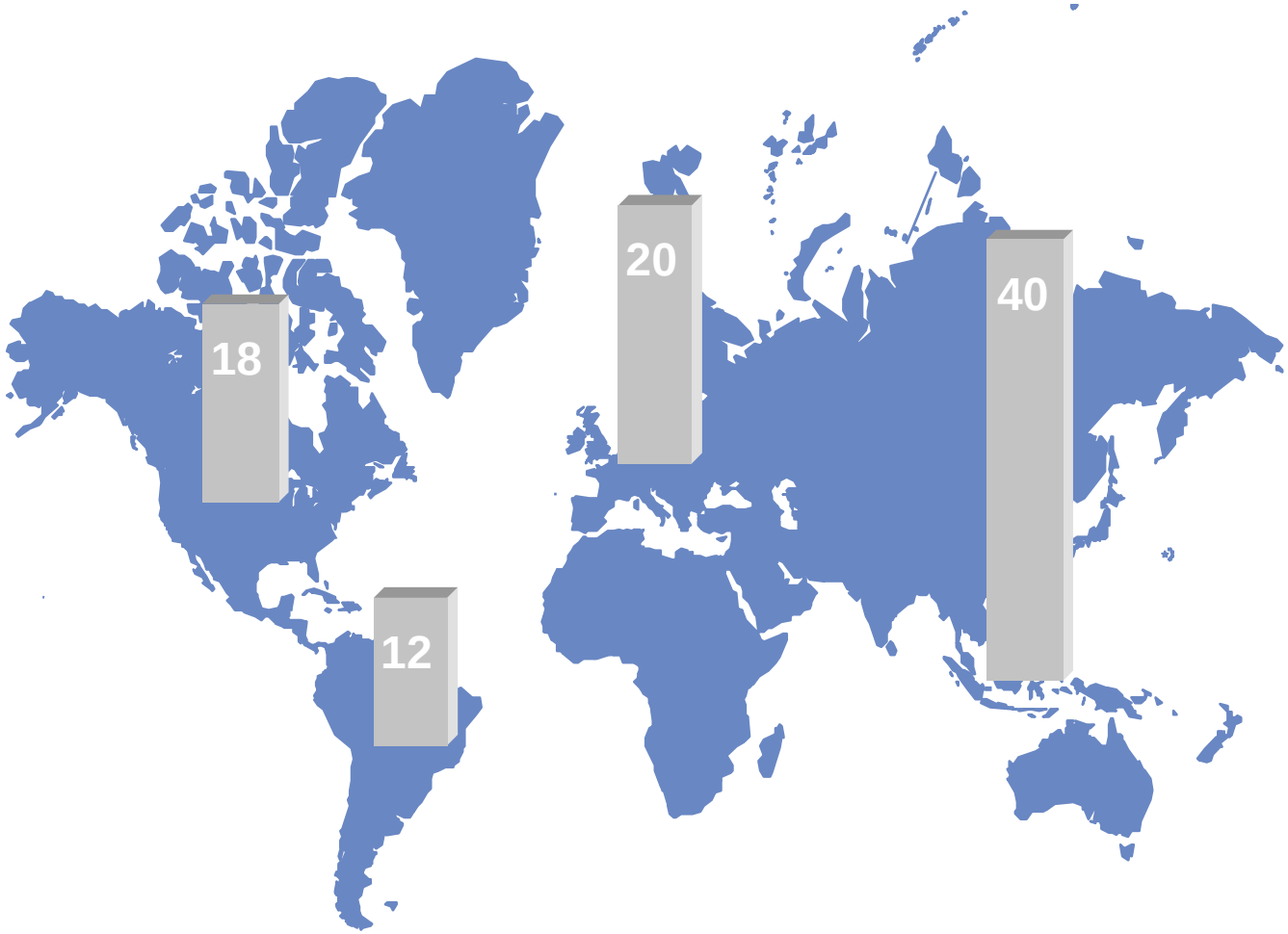
World Production of Oils and Fats 2002 (mil mt)





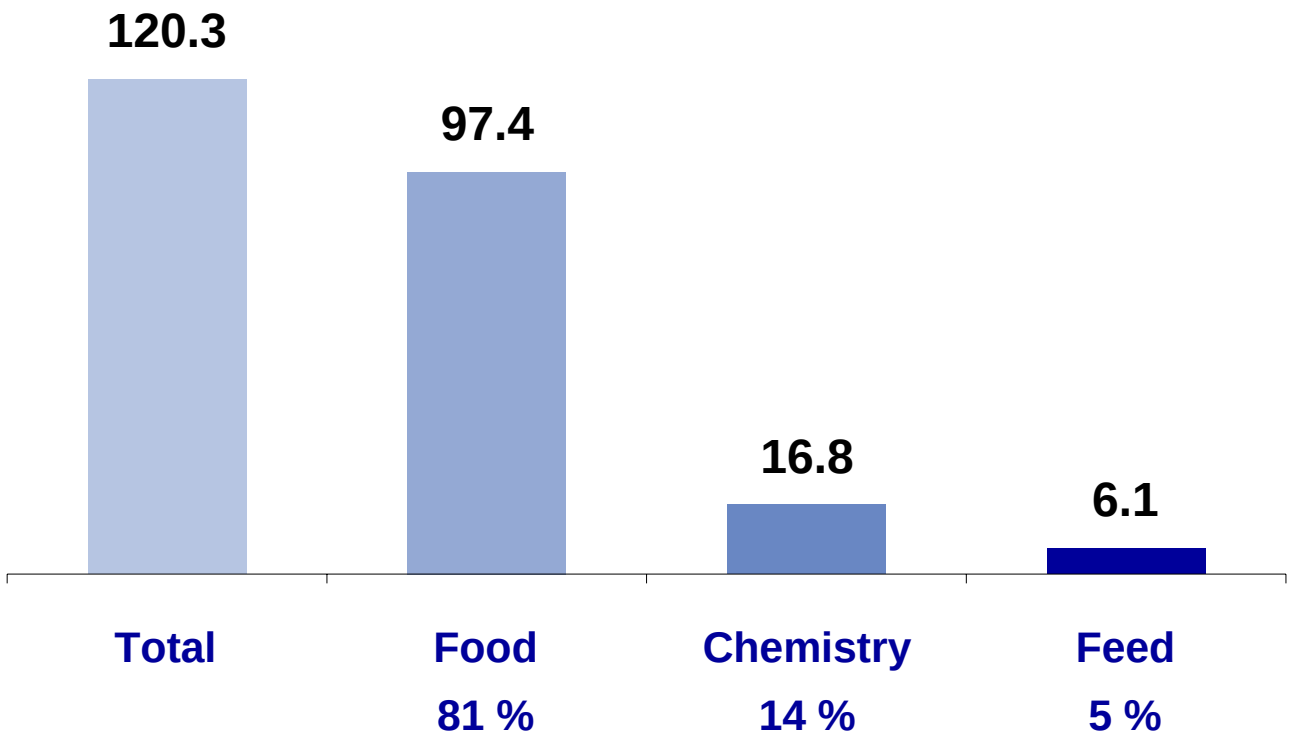
Raw Materials

Regions of Production / Share of World Production 2002 (%)



Raw Materials

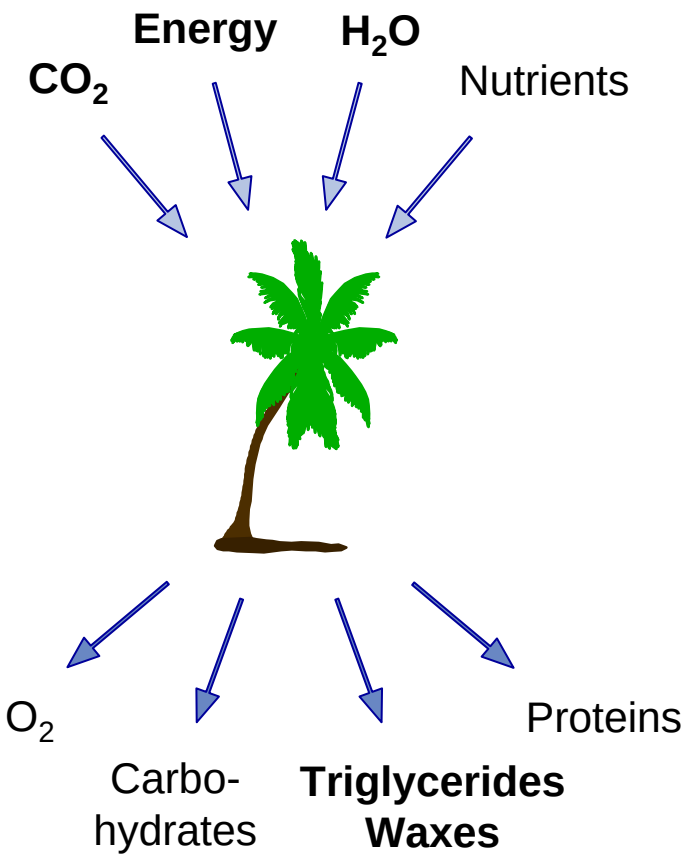
World Consumption of Oils and Fats (mil mt)

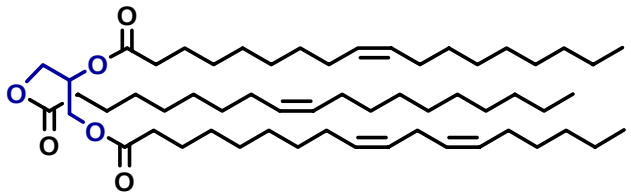


World Consumption of Mineral Oil in 2004: approx. 4.000 mil mt

Raw Materials

Natural Generation of Triglycerides

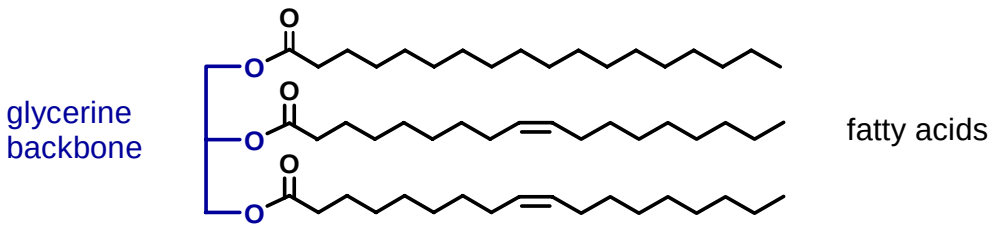




- **linear, sat./unsat. FA with even numbered C-chains**
- **renewable resources**
- **biodegradable**
- **balanced life cycle analysis**

Raw Materials

Distribution of Fatty Acids in Triglycerides

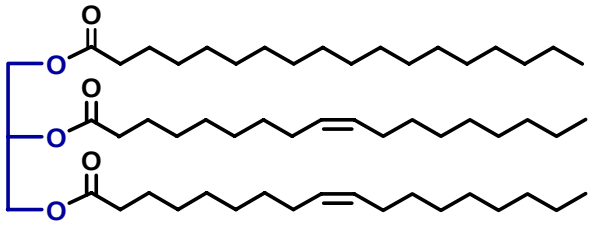


Material	Carbon Chain								C18			
	8	10	12	14	16	18	20	22	0	1	2	3
coconut oil	8	7	48	17	9	10			2	7	1	
palm kernel oil	4	5	50	15	7	18			2	15	1	
palm oil				2	42	56			5	41	10	
rape oil (old)					2	38	7	51	1	15	15	7
rape oil (new)					4	90	2	3	1	60	20	9
sunflower (old)					6	93			4	28	61	
sunflower (new)					4	93		1	4	84	5	
soy oil					8	91			4	28	53	6
lard				1	31	65	2		13	46	6	

Raw Materials

Distribution of Fatty Acids in Triglycerides

glycerine backbone



fatty acids

- **no statistic distribution of fatty acids in triglycerides**

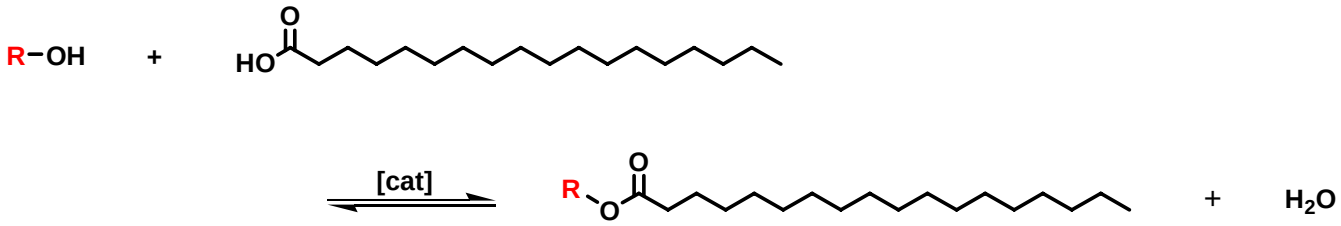
  example cocoa butter:

PSO:	**36%**
SOS:	**25%**
PPO:	**15%**
PPS:	**1%**

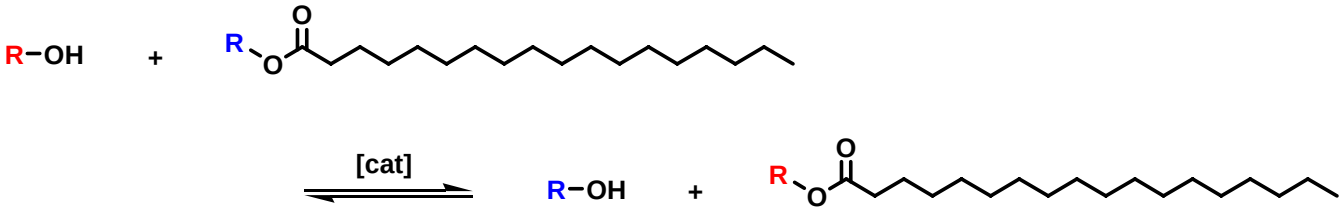
P = palmitic acid **S = stearic acid** **O = oleic acid**

Basic Oleochemical Transformations

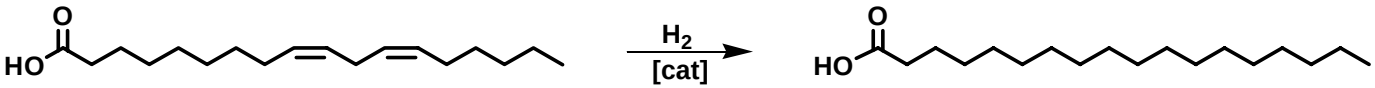
Esterification / Ester Cleavage

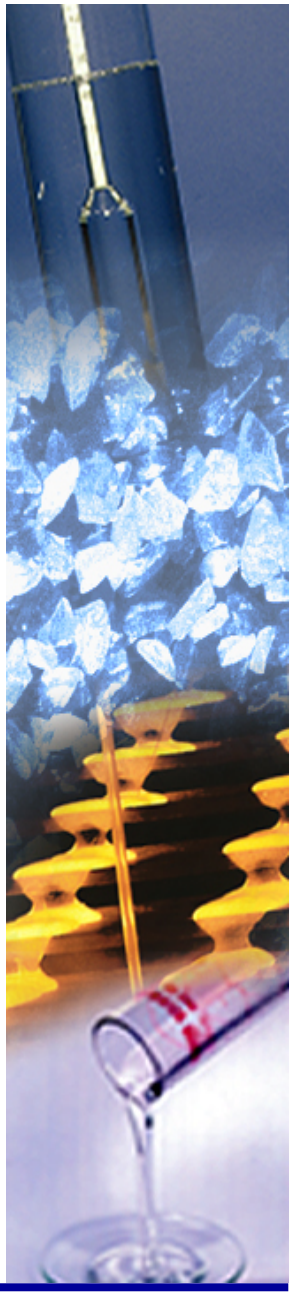


Transesterification

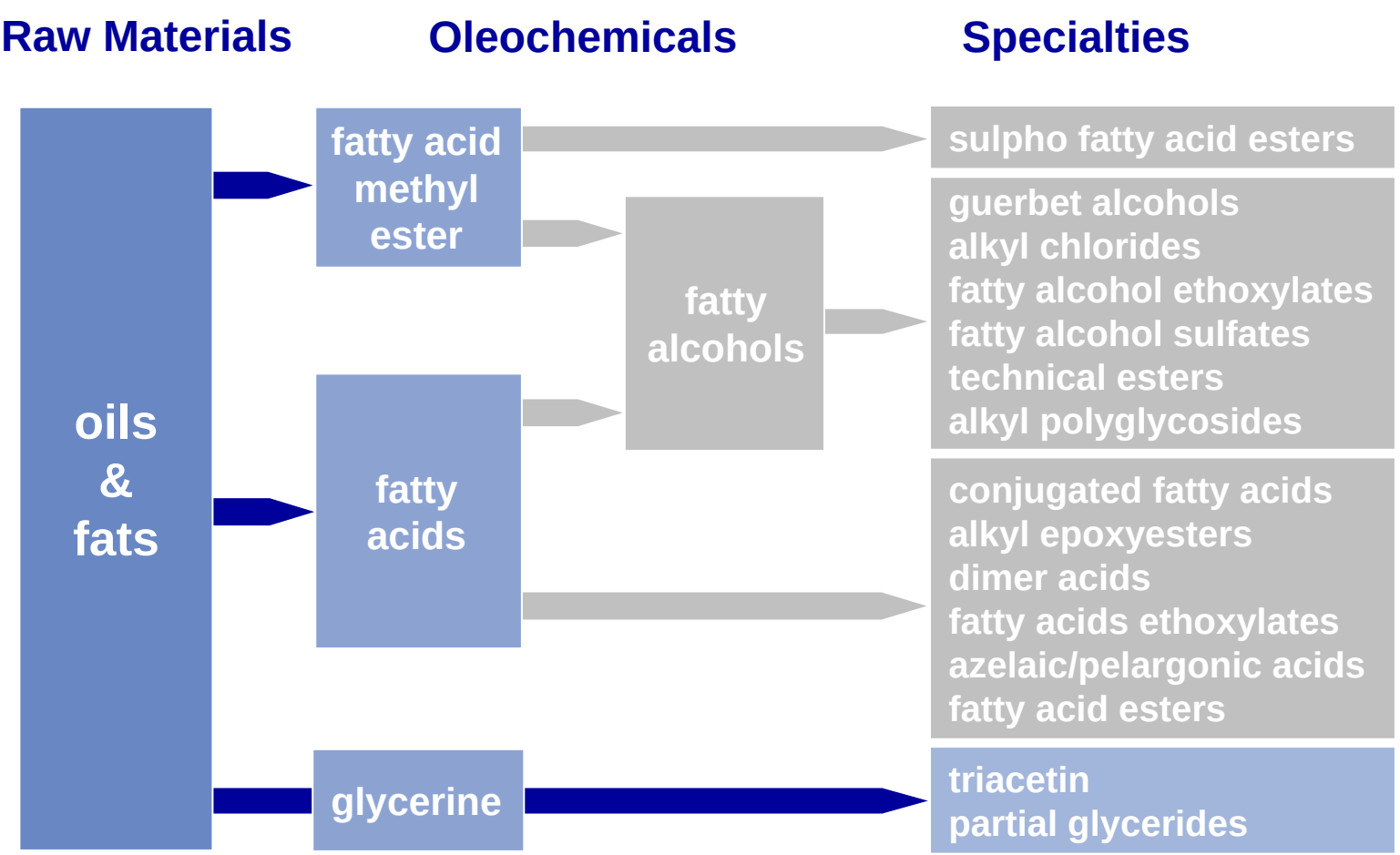


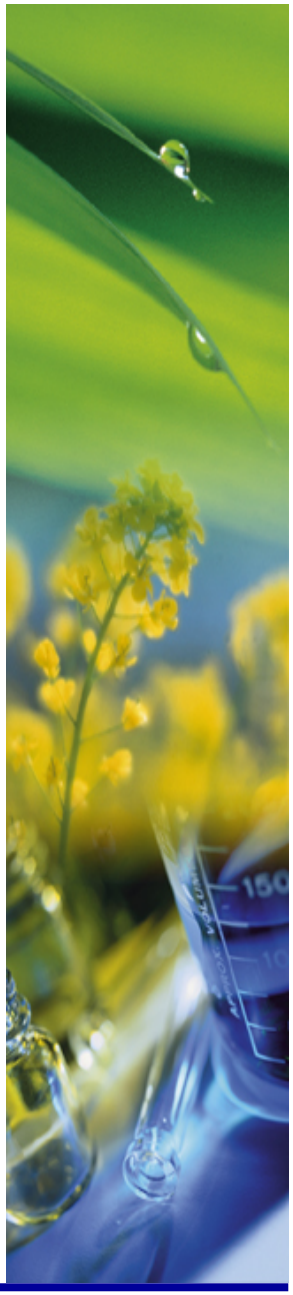
Hydrogenation





Production Flow Scheme

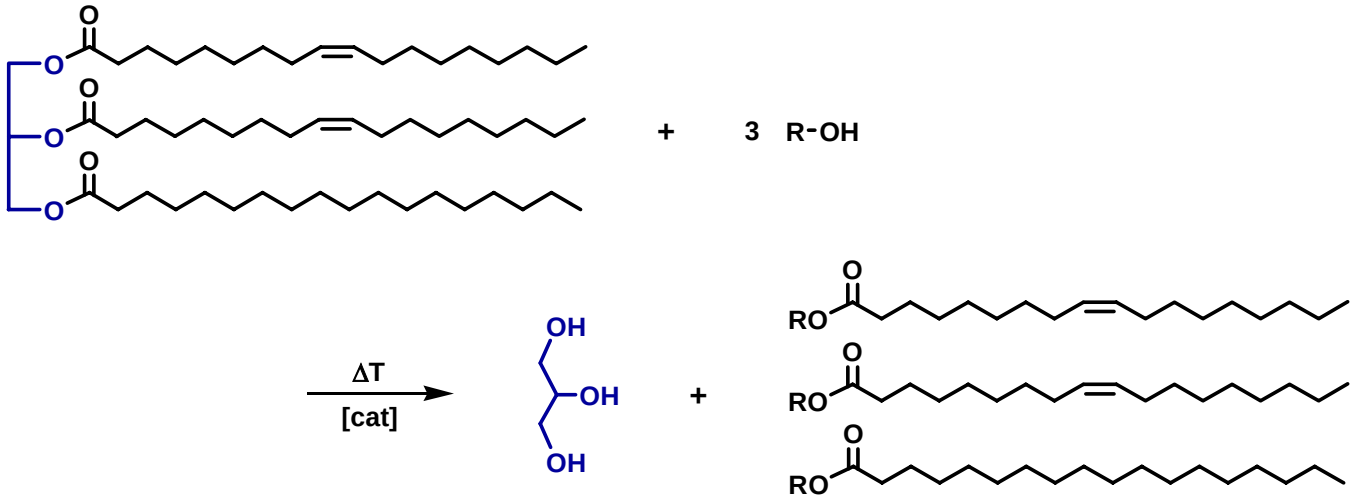




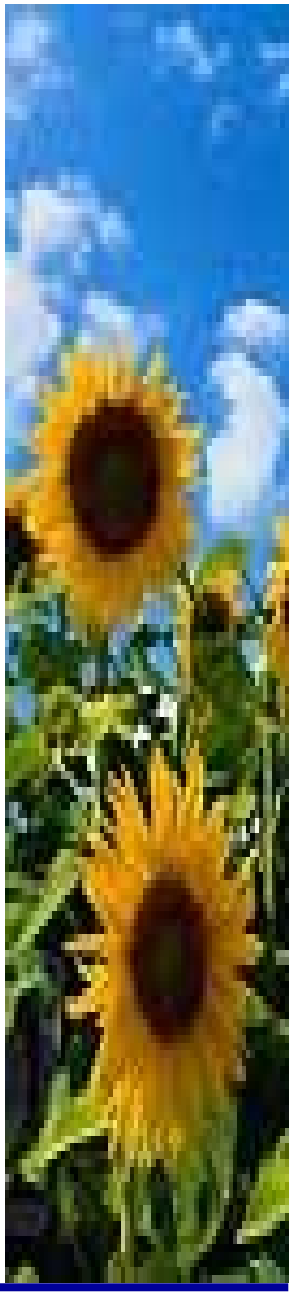
Oleochemicals

Chemical Conversion of Triglycerides

- **Splitting**



TG + water / alcohol → glycerine + fatty acids / fatty acid esters

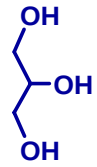


Oleochemicals

Glycerine / Derivatives

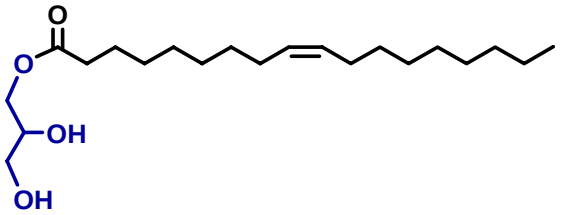
Glycerine

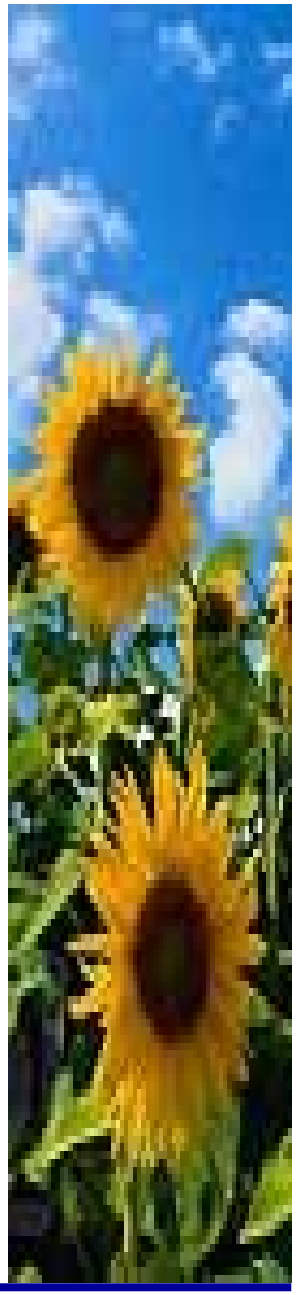
- purification by distillation or ion exchange
  - → pharma-grade glycerine (86%, > 99%)
  - → cosmetics, pharma, nutrition, graphic & printing, ...



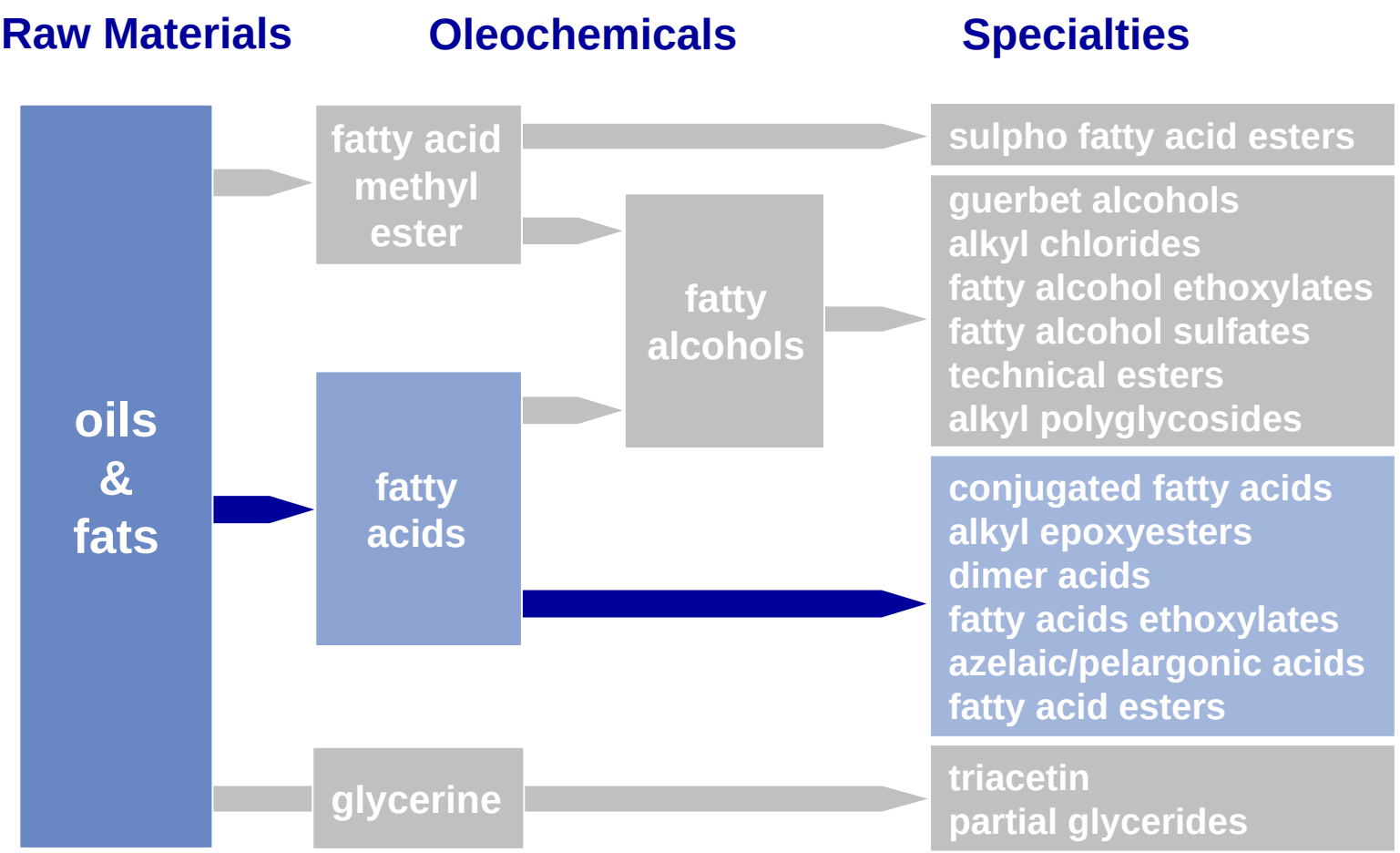
Glycerides

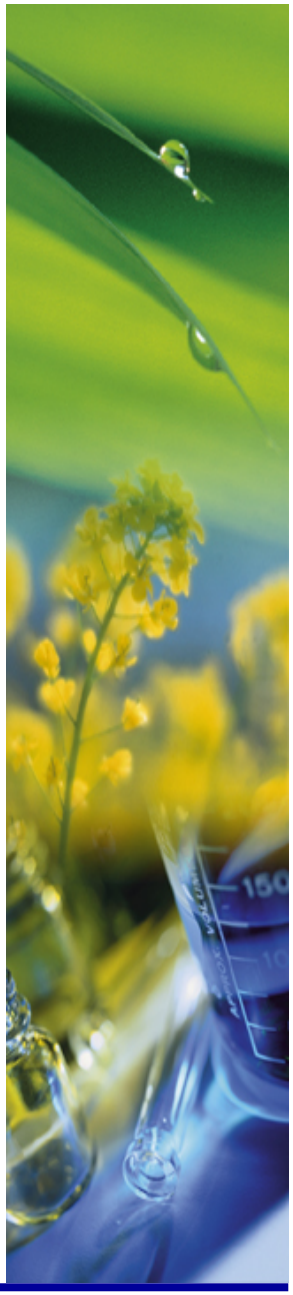
- esterification / transesterification
  - → special mono-, di-, tri-glycerides
    - GMO (glycerine monooleate)
    - triacetin (triacetyl glycerine)





Production Flow Scheme

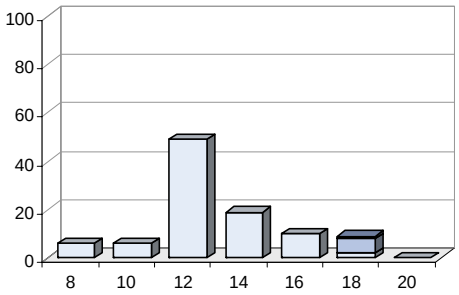




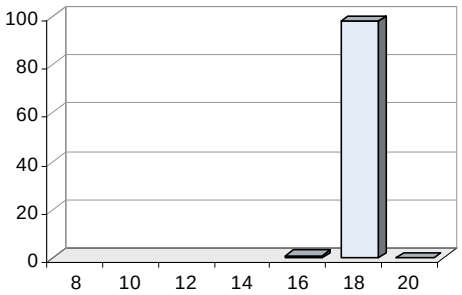
Oleochemicals

Fatty Acids

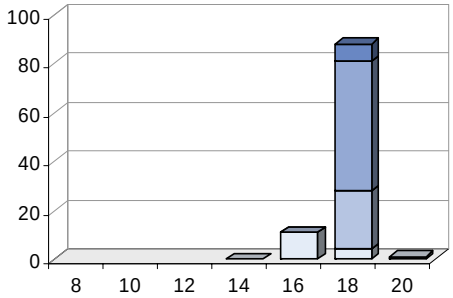
Distilled FA	**C6-18**	**broad cuts**
Fractionated FA	**C8-18**	**fine cuts, purity > 98%**
Stearines	**C16/C18**	**saturated**
Oleines	**C18**	**monounsaturated**
Polyunsaturated FA	**C18**	**polyunsaturated**



distilled FA

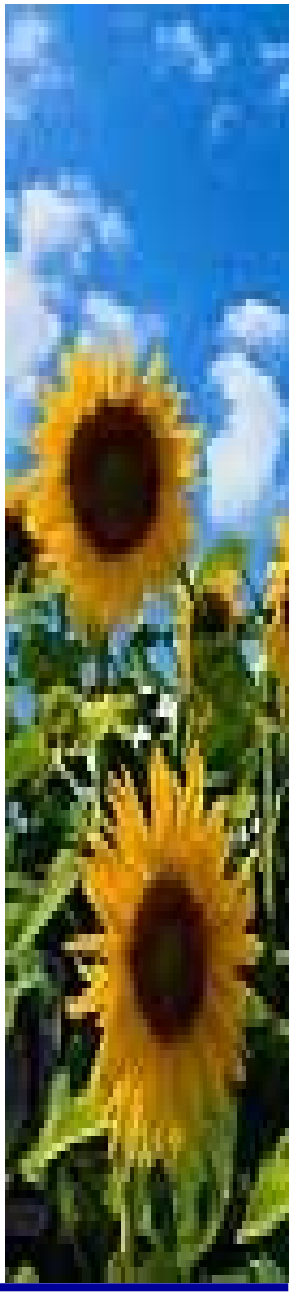


fractionated FA



polyunsaturated FA

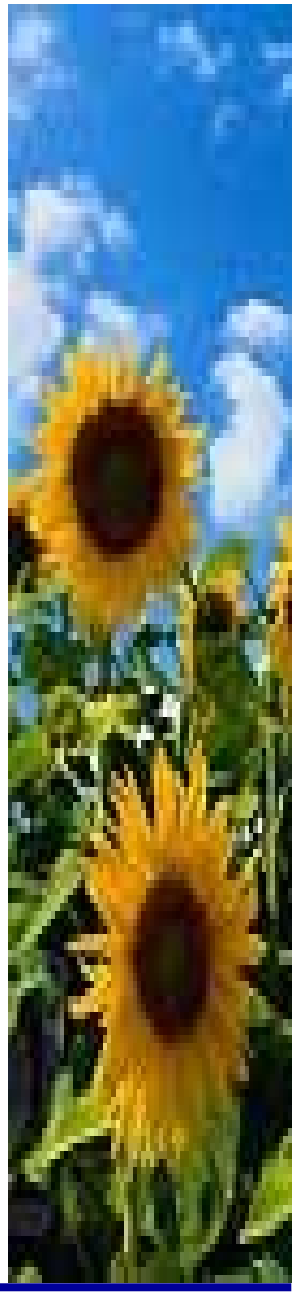
→ soaps, detergents, emulsifiers, other oleochemicals, ...



Oleochemicals

Fatty Acids - Main Technologies

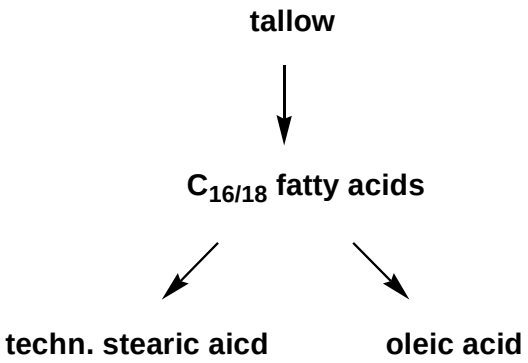
- Splitting
- Distillation
- Fractionation
- Crystallisation (Hydrophilisation)
- Hydrogenation (partial or full)
- Esterification



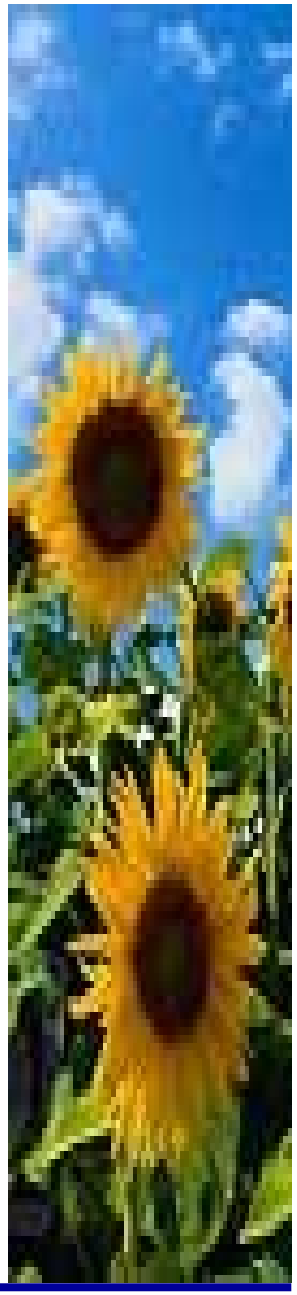
Oleochemicals

Fatty Acids – Oleic Acid

- **Production**
  - **crystallisation (hydrophilisation)**
  - **saturated acids as by-products**

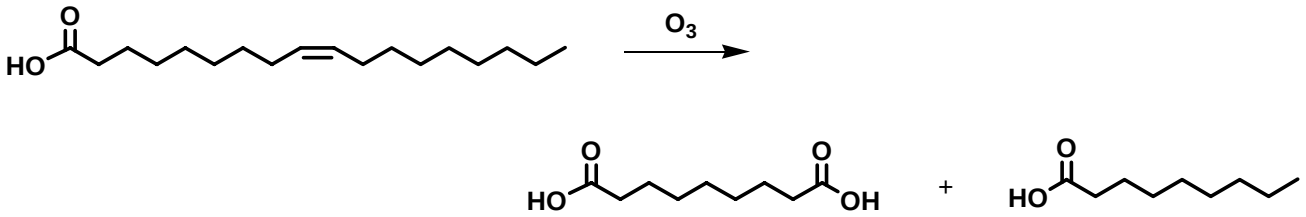


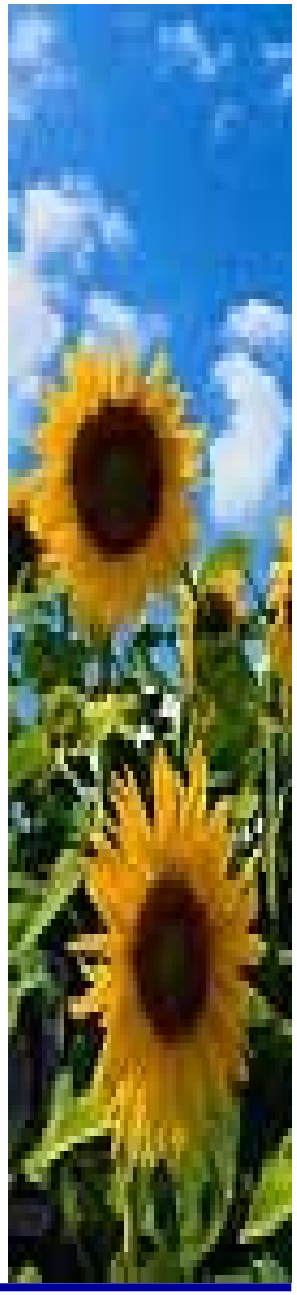
- **Properties**
  - **compromise of low melting point and oxidative stability**
  - **melting point: 5 – 8 °C, esters even lower**
  - **relative good stability compared to e.g. rape seed fatty acid due to low amount of polyunsaturated acids**
  - **same behavior in oleic acid derivatives**



Oleochemicals

Fatty Acids - Specialties





Azelaic Acid

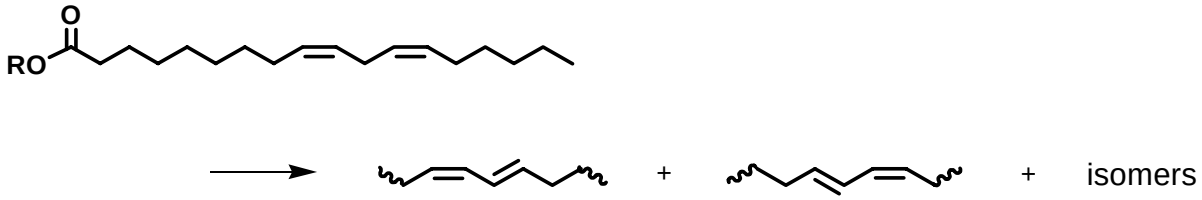
→ esters, plasticizer, soaps, polyamides, nylon, adhesives, coatings

Pelargonic Acid

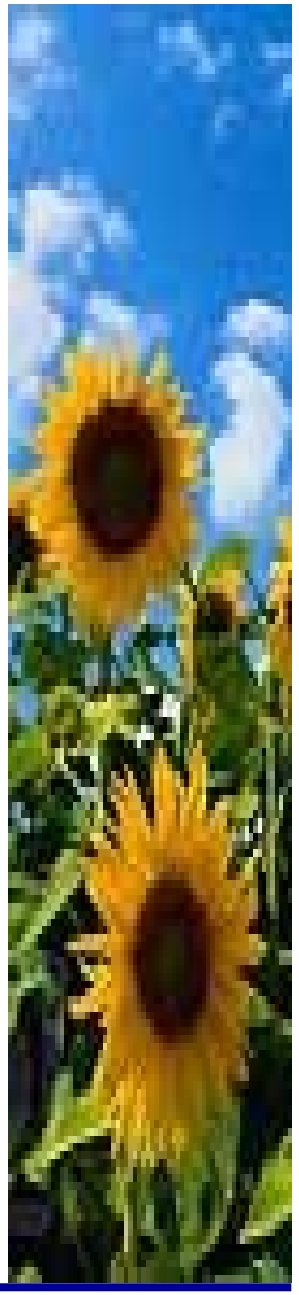
→ esters plasticizers, lubricants, corrosion inhibitors

Oleochemicals

Conjugated Fatty Acids

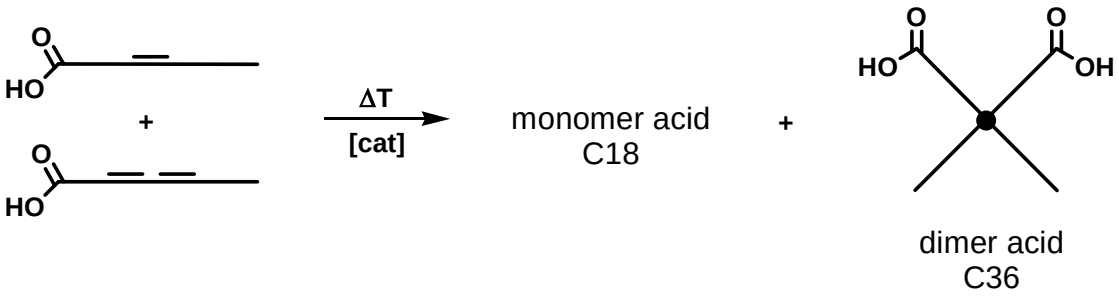


UKD Fatty Acids®	Tonalin®
mixture of many isomers → alkyd resins	two isomers: *c*9,*t*11- / *t*10,*c*12- CLA → functional foods



Specialties

Monomer / Dimer Acids

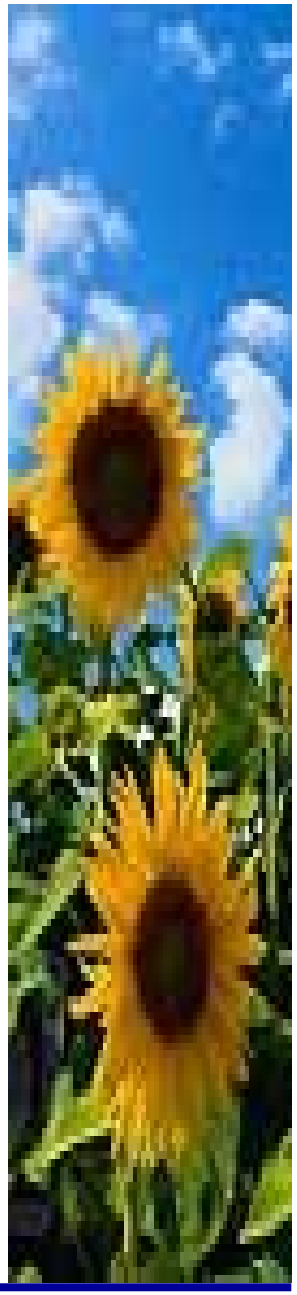


Isostearic Acids **Emersol®**

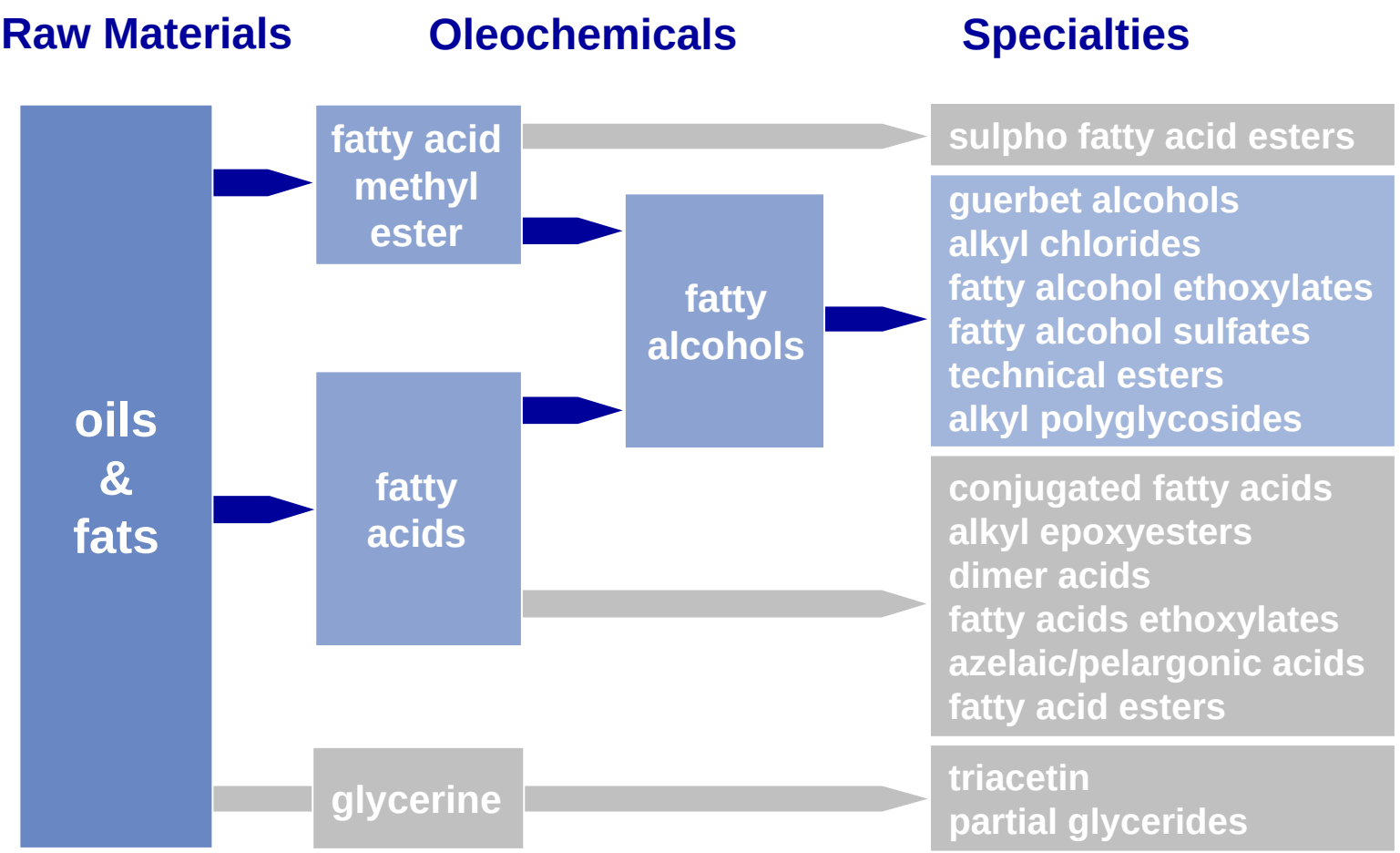
hydrogenation, fractionation → isostearic acid
→ cosmetics, lubricants, plastic auxilliaries

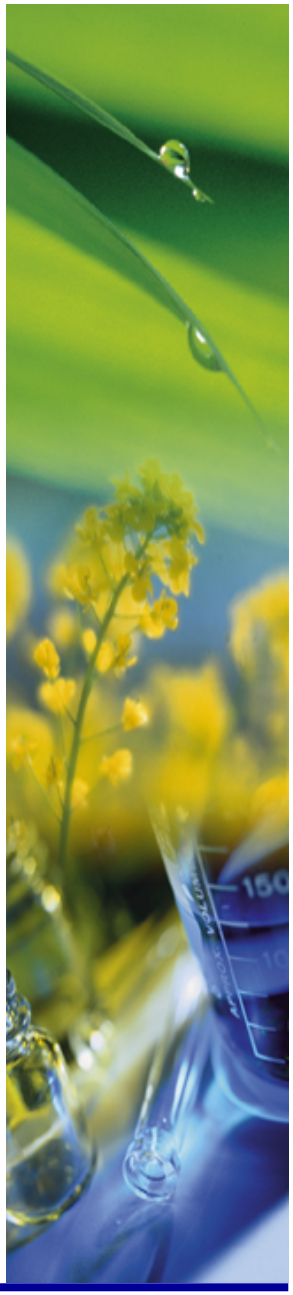
Dimer Acids **Empol®**

purification
→ polyamides, polyesters, lubricants, corrosion inhibitors



Production Flow Scheme





Oleochemicals

Fatty Acid Methyl Esters

→ fatty alcohols

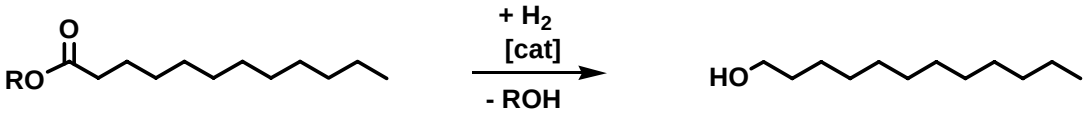
→ intermediate to production of special esters

→ solvents, lubricants

→ Biodiesel (rape seed oil methyl ester)

Oleochemicals

Fatty Alcohols

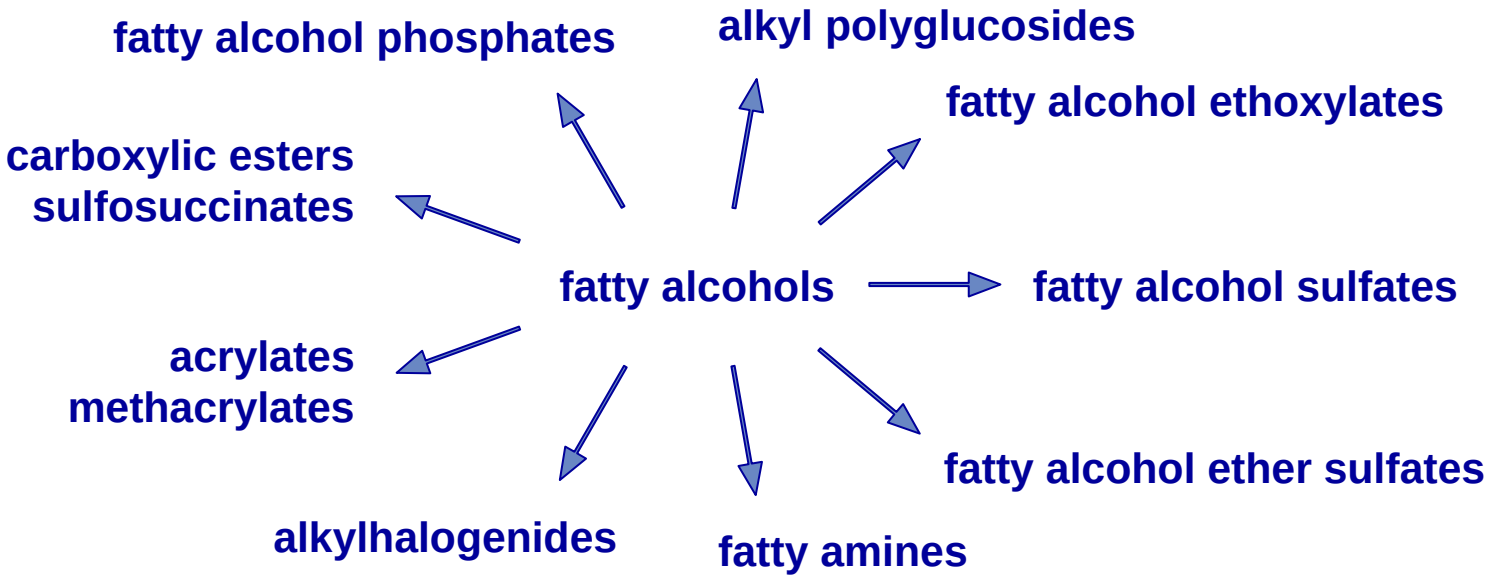


- production by continuous hydrogenation of esters
- over 1 mil mt produced from renewable raw materials
- main raw material for saturated alcohols:
  coconut and palm kernel oil
- competing processes using petrochemical sources
  - Ethylene: Ziegler, Alfol-Process
  - Olefins: Hydroformylation/Reduction
- share of natural sources is rising

Oleochemicals

Fatty Alcohols

→ main intermediate to other oleochemicals

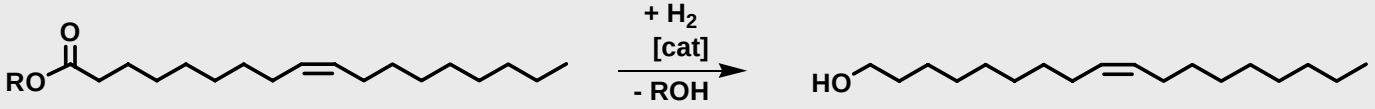


→ main application as detergents

Oleochemicals

Fatty Alcohols

Saturated Alcohols		**Lorol®, Hydrenol®, Stenol®**
C 6-10	plasticizer range	solubiliser, defoaming agents, ...
C12-14	detergent range	foam stabilisers, lubricant additives, ...
C12-18 C16-22		consistency giving factors, melting point regulators, lubricants for cosmetics and pharma, ...
Unsaturated Alcohols		**HD-Ocenols®**
C16-18		solvents, defoamers, plasticizer, emulsifier, oil component in cosmetics



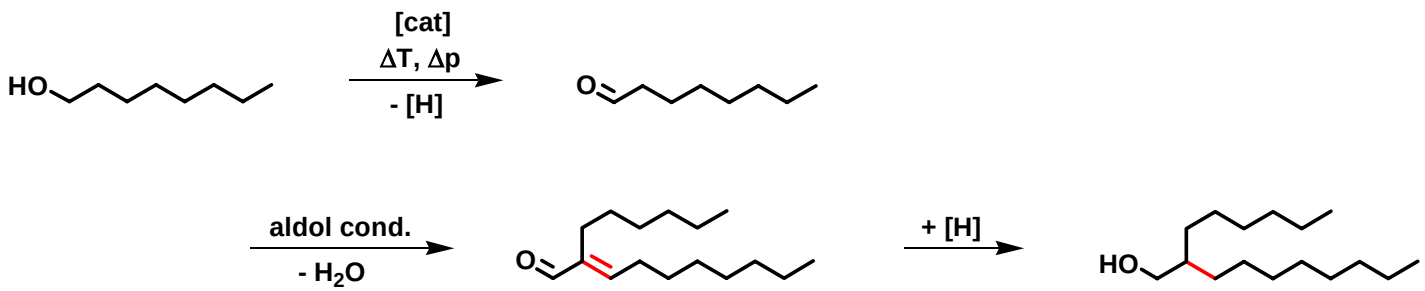
Oleochemicals

Fatty Alcohols Specialties

Branched Alcohols	**Speziol®**
C16-18 satur. / unsatur.	**detergents** **cosmetics** **fine chemicals**
Diols	**Speziol®**
C8 / C10 / C12 / C18	**cosmetics** **agro chemicals** **pharmaceuticals** **plasticizer**

Specialties

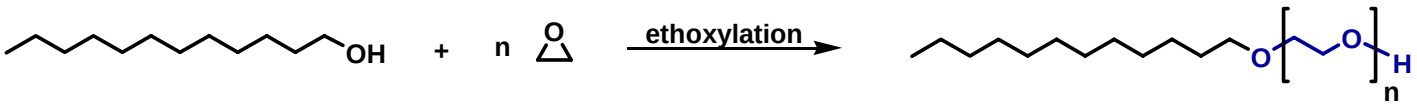
Guerbet Alcohols



Guerbet Alcohols	Rilanit®
C16 / C20	plasticizers spray lubrication (metalworking) solubilizer for water-miscible MWF mold release agents oil components in cosmetic application dispersing agents

Surfactants

Fatty Alcohol Ethoxylates (FAEO)



- nonionic surfactant, low foaming

→ good emulsifiers for W/O and O/W emulsions

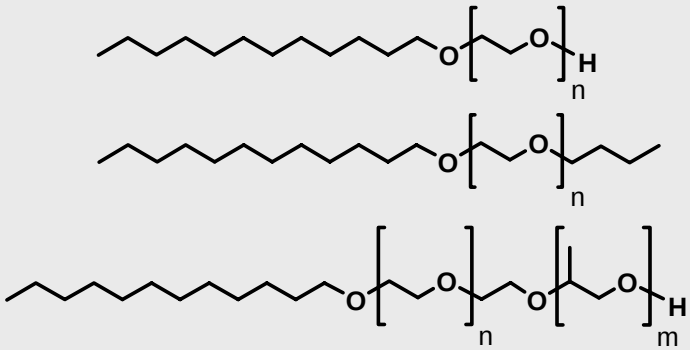
→ intermediate to oleochemical products

FAEO

Narrow Range Ethoxylates (NRO)

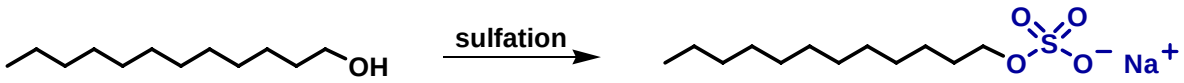
End-Capped Ethoxylates

Fatty Alcohol EO/PO Adducts



Surfactants

Fatty Alcohol Sulfates (FAS)

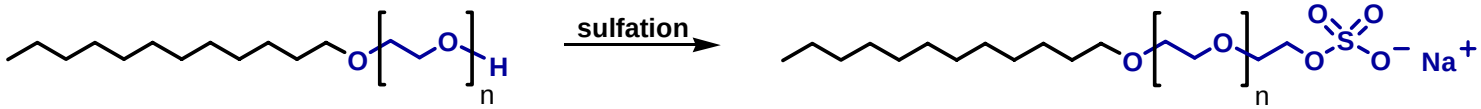


- anionic surfactants
- good foaming power
- insensitive to water hardness

→ fire extinguisher foams

→ detergents for home care and cosmetic application

Fatty Alcohol Ether Sulfates (FAES)

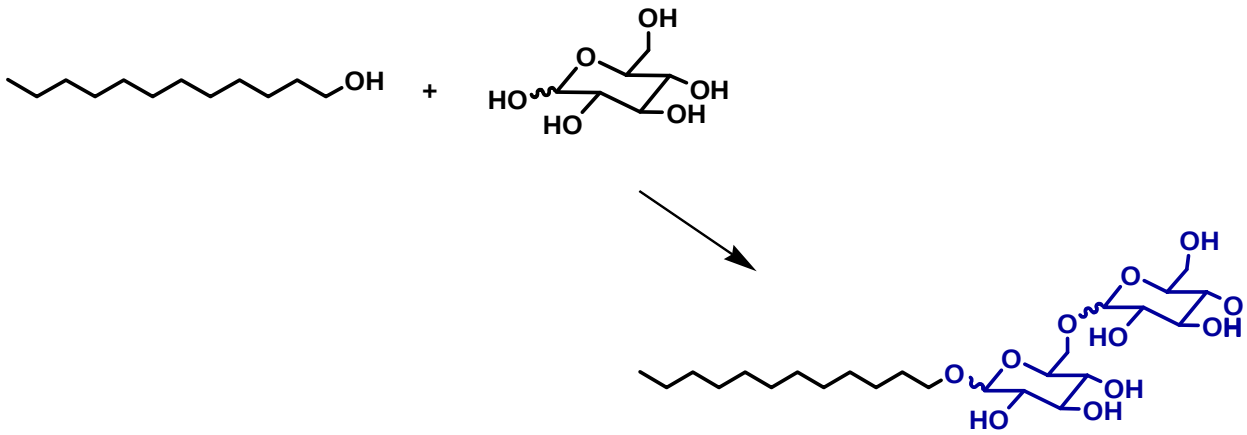


- anionic surfactants
- very good skin compatibability
- very good foaming power
- insensitive to water hardness
- very good water-solubility

→ basic surfactants in cosmetic detergents and cleaners

Surfactants

Alkyl Polyglucosides (APG)

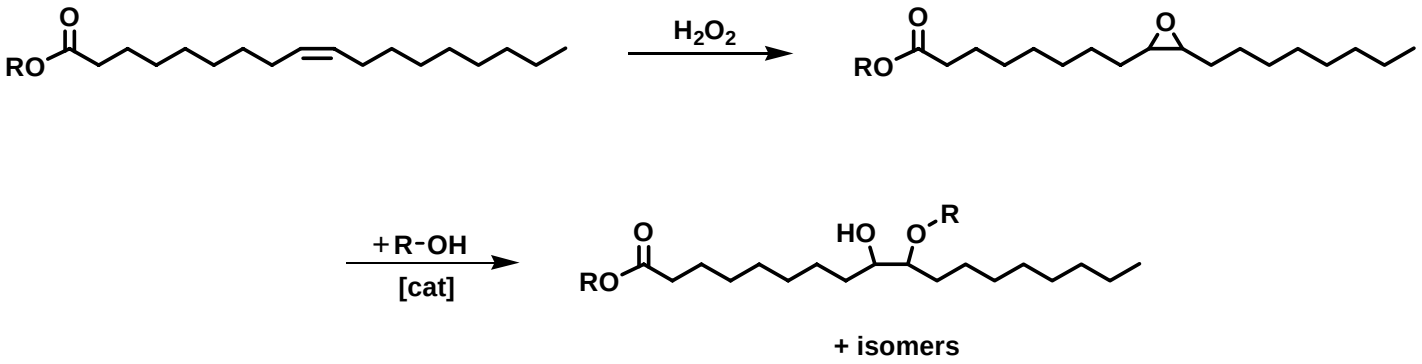


- **nonionic surfactant**
- **very good biodegradability**

→ **detergent for home care applications, cosmetics**

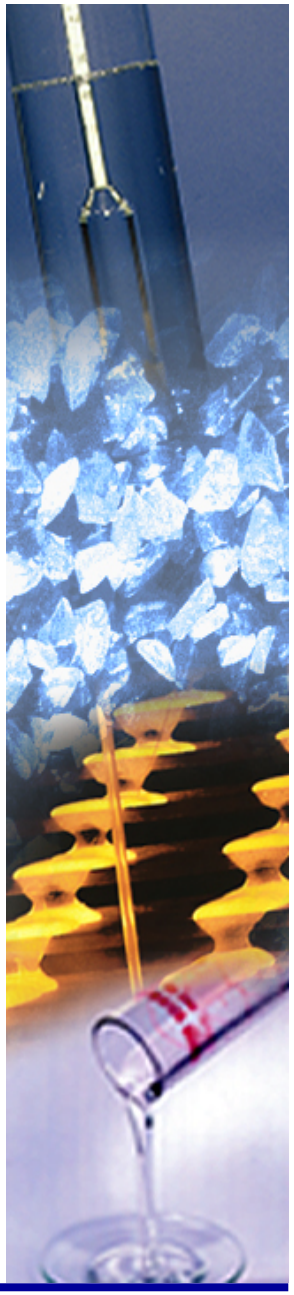
Specialties

Polyols - Polymers



- **hydrophobic fatty acid polyol**
- **adjustable properties / performance**

→ **self-stabilising softeners, PU components**



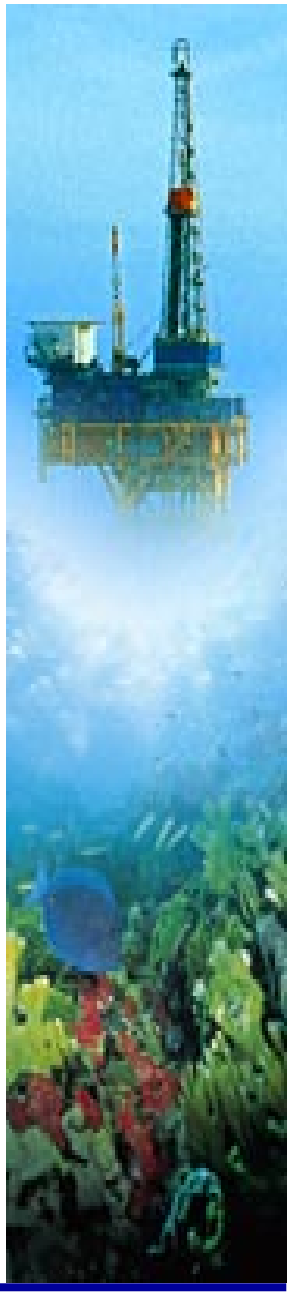
Specialties

Polyol Esters - Synlubes

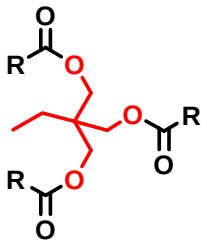
lubricants, hydraulic fluids, power transmission, MWF, ...

challenging requirements

- temperature
- oxidative stress
- long service-life
- price
- viscosity
- CP/PP
- emulsifying properties



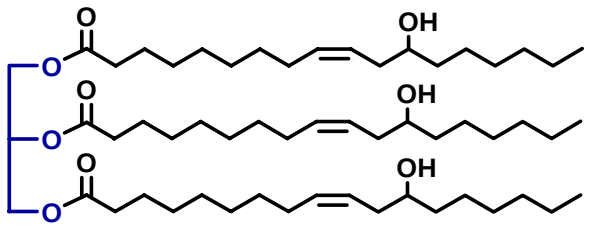
Polyol Esters



- structural variability
- tunable properties / performance
- biodegradable

Specialties

Castor Oil

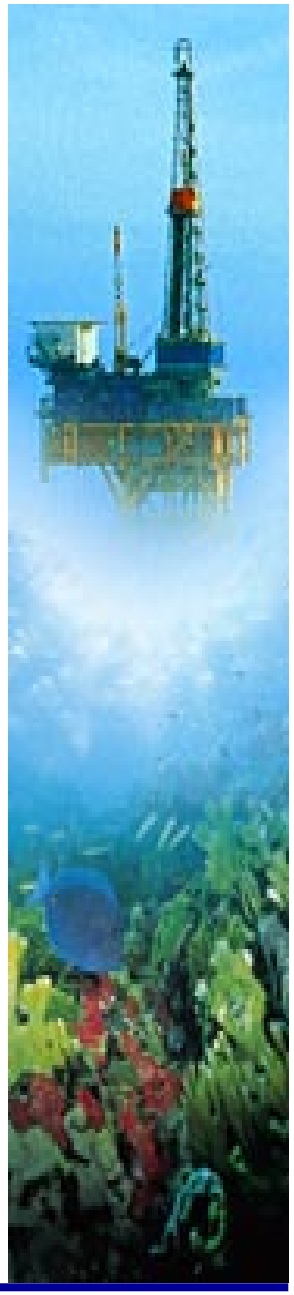


- **maily produced in India, China and Brazil**
- **liquid at room temperature**
- **contains ca. 85% of 12-hydroxy-9-octadedenoic acid**

→ triglyceride used as component of polyurethans (often with resins)

→ ricinoleic acid / ricinoleic acid methyl ester

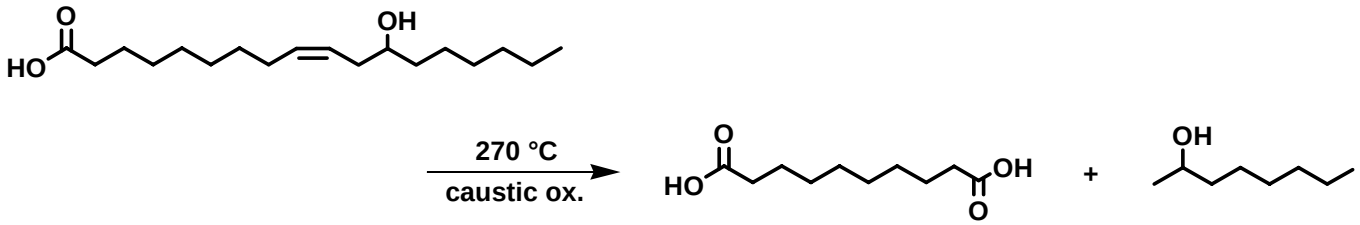
→ 12-hydroxy-stearic acid

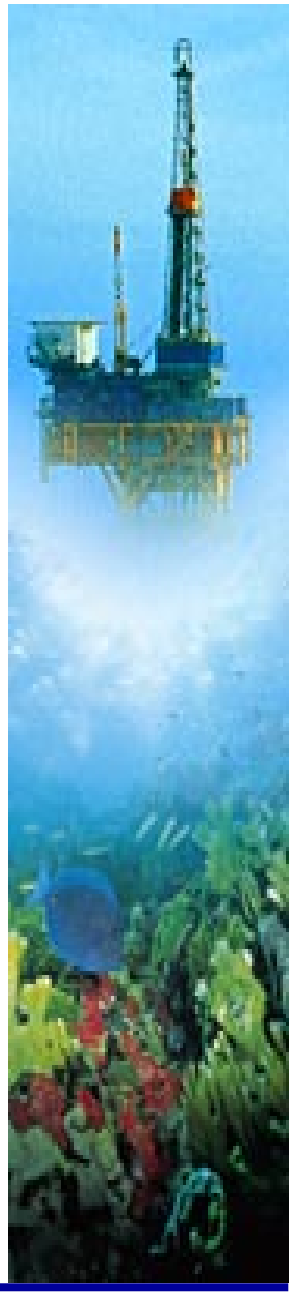


Specialties

Ricinoleic Acid

→ intermediate to sebacic acid (used for Nylon) and 2-octanol



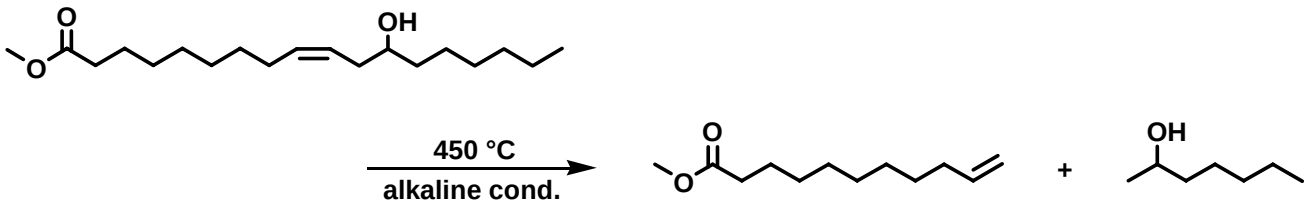


Specialties

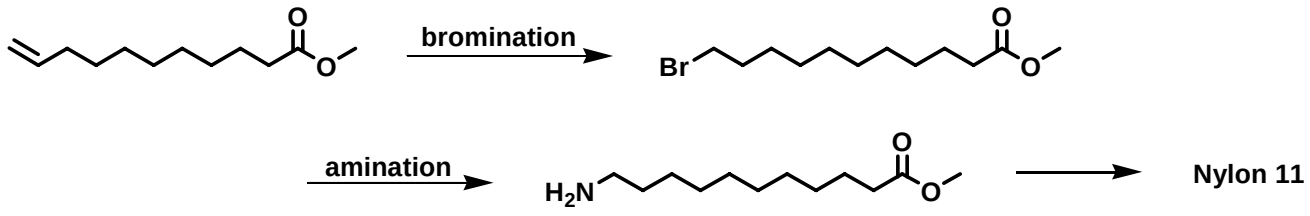
Ricinoleic Acid Methyl Ester

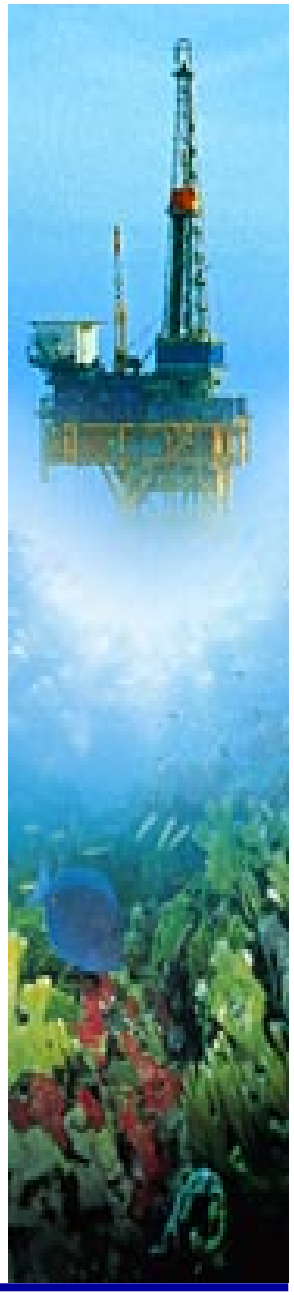
→ intermediate to undecylenic acid / Nylon 11

- undecylenic acid methyl ester

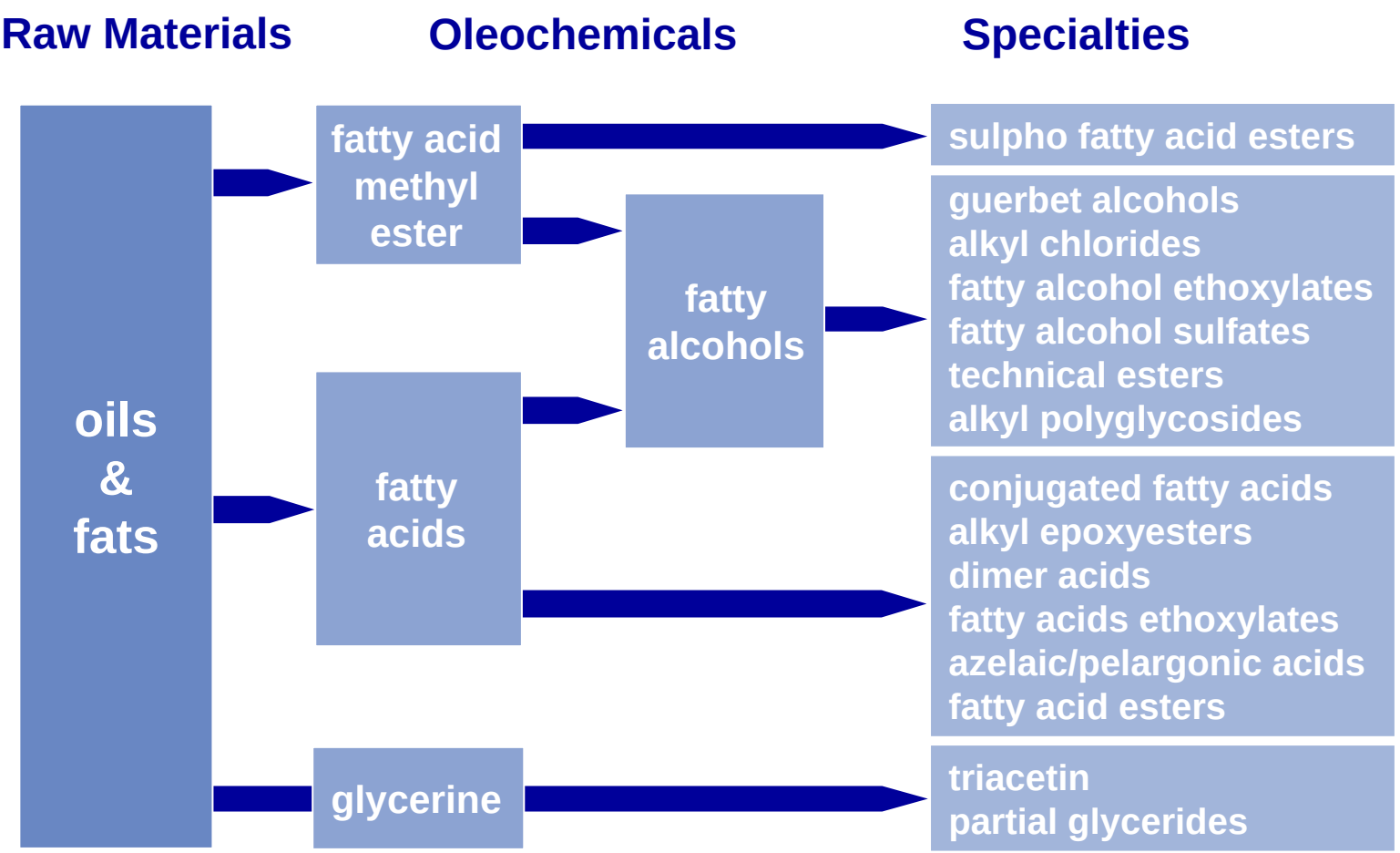


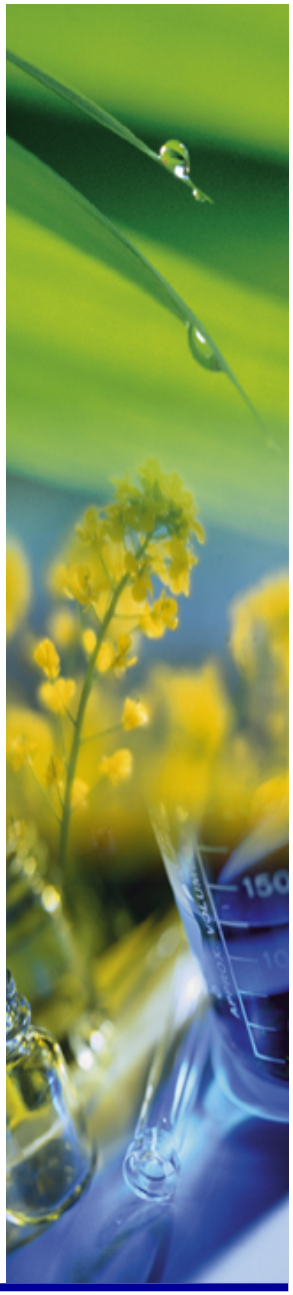
- Nylon 11





Summary - Production Flow Scheme





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  - **Carboxylic acids** **Vol. 5, p. 147**
  - **Fats and Oils** **Vol. 10, p. 252**

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  - **Fatty Acids** **Vol. A 10, p. 245**
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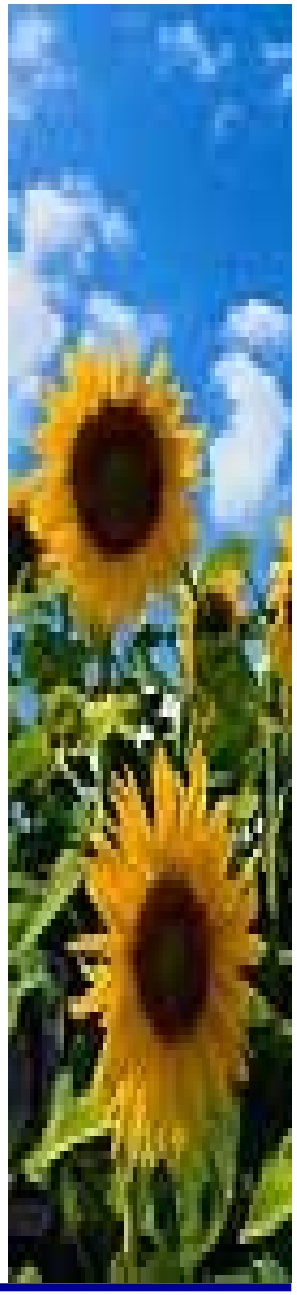
  edited by F. D. Gunstone, J. L. Harwood, F. B. Padley
  Chapman and Hall Ltd.




cognis.