

# Lipids

## 第三章 脂 类

- 构造和命名
- 物理性质
- 化学性质

# 1. 概述

## 脂类的定义

能溶于有机溶剂如醚、氯仿、丙酮、苯等，不溶或微溶于水的有机化合物。

脂类和碳水化合物及蛋白质共同构成了生物细胞的主要构造组分。

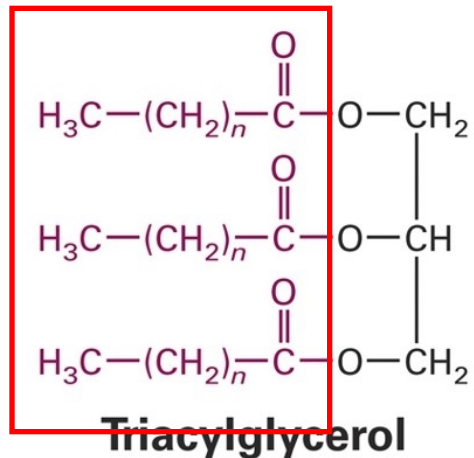
主要有脂肪（三酰基甘油），衍生化合物（磷脂、糖脂）、类固醇及类胡萝卜素

# 脂类的功能

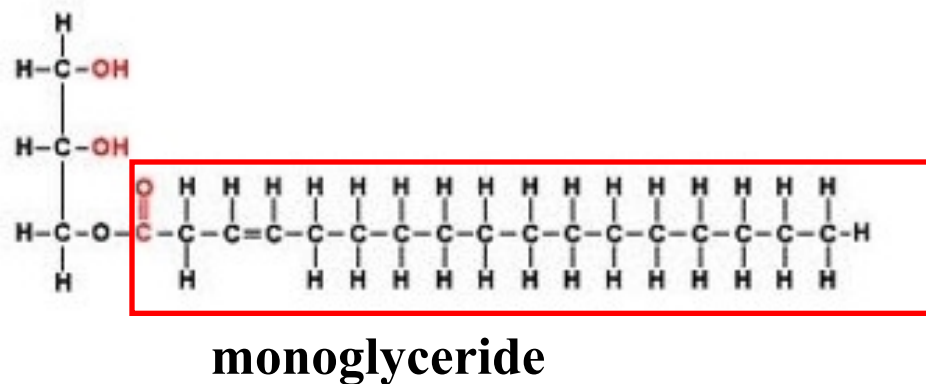
- 营养
- 生物生理
- 食品品质
  - 颜色
  - 质构
    - 细滑, 柔软
  - 风味
  - 饱腹感

# • 分类

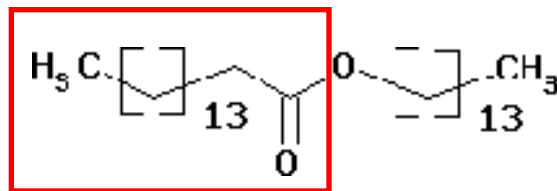
groups	sub-group	composition
简单脂类	甘油酯	脂肪酸+ 甘油
	蜡	脂肪酸+ alcohols(醇)
复合脂类	phospholipides (phosphatides) (磷脂)	脂肪酸+甘油+phosphoric acid(磷酸), + 其他含氮的基团
	glycolipids (糖脂)	脂肪酸+ 甘油+ 碳水化合物
	其他	sphingolipids(鞘脂) and sulfolipids(硫脂)
衍生脂类	fatty acids (脂肪酸)	
	醇	高碳醇and sterols (固醇)
	Hydrocarbons(烃)	



三甘酯



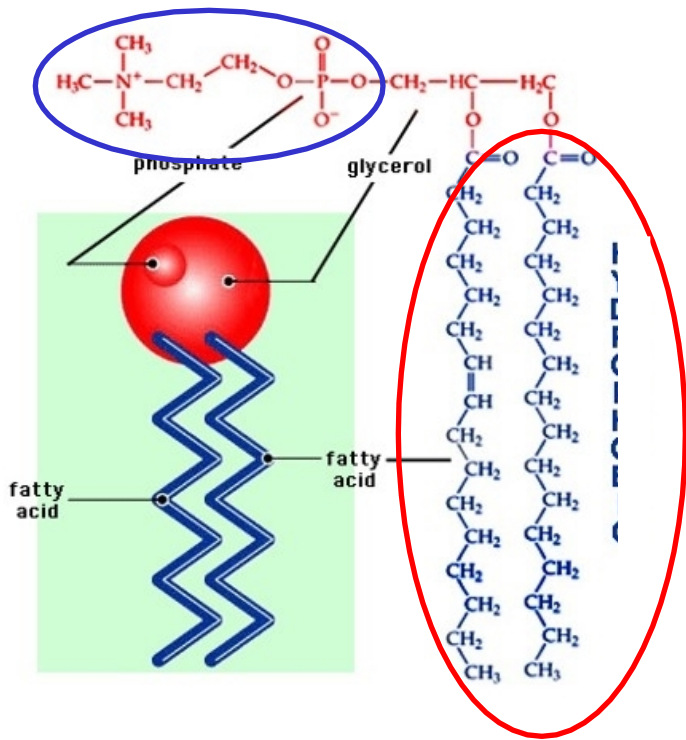
单甘酯



蜡

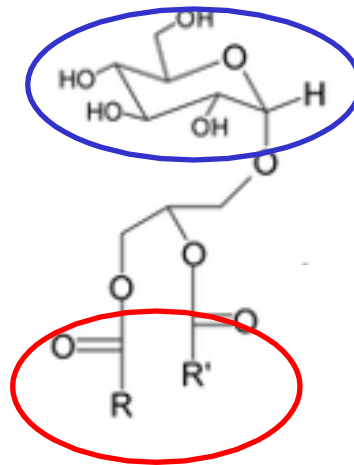
wax

简朴脂类



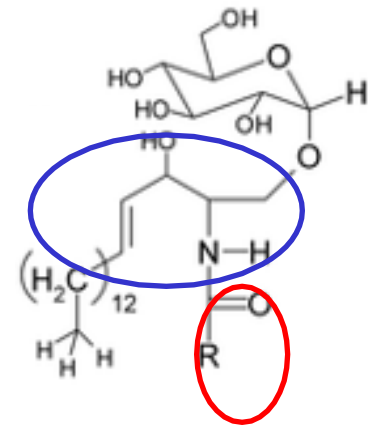
**phospholipid**

磷酯



**glyceroglycolipid**

糖酯



**sphingolipid**

鞘酯

复杂脂类





## 2 构造和命名

## 2.1 简朴脂类

### 2.1.1 脂肪酸

## 2.1.1.1 脂肪酸构造

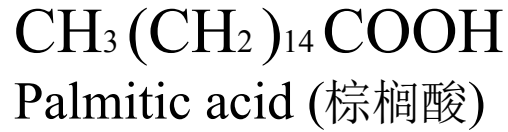


methyl end (甲基端)

carboxyl end (羧基端)

- 偶数碳
- 直链无分支
- 碳链含 4 to 24 碳原子

■ saturated  
(饱和的)

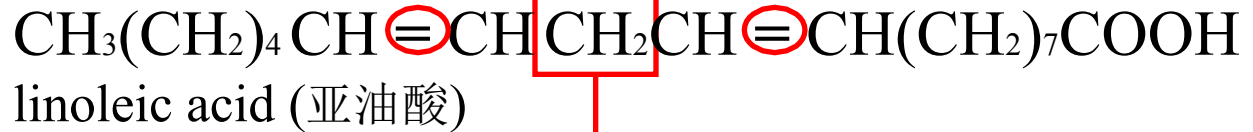


双键

■ monounsaturated  
(单不饱和的)

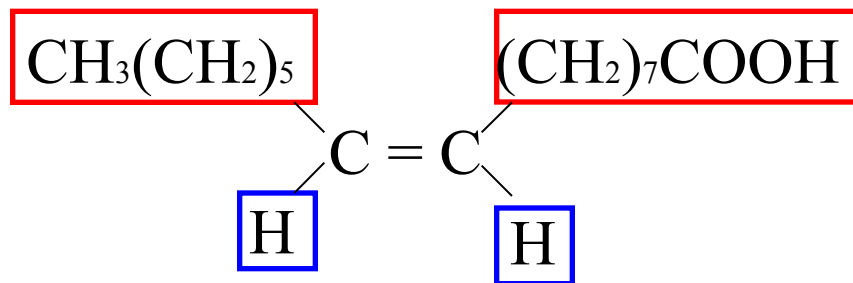


■ polyunsaturated  
(多不饱和的)



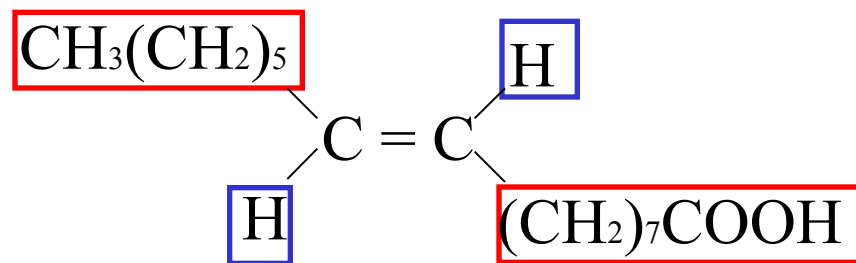
methylene (亚甲基)

■ *cis* configuration  
(顺式构型)

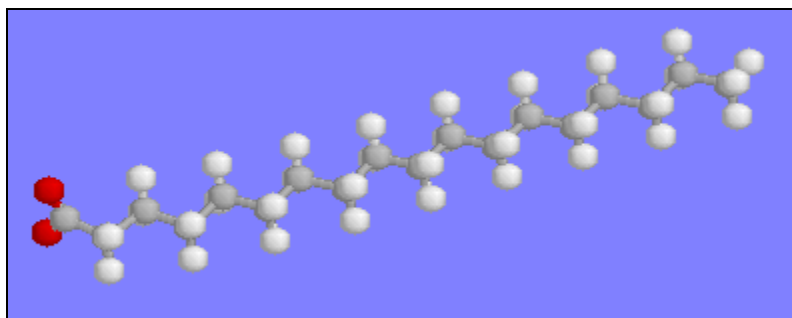


棕榈油酸(*cis*)

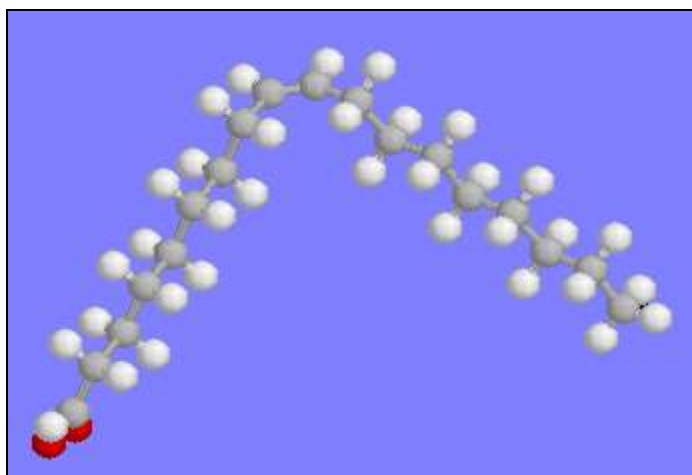
■ *trans* configuration  
(反式构型)



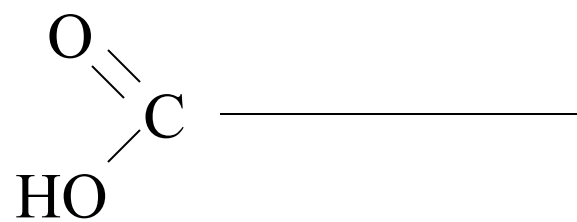
棕榈油酸(*trans*)

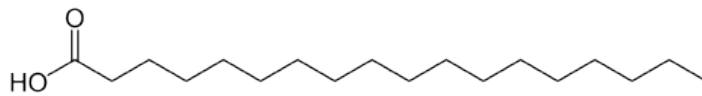


硬脂酸

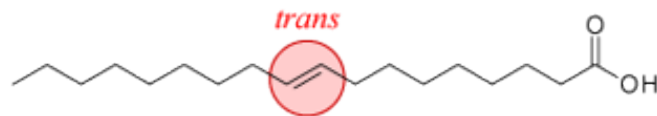


油酸

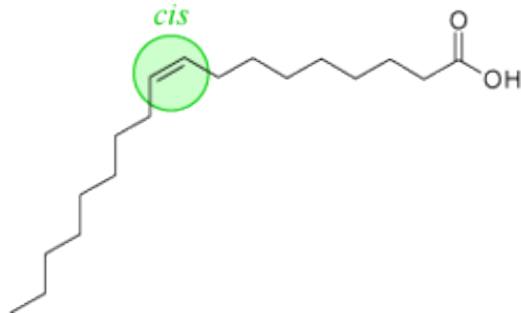




Stearic acid (硬脂酸)



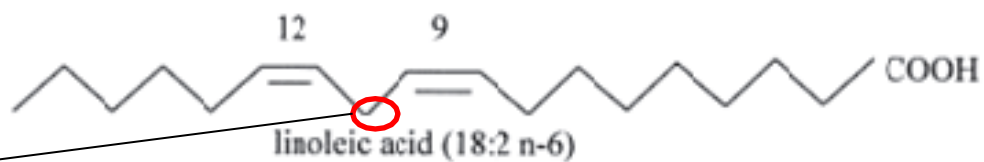
Elaidic acid (反油酸)



Oleic acid (油酸)

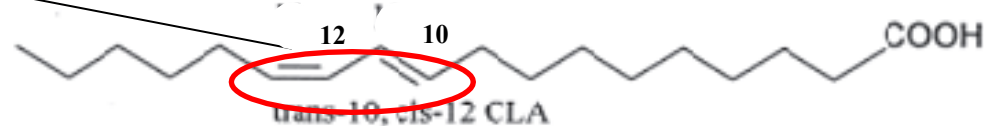
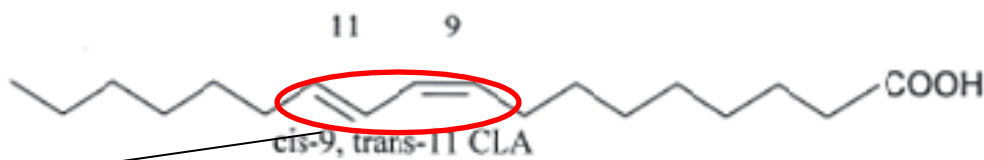
## ■ Conjugated (共轭亚油酸)

亚甲基



linoleic acid

共轭



conjugated  
linoleic acid  
异构体

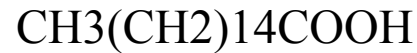


- ability to inhibit cancer
- ability to lower blood cholesterol
- ability to reduce body fat and increase lean muscle mass

In July 2023, CLA is generally recognized as safe by FDA for certain food categories, including fluid milk, yogurt, meal replacement shakes, nutritional bars, fruit juices and soy milk

## 2.1.1.2 脂肪酸的命名

饱和



### ■ 系统命名法

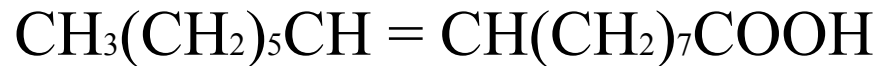
hexadecane(十六烷烃) → hexadecanoic (十六酸)

■ 一般名称或俗名：棕榈酸

■ 缩写: 16:0

■ 符号: P

## 不饱和脂肪酸



■ 一双键:

hexadecene(十六烯烃) → hexadecenoic(十六烯酸)

■ 两个双键: -dienoic

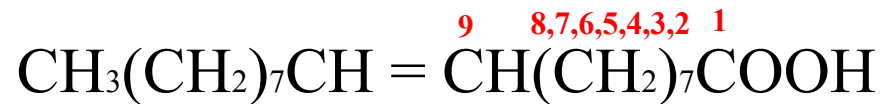
octadecadienoic(十八二烯酸)

■ 三个双键: -trienoic

octadecatrienoic(十八三烯酸)

# 不饱和脂肪酸

- 双键位置
- geometrical configuration(几何构型)



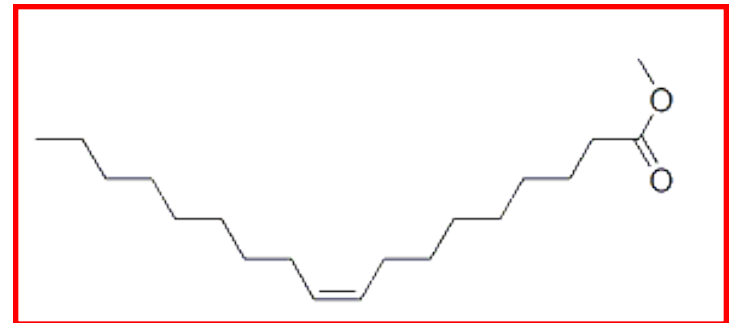
➤ 系统命名:

*cis*-9-octadecenoic ( $\Delta$ 9-octadecenoic) (顺-9-十八烯酸)

➤ 俗名: 油酸

➤ 缩写: 18:1(9c)

➤ 符号: O



## 不饱和脂肪酸-另一种命名方式

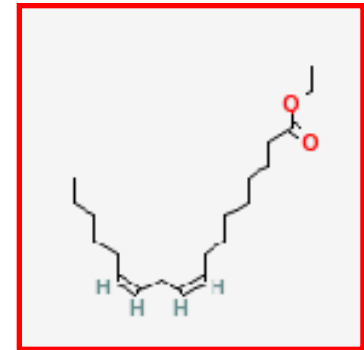
- 编号从碳链的甲基端开始， $\omega$  或 n-



*cis*-9, *cis*-12-octadecadienoic (顺-9, 顺-12-十八二烯酸)

亚油酸, L

18:2 (9c,12c)  
18:2  $\omega$ 6 (n-6)



➤ *cis* 构型

➤ 双键被亚甲基隔开

# 不饱和脂肪酸

## ■ $\omega$ 3 fatty acids

- 亚麻酸: 植物种子
- EPA (20:5  $\omega$ 3): fish oil
- DHA (22:6  $\omega$ 3): fish oil

## ■ $\omega$ 6 脂肪酸

## ■ $\omega$ 9 脂肪酸

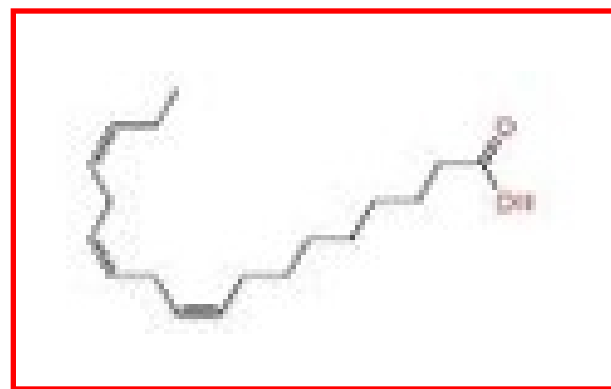
Practice:



Linolenic acid (亚麻酸), Ln

系统命名?

缩写:  $\Delta$  and  $\omega$ ?



## 食品中脂肪酸的命名

缩写	系统名称	俗名	符号
4:0	丁酸	Butyric(丁酸)	B
6:0	己酸	Caproic(己酸)	H
8:0	辛酸	Caprylic(辛酸)	Oc
10:0	癸酸	Capric(癸酸)	D
12:0	Dodecanoic(十二酸)	Lauric(月桂酸)	La
14:0	Tetradecanoic(十四酸)	Myristic(肉豆蔻酸)	M
16:0	Hexadecanoic 十六酸	Palmitic 棕榈酸	P
16:1(n-7)	9-Hexadecenoic 9-十六烯酸	Palmitoleic 棕榈油酸	Po
18:0	Octadecanoic 十八酸	Stearic(硬脂酸)	St
18:1(n-9)	9-Octadecenoic 9-十八烯酸	Oleic 油酸	O
18:2(n-6)	9,12-Octadecadienoic 9, 12十八碳二烯酸	Lin 亚油酸oleic	L
18:3(n-3)	9,12,15-Octadecatrienoic(十八三烯酸)	Linolenic ( $\alpha$ -亚麻酸)	Ln



Abbreviation	Systematic name	Trivial name	Symbol
20:0	Eicosanoic(二十酸)	Arachidic(花生酸)	Ad
20:4(n-6)	5,8,11,14-Eicosatetraenoic (二十碳四烯酸)	Arachidonic(花生四烯酸)	An
20:5(n-3)	5,8,11,14,17-Eicosapentanoic (二十碳五烯酸)	EPA	
22:1(n-9)	Erucic acid (13-二十二烯酸)	(芥子酸)	
22:6(n-3)	4,7,10,13,16,19-Docosahexanoic (二十二碳六烯酸)	DHA	

- 短链脂肪酸:  $\leq 10\text{ C}$
- 中档链长的脂肪酸:  $12\text{C}-14\text{C}$
- 长链脂肪酸:  $\geq 16\text{C}$





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