

Carboxylic acids

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Properties


- widely distributed in the nature (AA, FA)
- **tart taste** (vinegar, sour milk, fruits)
- low MW: liquids (sharp, unpleasant odor)
- high MW: waxlike solids
- hydrogen bonds
 - high boiling points
 - solubility in water (low MW)
- **weak acids** (carboxylate is stabilized by free e^-)
- α -halogen derivatives are stronger acids

carboxyl group: $R\text{-COOH}$ / $R\text{-CO}_2\text{H}$

- suffix: **-oic / -dioic acid**
parent hydrocarbon **carboxylic acid**
- **trivial names!**
- saturated / unsaturated
- mono-, di-, tri-carboxylic acids
- alpha (α) / omega (ω) carbon
- ω - or n - fatty acids
- acyl / anion

A. Carboxylic acids

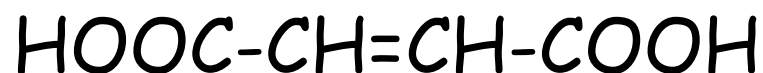
Name	Number of carbons	Number of double bonds		Position of double bonds
Formic acid	1 : 0			Not contained in lipids
Acetic acid	2 : 0			
Propionic acid	3 : 0			
Butyric acid	4 : 0			
Valerianic acid	5 : 0			
Caproic acid	6 : 0			$\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$ Caproic acid
Caprylic acid	8 : 0			
Capric acid	10 : 0			
Lauric acid	12 : 0			
Myristic acid	14 : 0			
Palmitic acid	16 : 0			
Stearic acid	18 : 0			
Oleic acid	18 : 1; 9			
Linoleic acid	18 : 2; 9,12			
Linolenic acid	18 : 3; 9,12,15			
Arachidic acid	20 : 0			
Arachidonic acid	20 : 4; 5,8,11,14			
Behenic acid	22 : 0			
Erucic acid	22 : 1; 13			
Lignoceric acid	24 : 0			
Nervonic acid	24 : 1; 15			

 Essential in human nutrition

The figure was adopted from: J.Koolman, K.H.Röhm / Color Atlas of Biochemistry, 2nd edition, Thieme 2005

Important dicarboxylic acids

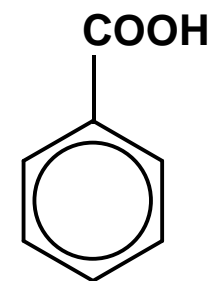
C2	HOOC-COOH	oxalic acid
C3	$\text{HOOC-CH}_2\text{-COOH}$	malonic acid
C4	$\text{HOOC-(CH}_2\text{)}_2\text{-COOH}$	succinic acid
C5	$\text{HOOC-(CH}_2\text{)}_3\text{-COOH}$	glutaric acid
C6	$\text{HOOC-(CH}_2\text{)}_4\text{-COOH}$	adipic acid



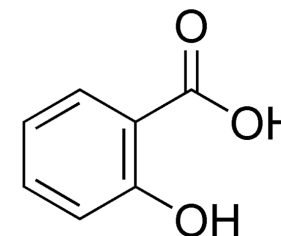
cis maleic acid
trans fumaric acid

Important aromatic carboxylic acids

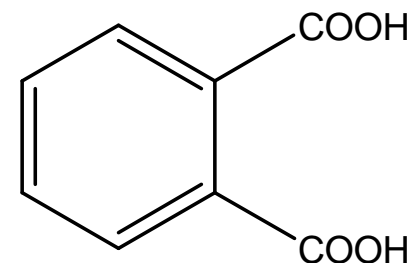
- **benzoic acid**
(= benzene carboxylic acid)



- **salicylic acid**
(= 2-hydroxybenzoic acid)



- **phthalic acid**
(= benzene-1,2-dicarboxylic acid)



EXERCISE

- $\text{CH}_3\text{-COOH}$
- $\text{CH}_3\text{-COO}^-$
- $\text{CH}_3\text{-CO-}$
- $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-COOH}$
- $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-COO}^-$
- $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CO-}$
- acetic acid
- acetate
- acetyl
- butyric acid
- butyrate
- butyryl

R-COOH

carboxylic acid

R-COO^-

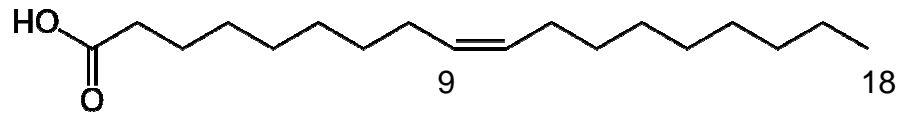
carboxylate

R-CO-

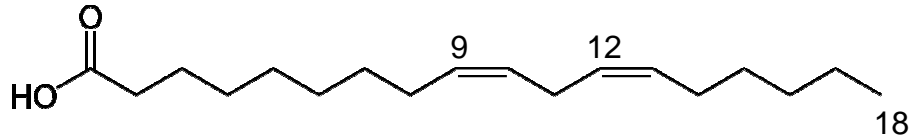
acyl

EXERCISE

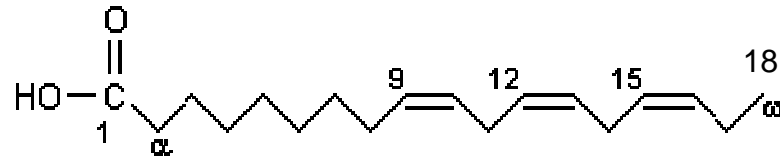
- $\text{CH}_3\text{-CHCl-COOH}$
- $\text{CH}_3\text{-CHBr-CH}_2\text{COOH}$
- $\text{CCl}_3\text{-COOH}$
- $\text{HO-CH}_2\text{-CH}_2\text{-COOH}$
- $\text{CH}_3\text{-CH(NH}_2\text{)-CH}_2\text{-CH}_2\text{-COOH}$
- $\text{CH}_3\text{-CH}_2\text{-CH(CH}_3\text{)-CH}_2\text{-CHCl-COOH}$
- $\text{HOOC-CH}_2\text{-CH}_2\text{-COOH}$
- $(\text{COOH})_2$



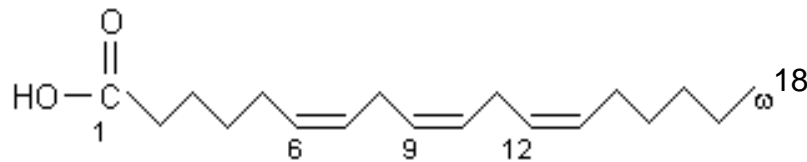
oleic acid



linoleic acid



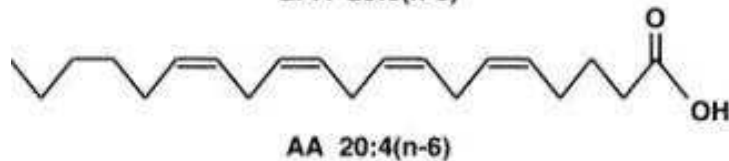
alpha linolenic acid



gamma linolenic acid



eicosapentenoic acid



arachidonic acid



docosahexenoic acid