

생유기화학
(*Bioorganic Chemistry*)

Lipids and Detergents-I
(지질과 세제-1)

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Lipids and Detergents

(지질과 세제)

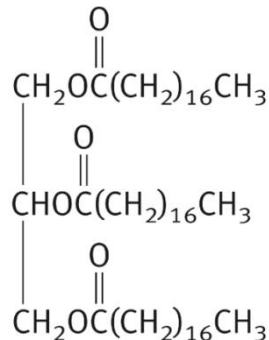
Lipid: organic molecule soluble to a great extent in nonpolar solvent
(insoluble in water)

fat, oil, wax, soap, detergent, phospholipid, steroid, vitamin, etc

Lipids can be extracted from cells and tissues by organic solvents. This solubility property distinguishes lipids from three other major classes of natural products- carbohydrates, proteins, and nucleic acid.



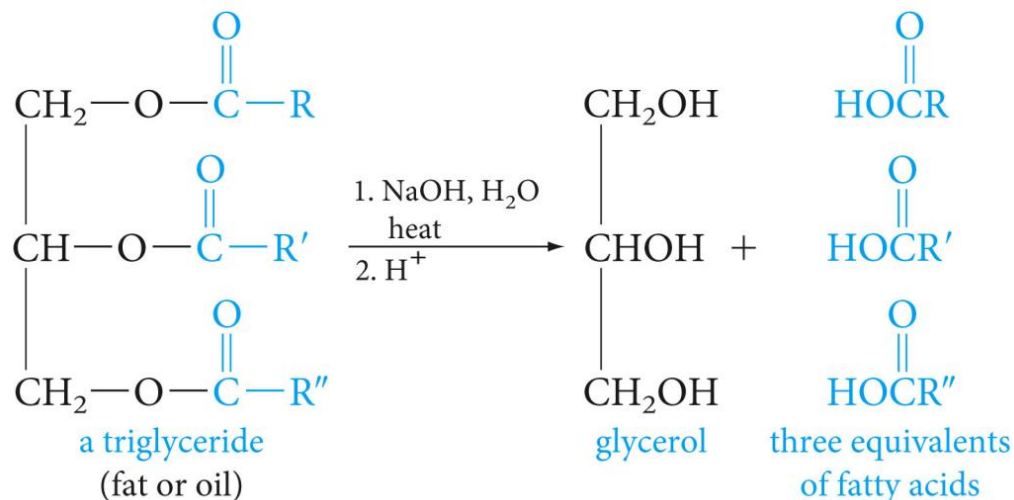
Cocoa butter



glyceryl tristearate

the same saturated fat found in beef

1. Fats and Oils; Triesters of Glycerol



(Saponification)

triglyceride : triesters of glycerol

fat : butter, lard, the fatty portions of meat (mainly come from animal)

oil : corn, cottonseed, olive, peanut, and soybean oils (mainly come from plants)

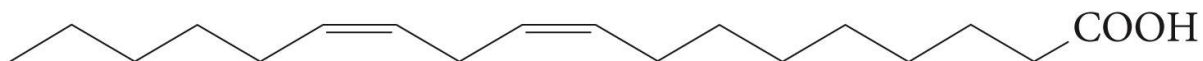
triglyceride → boil with alkali and acidify → glycerol and mixture of fatty acids

Table 15.1 Common Acids Obtained from Fats

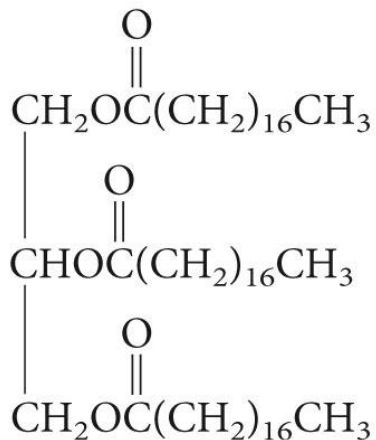
	Common name	Number of carbons	Structural formula	mp, °C
Saturated	lauric	12	CH ₃ (CH ₂) ₁₀ COOH	44
	myristic	14	CH ₃ (CH ₂) ₁₂ COOH	58
	palmitic	16	CH ₃ (CH ₂) ₁₄ COOH	63
	stearic	18	CH ₃ (CH ₂) ₁₆ COOH	70
	arachidic	20	CH ₃ (CH ₂) ₁₈ COOH	77
Unsaturated	oleic	18	CH ₃ (CH ₂) ₇ CH=CH(CH ₂) ₇ COOH (<i>cis</i>)	13
	linoleic	18	CH ₃ (CH ₂) ₄ CH=CHCH ₂ CH=CH(CH ₂) ₇ COOH (<i>cis, cis</i>)	-5
	linolenic	18	CH ₃ CH ₂ CH=CHCH ₂ CH=CHCH ₂ CH=CH(CH ₂) ₇ COOH (<i>all cis</i>)	-11

They are unbranched, and contain even number of carbon atoms.
usually *cis*(Z) configuration

Example 1. Draw the structure of linoleic acid, showing the geometry at each double bond.



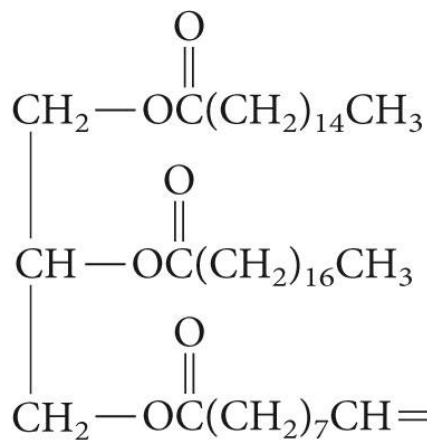
(Z configuration, staggered conformation)



a simple triglyceride

(glyceryl tristearate or tristearin)

(three fatty acids are identical)



ester of palmitic acid

ester of stearic acid

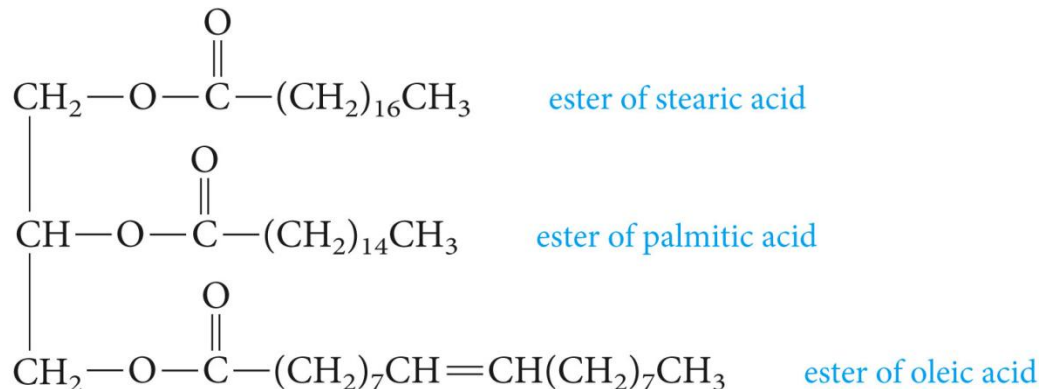
ester of oleic acid

a mixed triglyceride

(glyceryl palmitostearoöleate)

For mixed triglycerides, the name indicates the order in which the fatty acids are arranged.

Example 2. Draw the structure of glyceryl stearoplamitoöleate, an isomer of the mixed triglyceride shown above.



ester of stearic acid

ester of palmitic acid

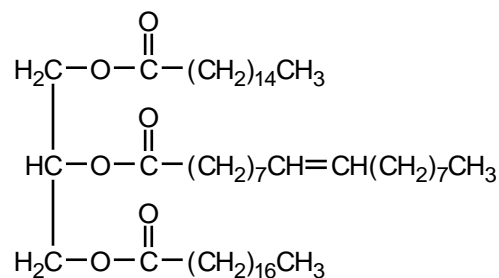
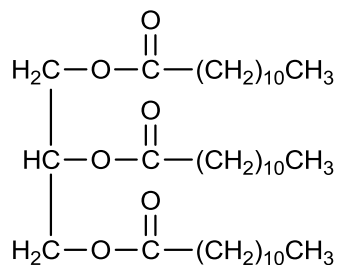
ester of oleic acid

(identical saponification products with glyceryl palmitostearoöleate)

Problem 2. Draw the structure of

a. glyceryl trimyristate

b. glyceryl palmitooleostearate



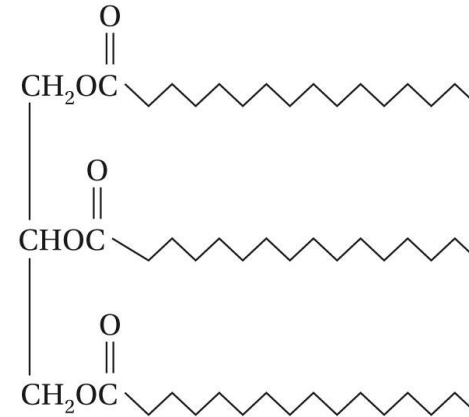
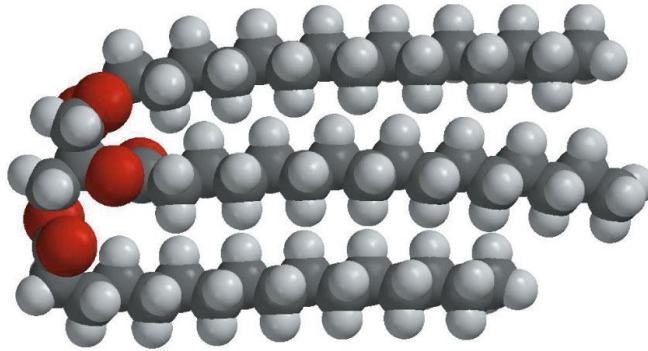
일반적으로 fat, oil은 single triglyceride가 아니라 여러 triglyceride의 혼합물질이다. Fat, oil의 성분은 saponification 반응으로 알 수 있다.

Table 15.2 Fatty Acid Composition of Some Fats and Oils (Approximate)

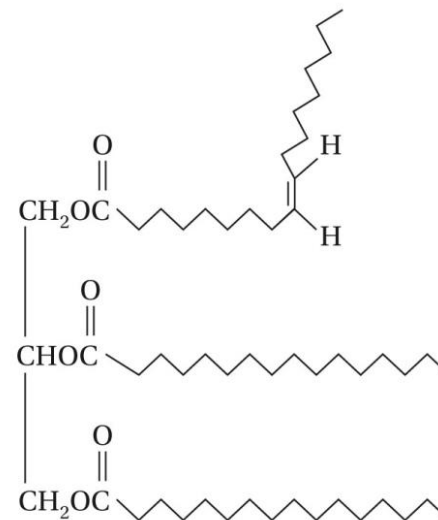
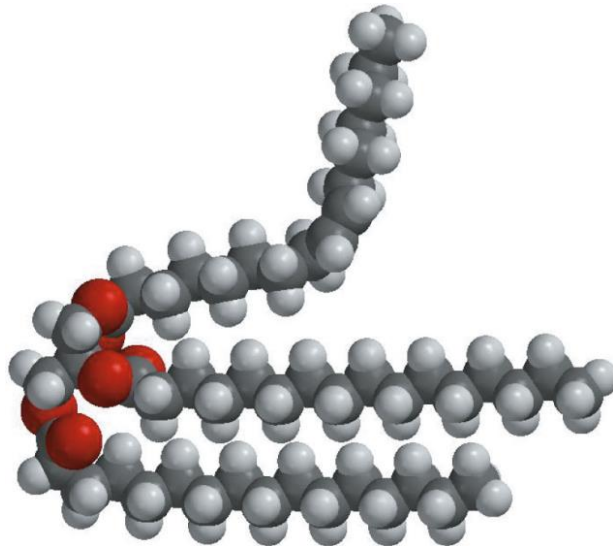
Source	Saturated acids (%)					Unsaturated acids (%)		
	C ₁₀ and less	C ₁₂ lauric	C ₁₄ myristic	C ₁₆ palmitic	C ₁₈ stearic	C ₁₈ oleic	C ₁₈ linoleic	
Animal Fats:								
Butter	12	3	12	28	10	26	2	} 28~56%
Lard	—	—	1	28	14	46	5	
Beef tallow	—	0.2	3	28	24	40	2	
Human	—	1	3	25	8	46	10	
Vegetable Oils:								
Olive	—	—	1	5	2	83	7	} 51~90%
Palm	—	—	2	43	2	43	8	
Corn	—	—	1	10	2	40	40	
Peanut	—	—	—	8	4	60	25	

Fish oils are high in unsaturated fatty acids. (77~84%).
Cocoa butter is solid in r.t.

The more double bonds in the fatty acid portion of the trimer, the lower its melting point.



pack as in a crystal



cannot align nicely
in a crystalline array

2. Hydrogenation of Vegetable Oils

Hardening(경화)

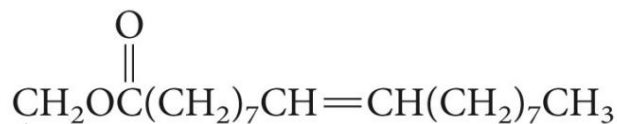
vegetable oils



solid vegetable fats

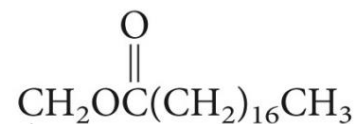
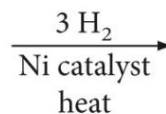
hydrogenation

margarine



glyceryl trioleate (triolein)

(mp -17°C)



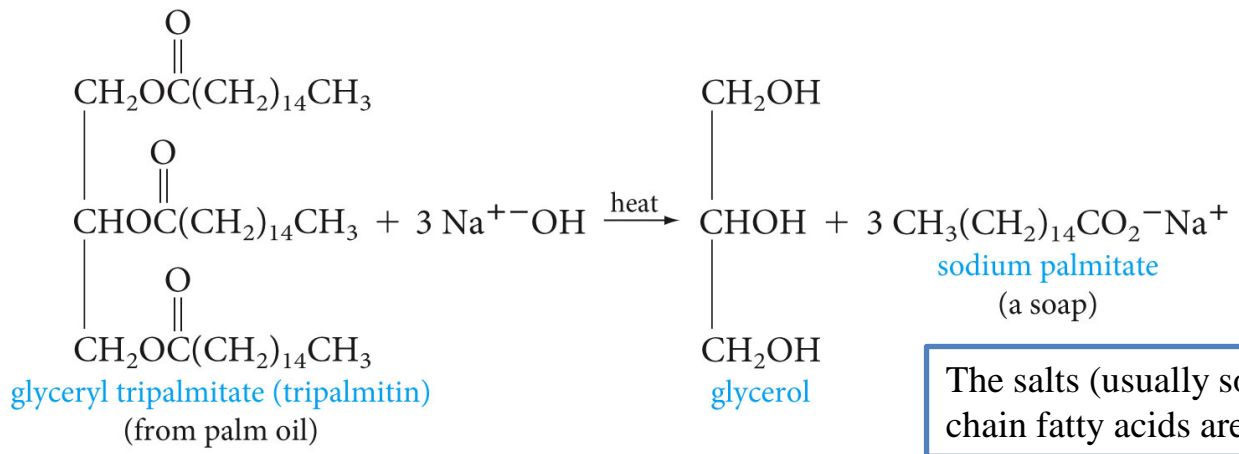
glyceryl tristearate (tristearin)

(mp 55°C)

Margarine is obtained by hydrogenating cottonseed, soybean, peanut, or corn oil.

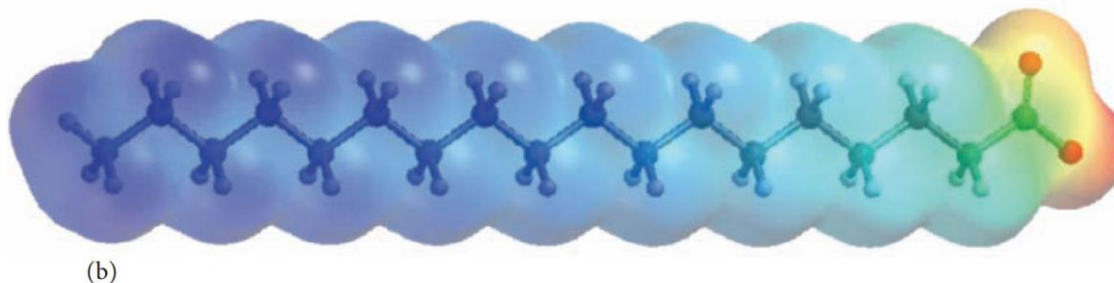
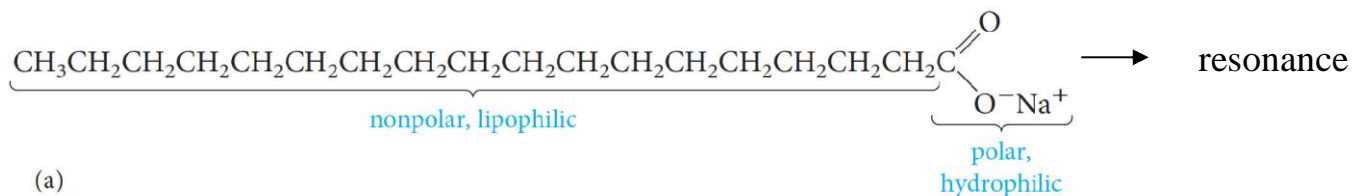
The product is churned with milk and artificially colored to mimic butter's flavor and appearance.

3. Saponification of Fats and Oils; Soap

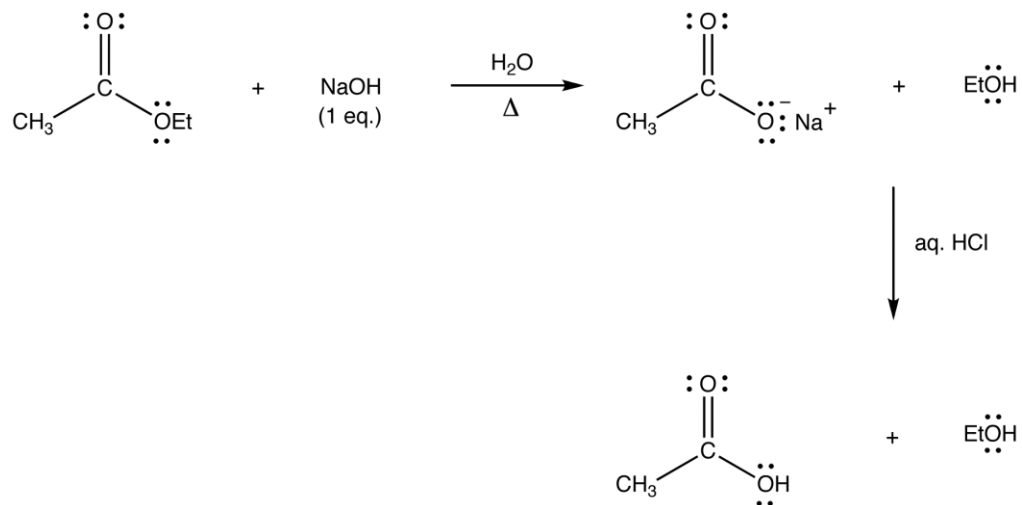


The salts (usually sodium) of long-chain fatty acids are soaps

The quantity of soap consumed by a nation was an accurate measure of its wealth and civilization.

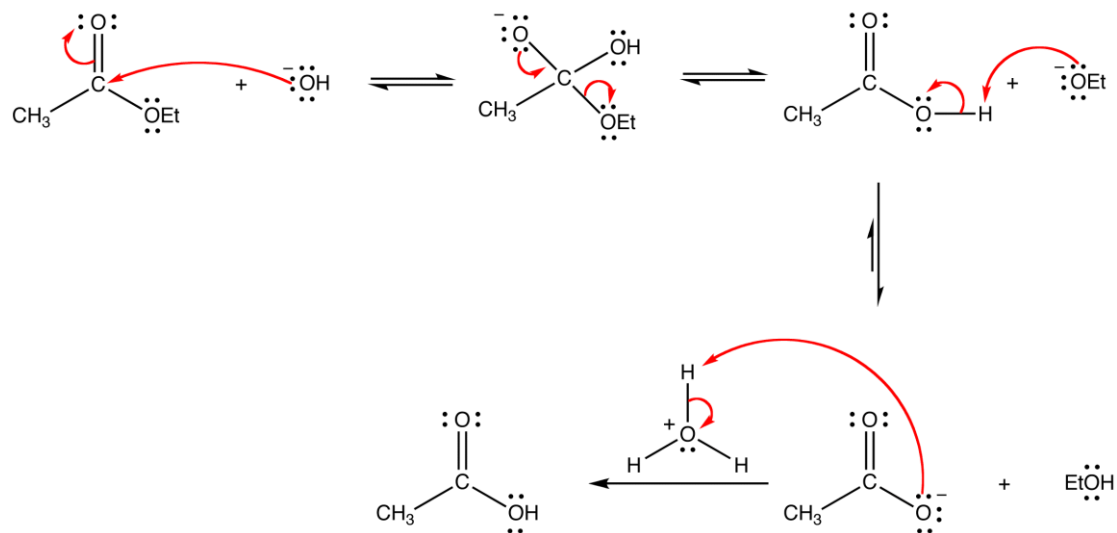


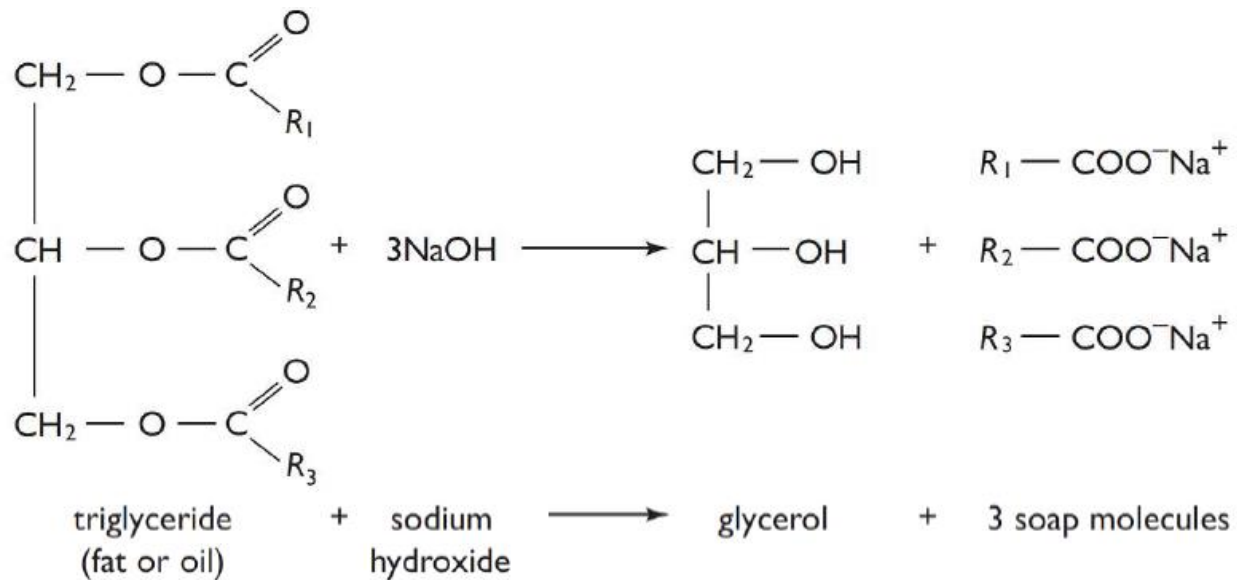
(Saponification)



Saponification is the hydrolysis of a carboxylic acid ester under basic conditions. The direct products are a carboxylic acid salt and an alcohol. To convert the salt to the corresponding carboxylic acid, acidic workup of the product mixture is required.

(Mechanism)





(2) transesterification

