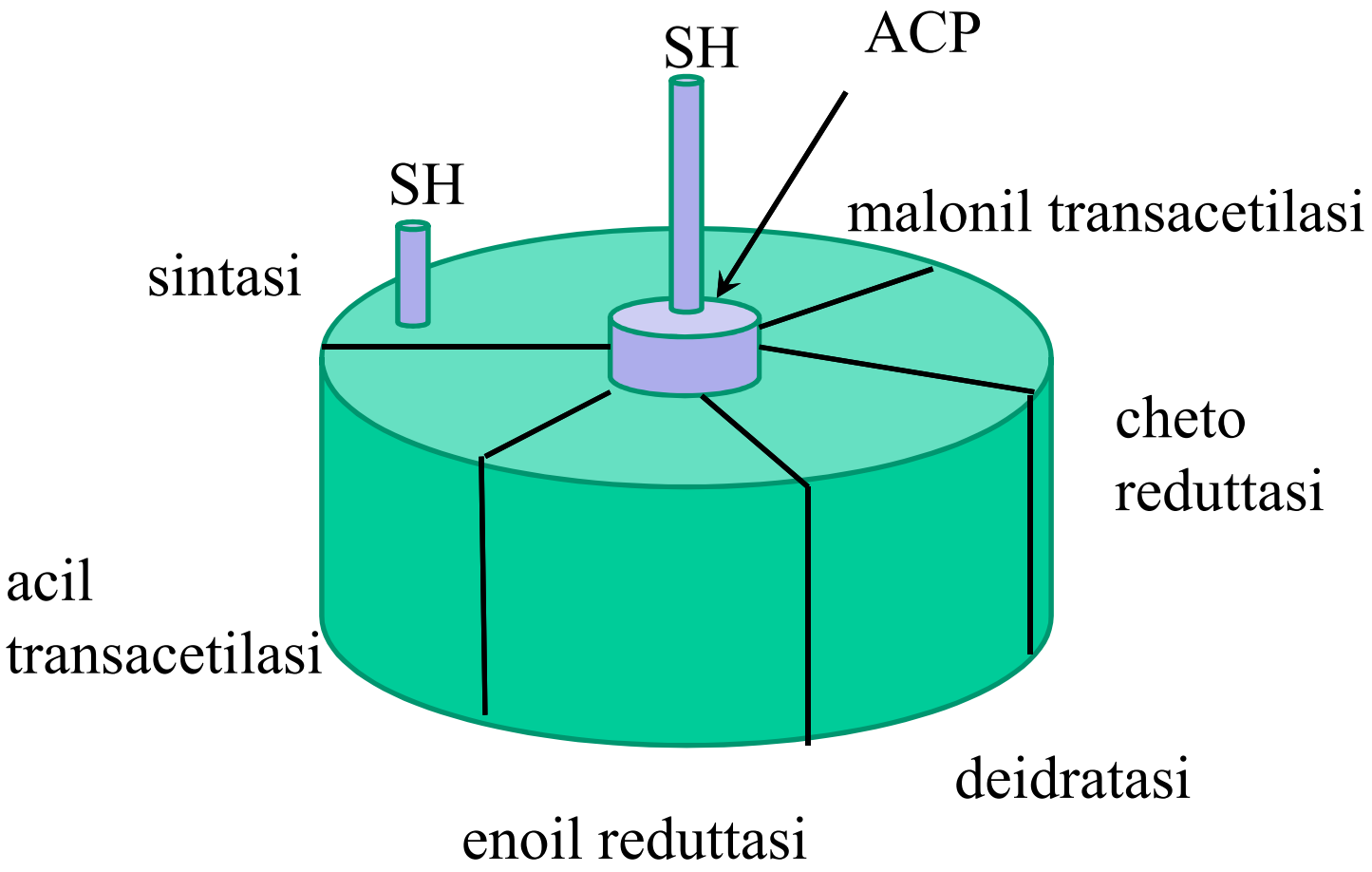
Biosintesi degli acidi grassi

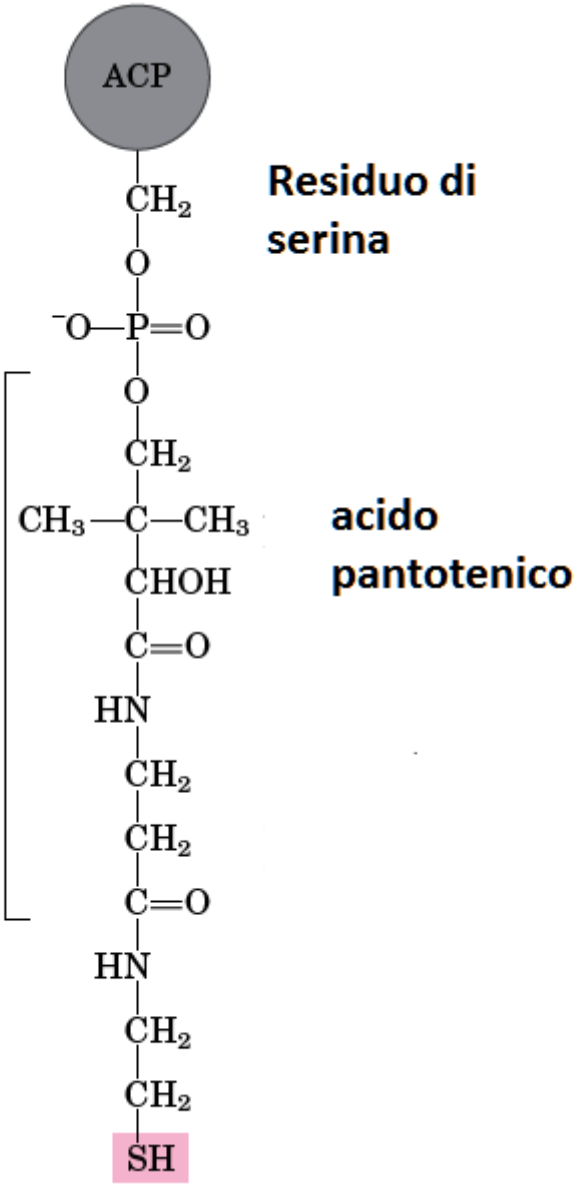
Caratteristiche principali

1. Avviene nel citosol (animali) o nei cloroplasti (piante)
2. Richiede NADPH
3. Utilizza un intermedio a 3 atomi di carbonio
4. E’ catalizzata da un complesso multienzimatico
5. E’ attivata da citrato

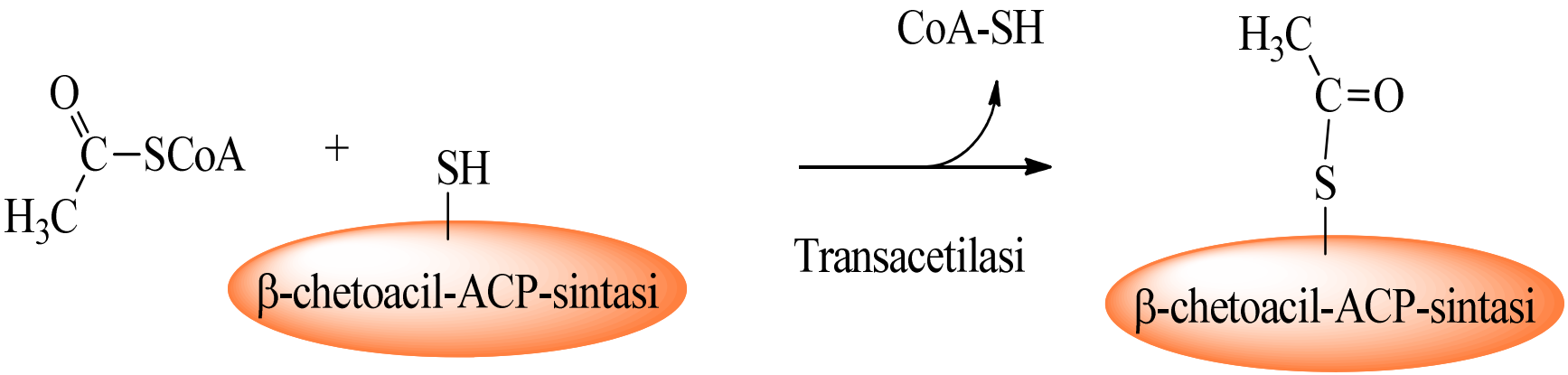
Acido grasso sintasi



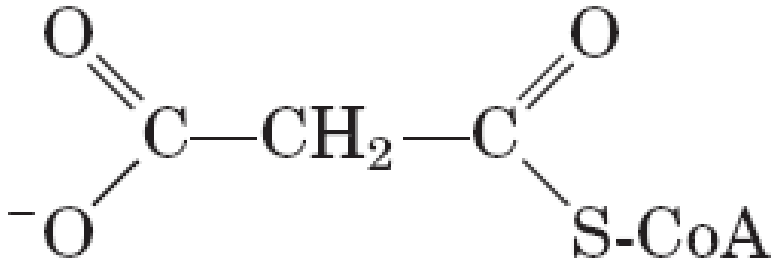
ACP, Acyl Carrier Protein



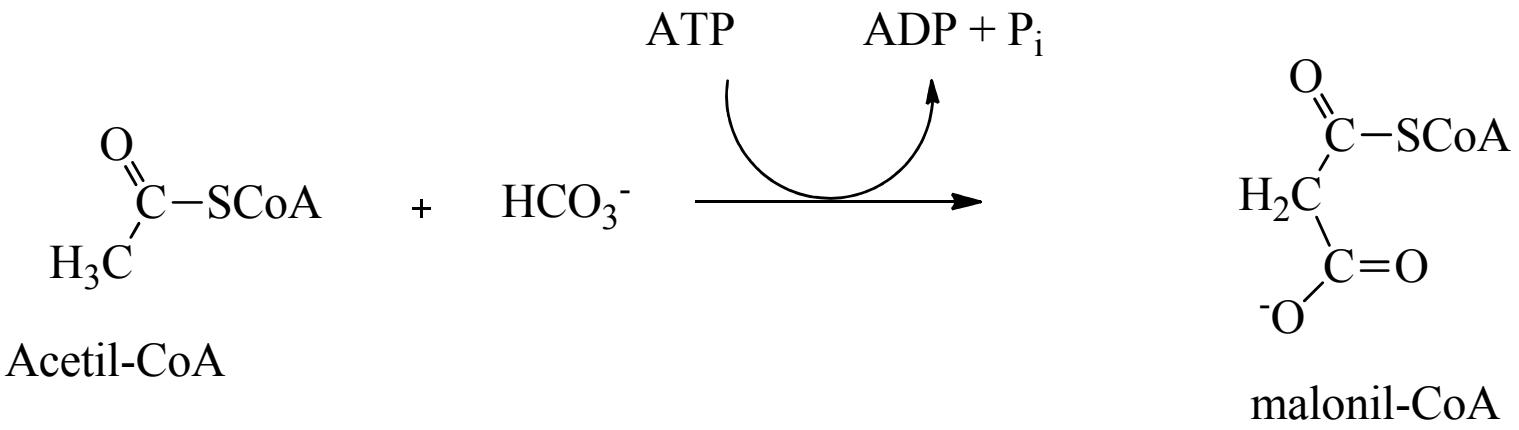
Acido grasso sintasi. Prima reazione



Il malonil-Coenzima A

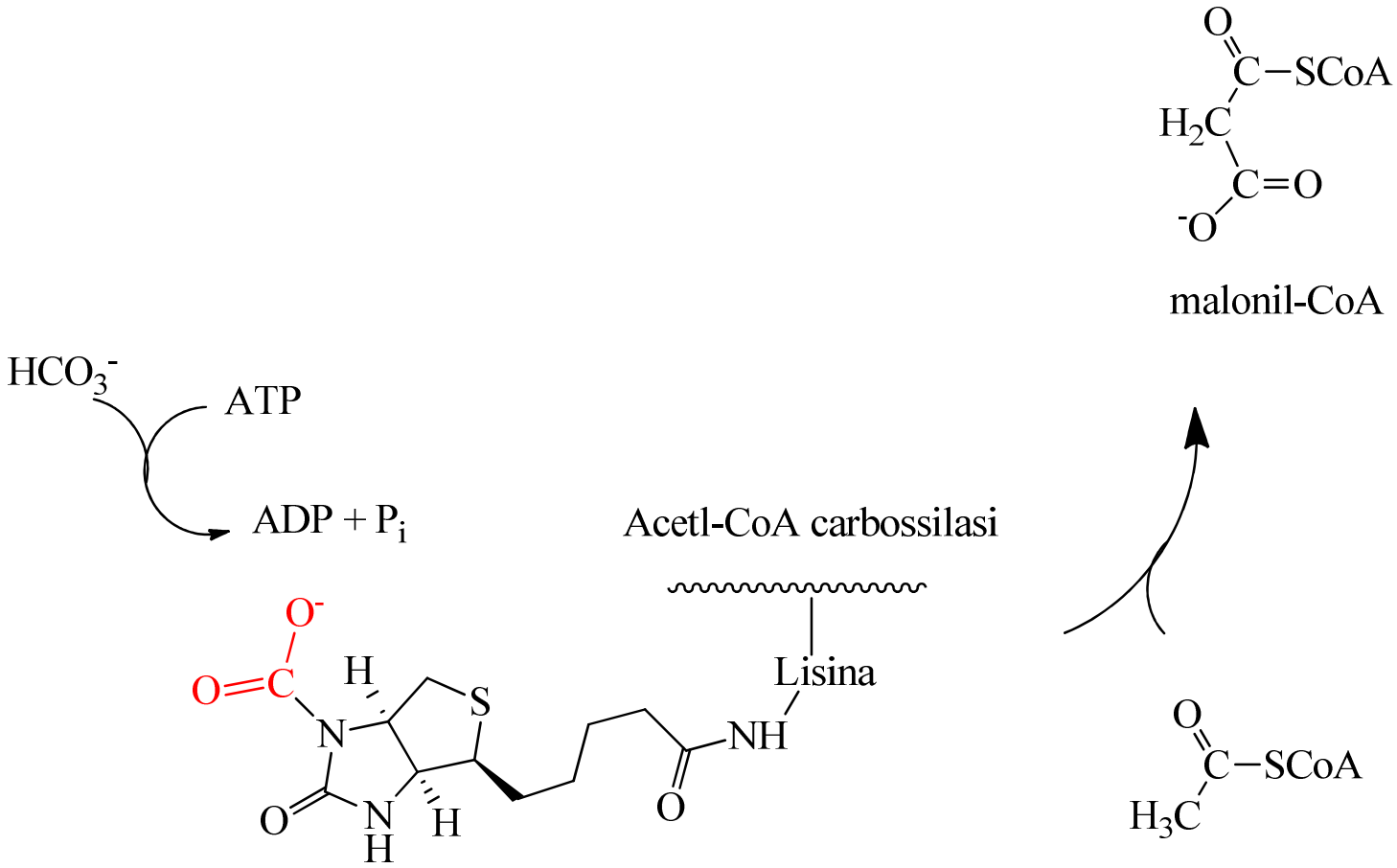


Attivazione dell'acetil-CoA.

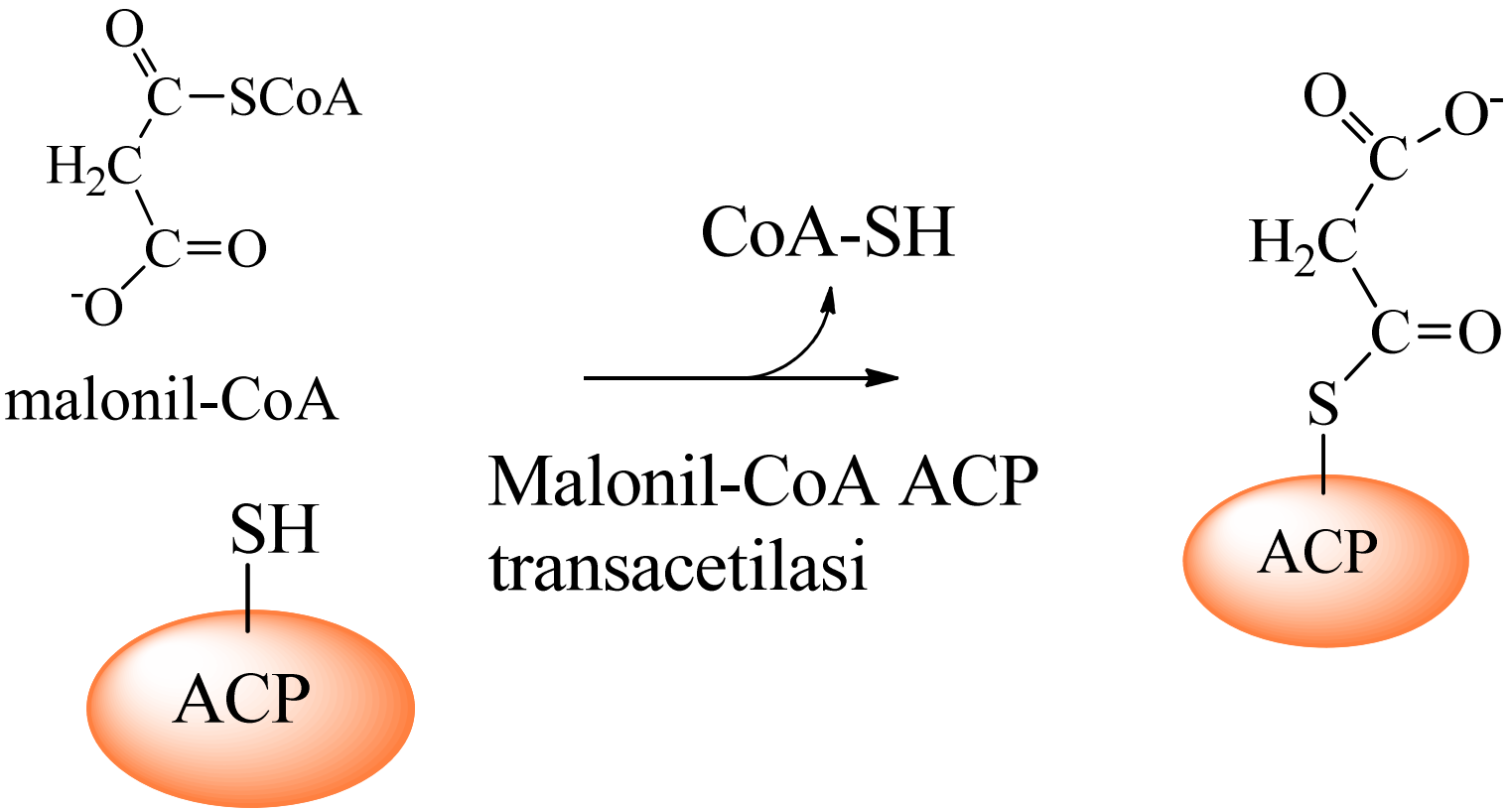


Acetil-CoA

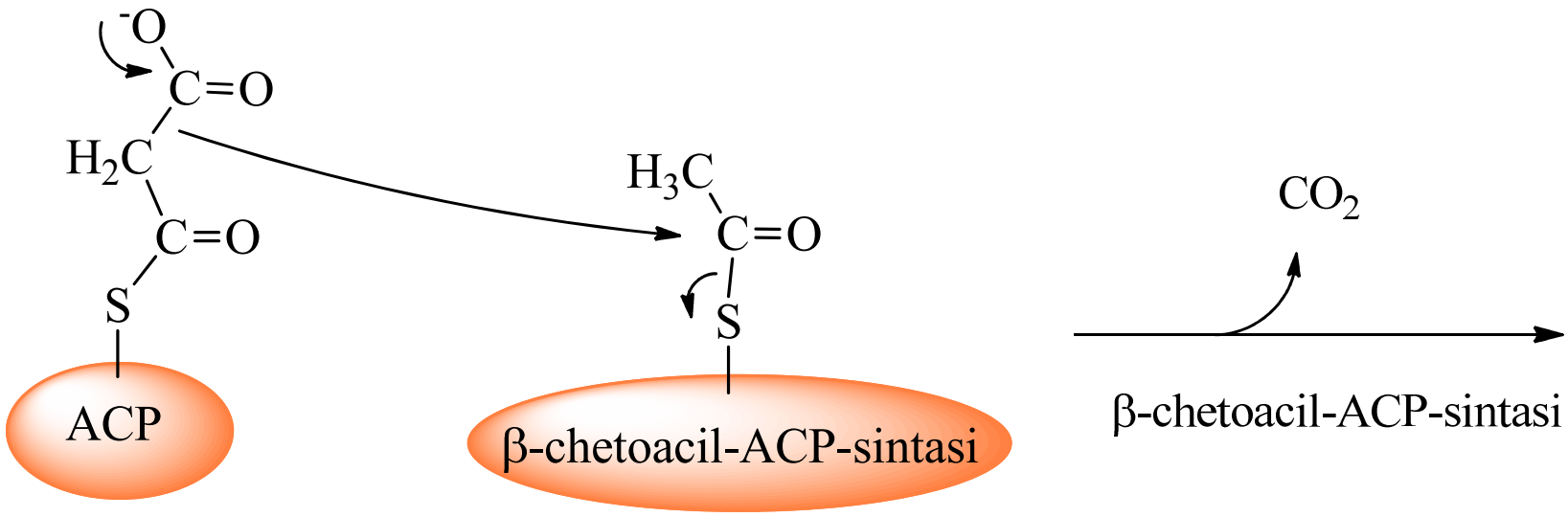
malonil-CoA



carbossibiotina
legato all'enzima mediante
un residuo di lisine

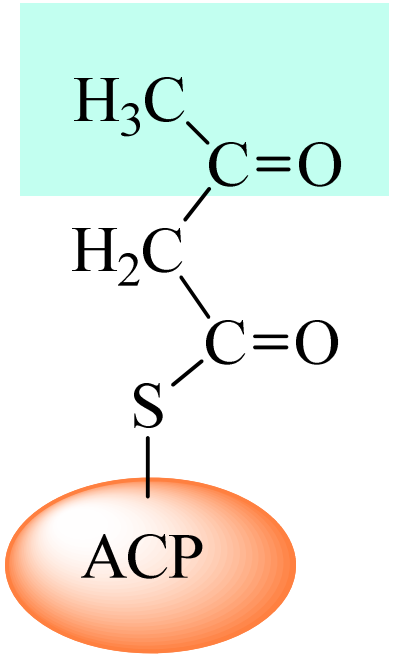


Acyl Carrier Protein

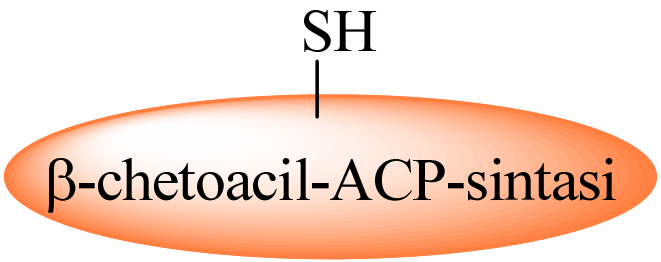

-O
C=O
H2C
C=O
S
ACP
H3C
C=O
S
β-chetoacil-ACP-sintasi
CO2
β-chetoacil-ACP-sintasi

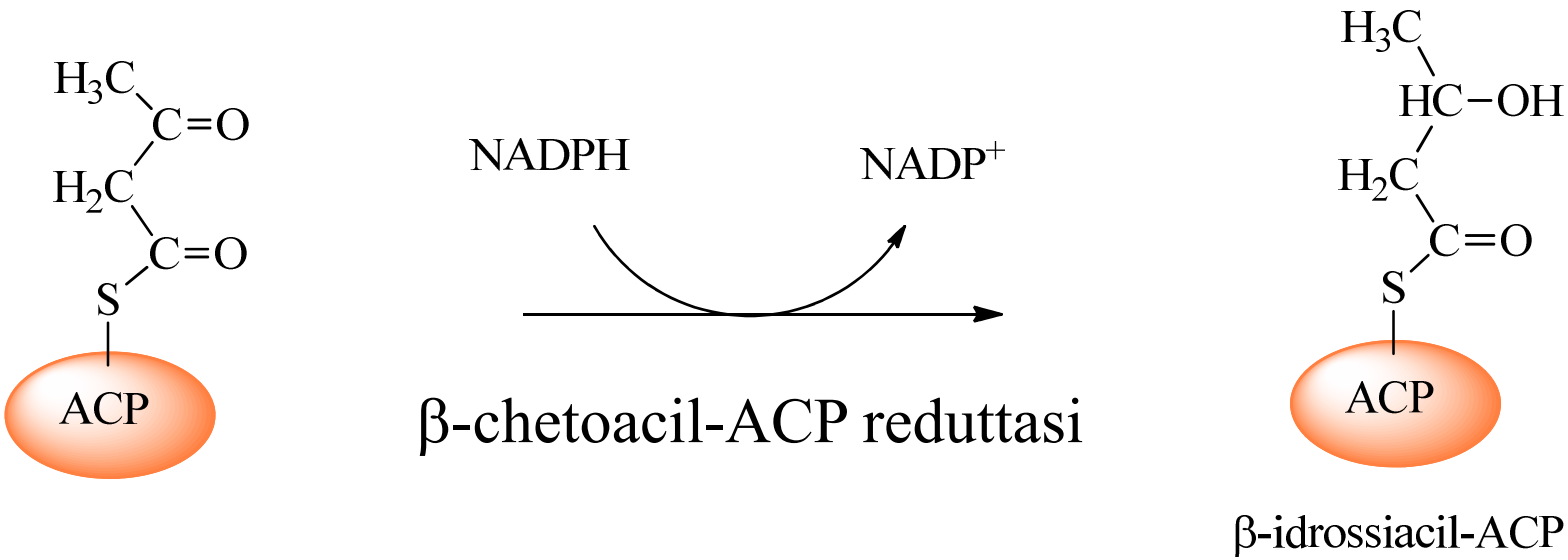
primo acetile

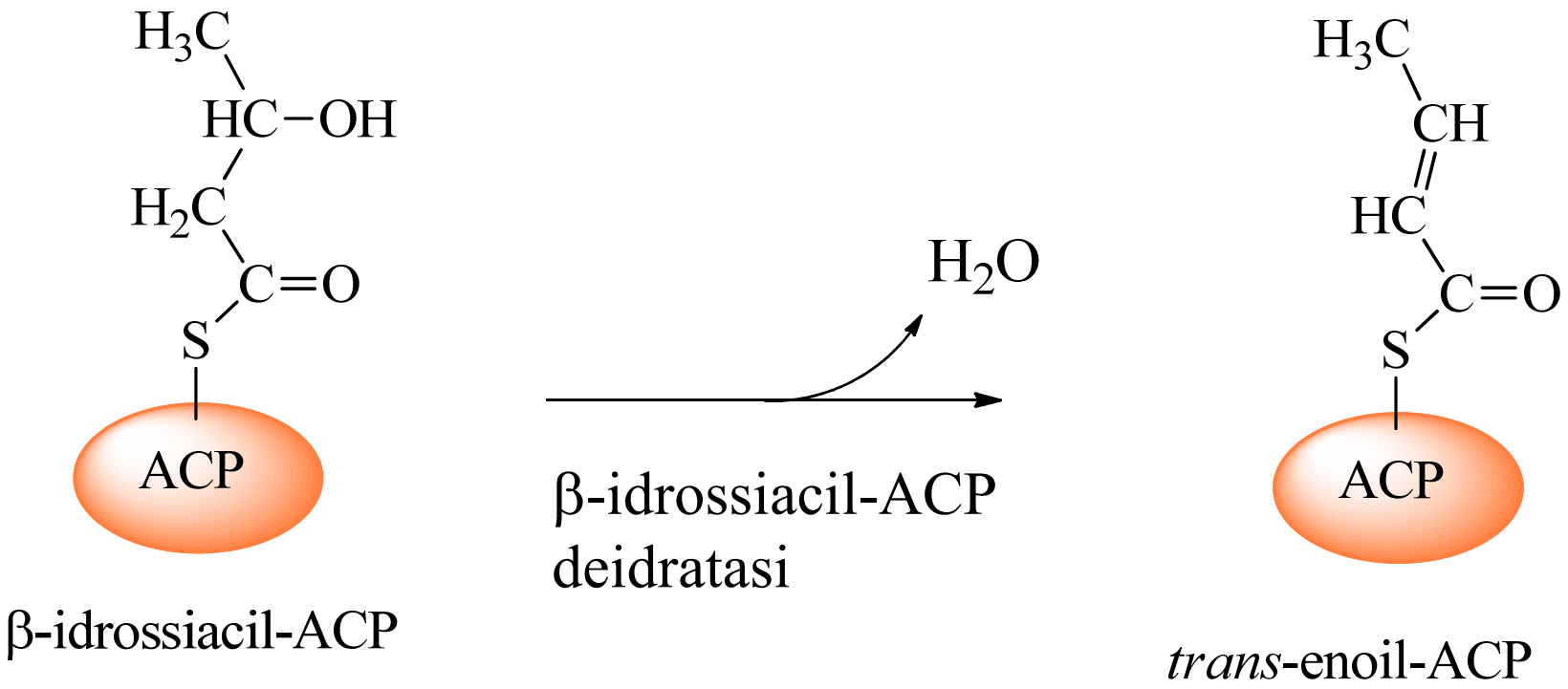
ex malonile



β-chetoacil-ACP

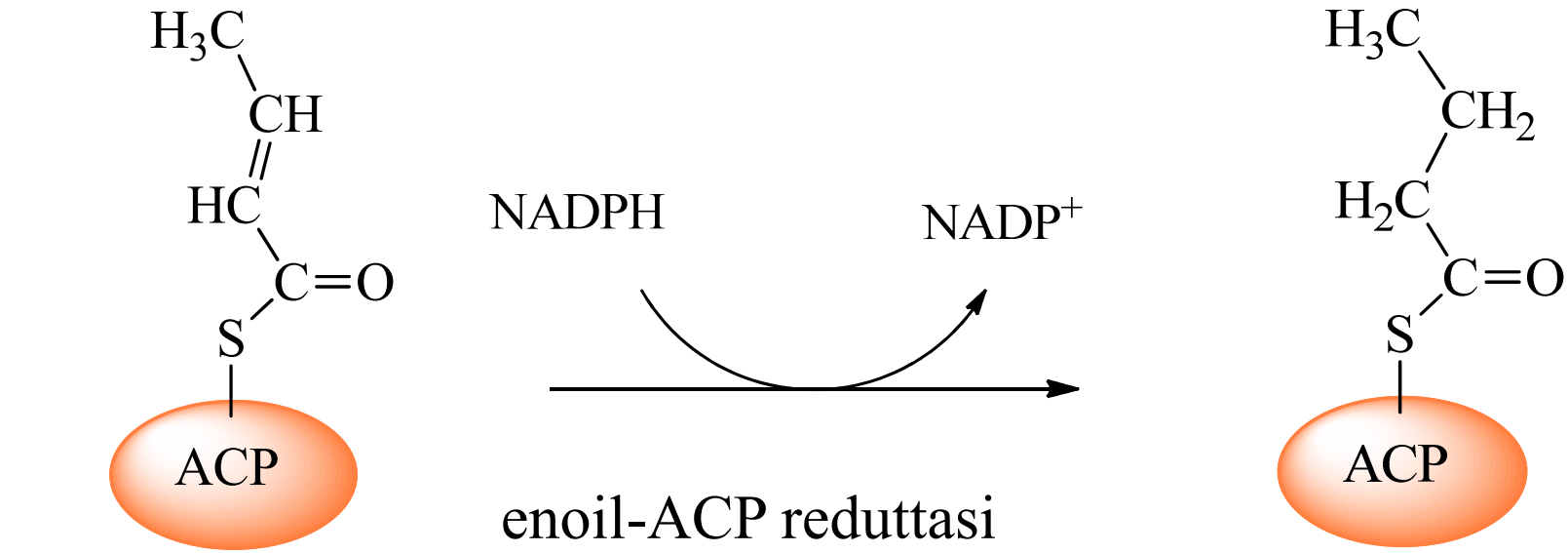



H3C
C=O
H2C
C=O
S
ACP
NADPH
NADP+
β-chetoacil-ACP reduttasi
H3C
HC−OH
H2C
C=O
S
ACP
β-idrossiacil-ACP



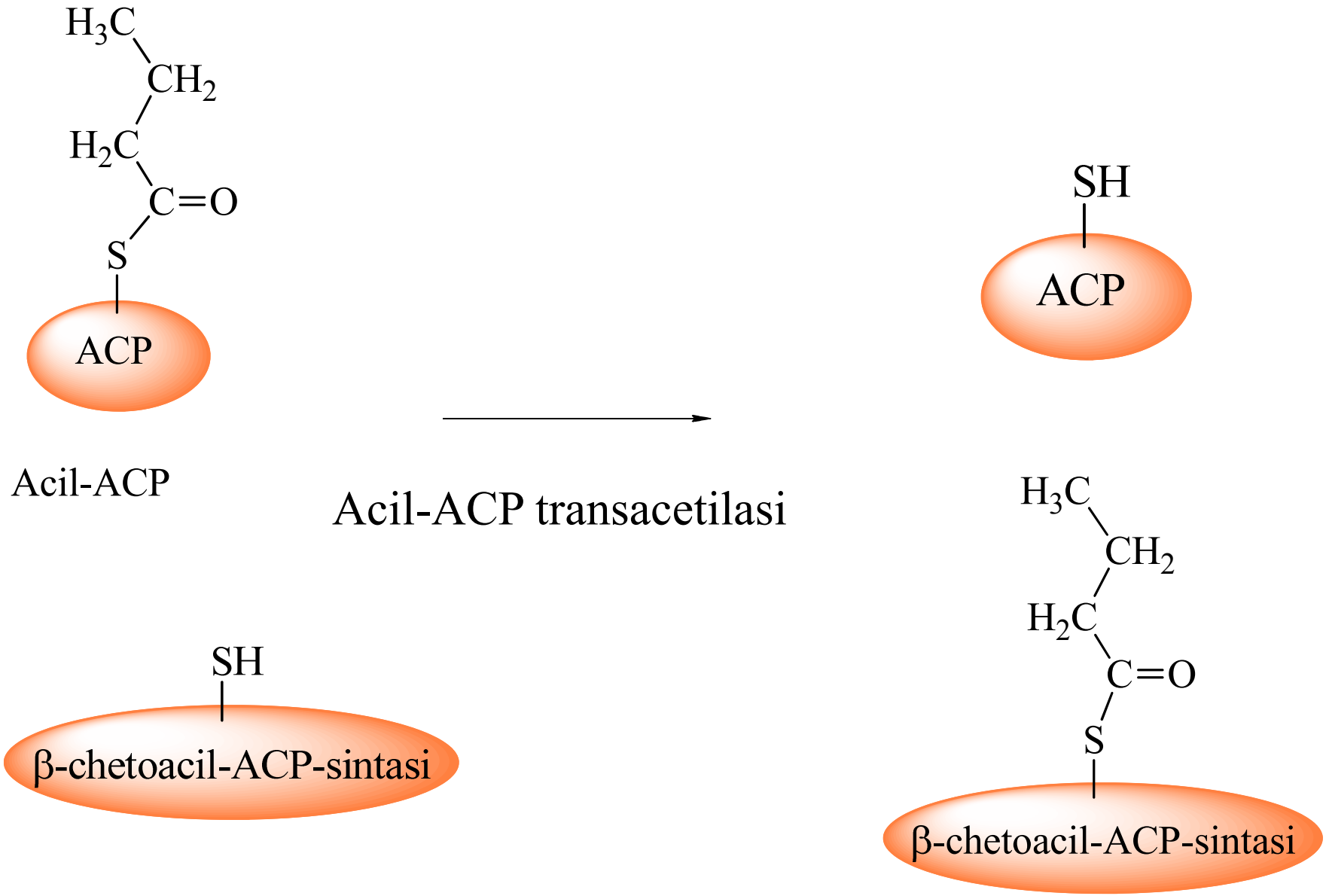
β-idrossiacil-ACP

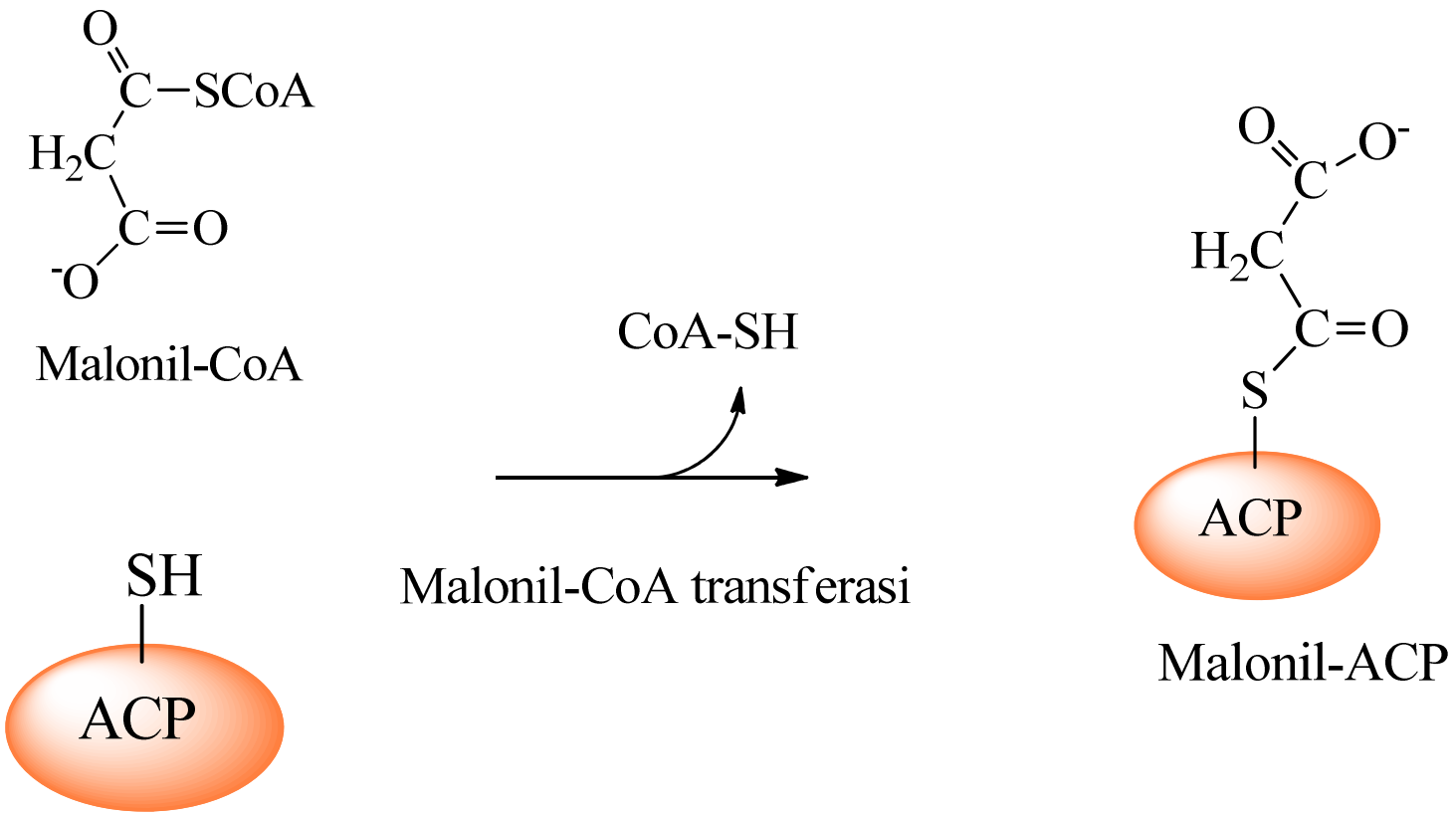
trans-enoil-ACP

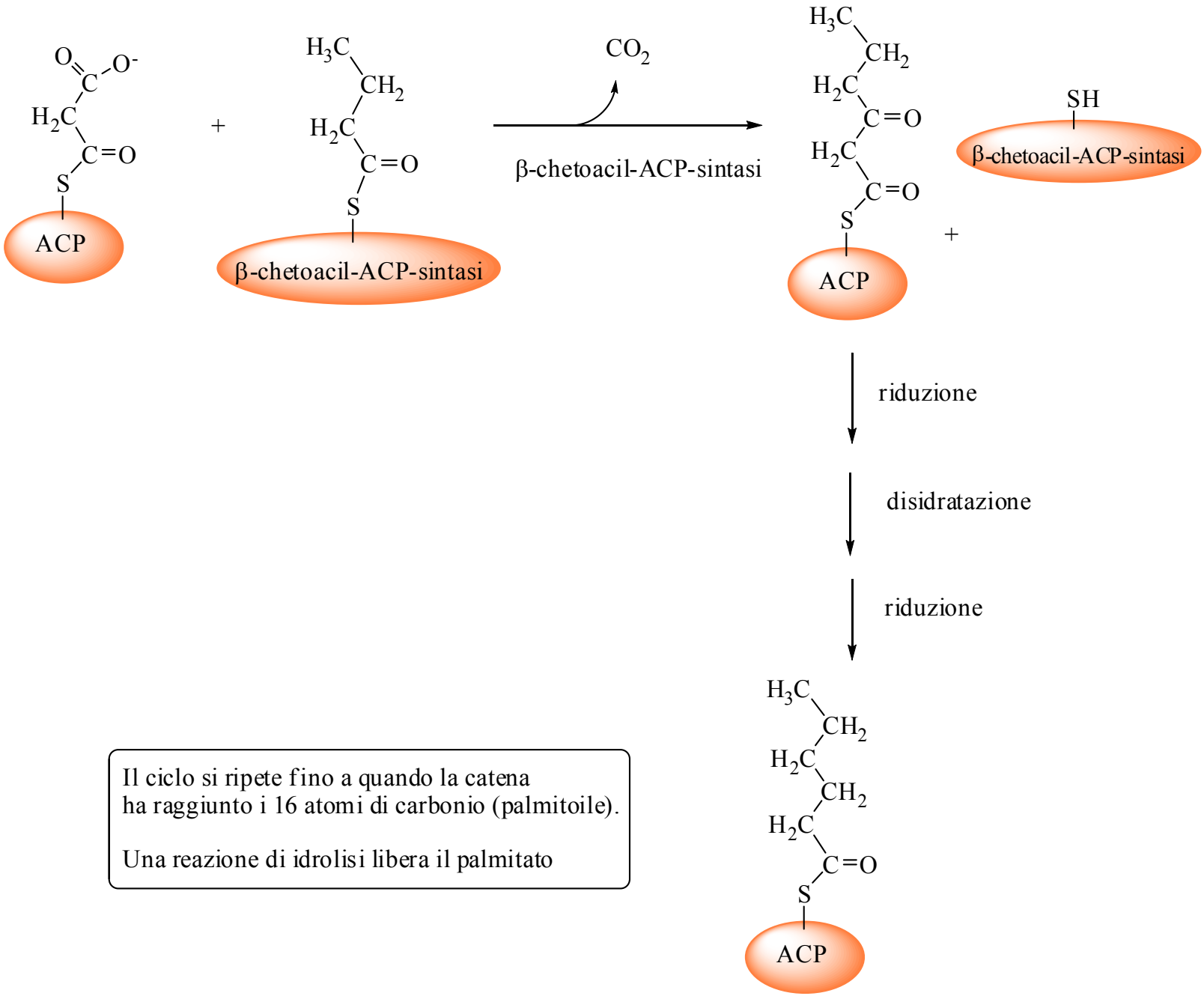


trans-enoil-ACP

Acil-ACP


H3C
CH2
H2C
C=O
S
ACP
Acil-ACP
Acil-ACP transacetilasi
SH
ACP
SH
β-chetoacil-ACP-sintasi
H3C
CH2
H2C
C=O
S
β-chetoacil-ACP-sintasi


O
C—SCoA
H2C
C=O
-O
Malonil-CoA
CoA-SH
Malonil-CoA transferasi
SH
ACP
O
O-
C
H2C
C=O
S
ACP
Malonil-ACP

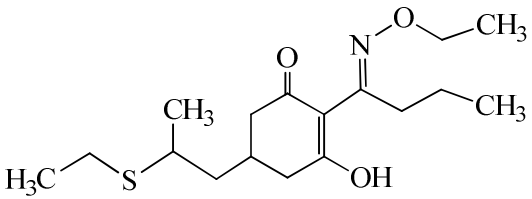


Il ciclo si ripete fino a quando la catena
ha raggiunto i 16 atomi di carbonio (palmitoile).

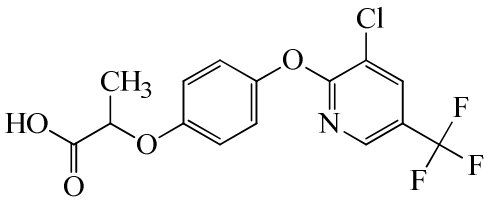
Una reazione di idrolisi libera il palmitato

Note: nelle piante l'acetil-CoA carbossilasi è un enzima diverso da quello animale.

Inibito da vari diserbanti



Sethoxydim
(Vantage®)



Haloxyfop
(Gallant®)

Biosintesi di un C_{16}: bilancio

$$7\ \text{acetilCoA} + 7CO_2 + 7\text{ATP} \longrightarrow 7\ \text{malonilCoA} + 7\text{ADP} + 7\text{Pi}$$

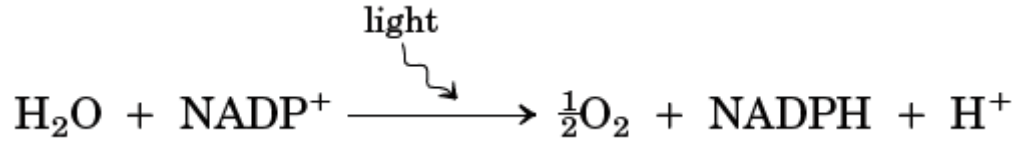
$$\text{AcetilCoA} + 7\ \text{malonilCoA} + 14\text{NADPH} + 14H^+ \longrightarrow \text{palmitato} + 7CO_2 + 8\text{CoASH} + 14NADP^+ + 6H_20$$

$$8\text{AcetilCoA} + 7\text{ATP} + 14\text{NADPH} + 14H^+ \longrightarrow$$

$$\text{palmitato} + 8\text{CoASH} + 7\text{ADP} + 7\text{Pi} + 14NADP^+ + 6H_20$$

Fonti di NADPH

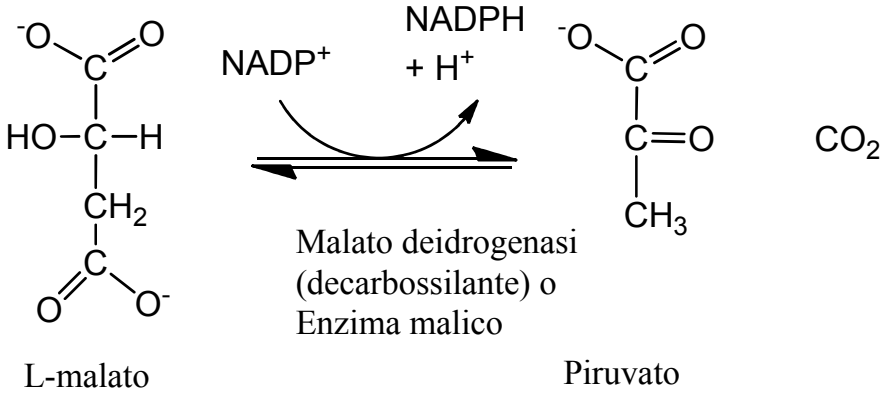
piante



via dei pentosi-fosfato

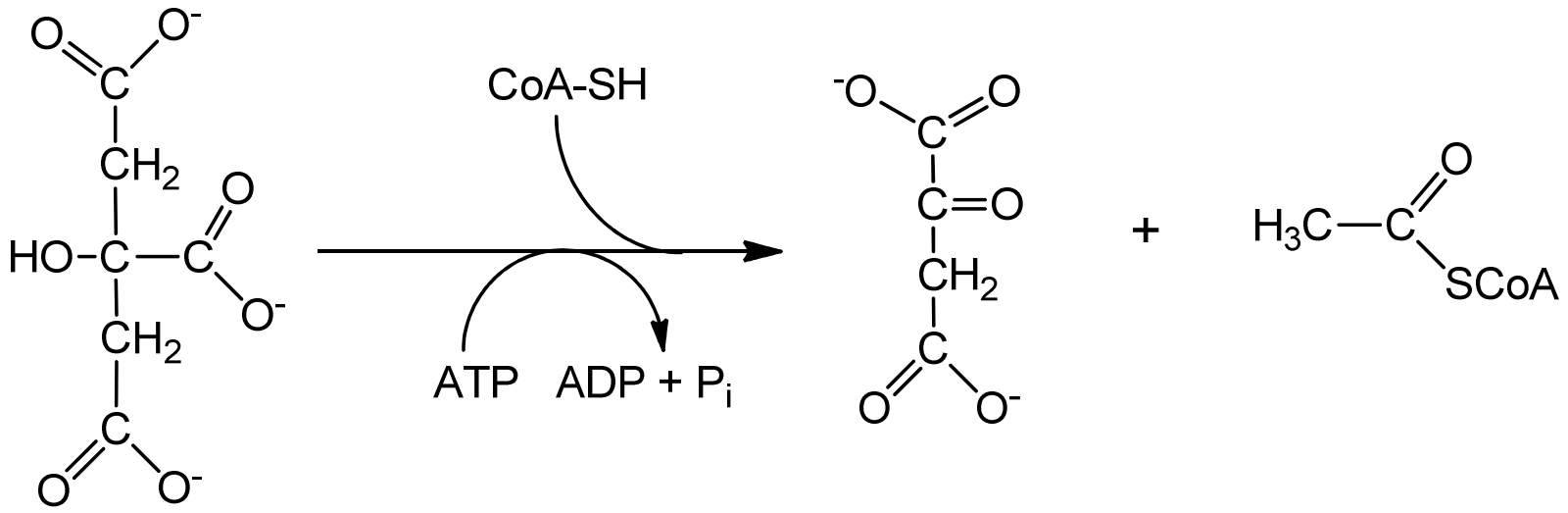
animali

via dei pentosi-fosfato



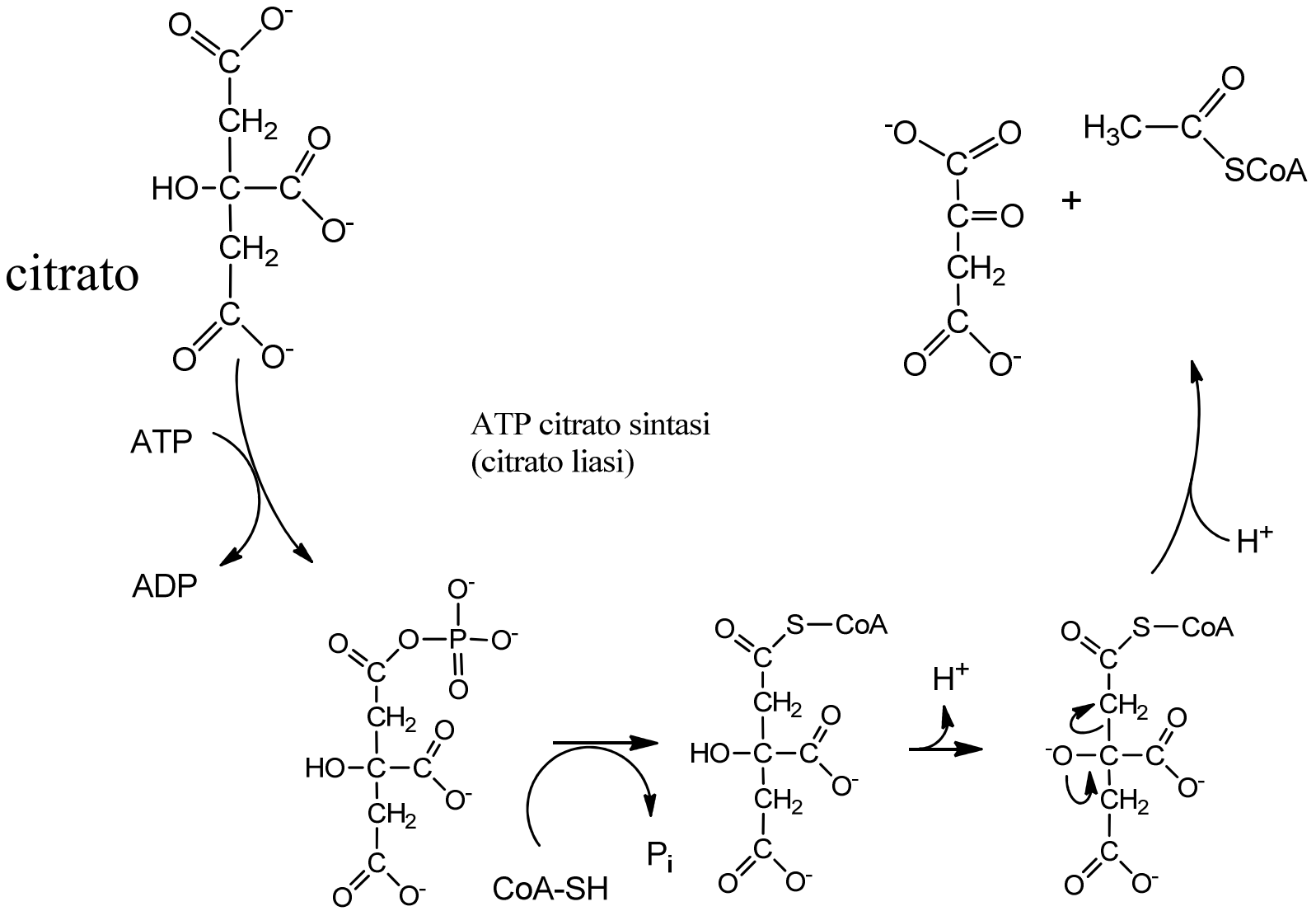
Isocitrato deidrogenasi (NADP) citosolica

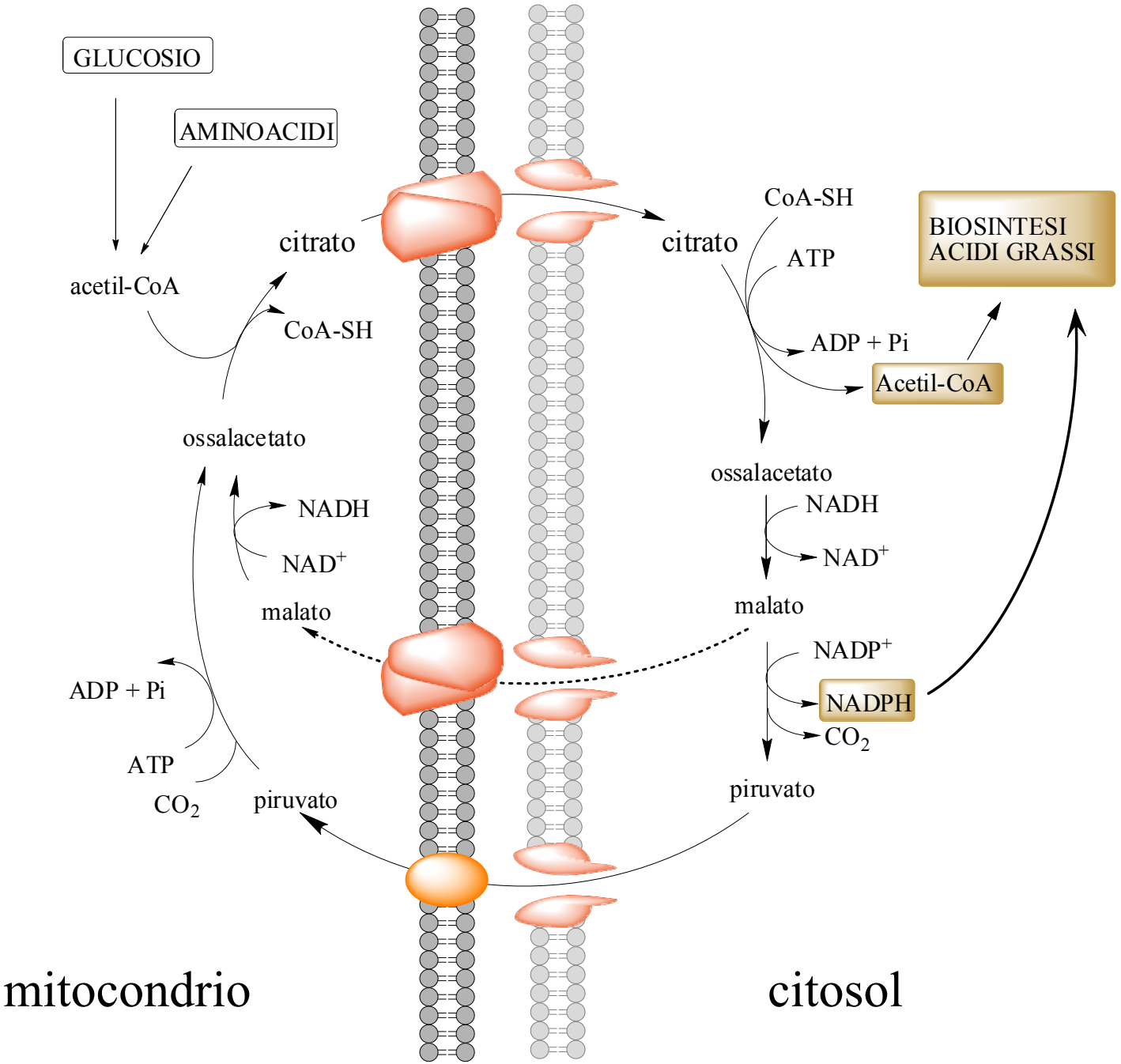
Fonti di acetile e malonile



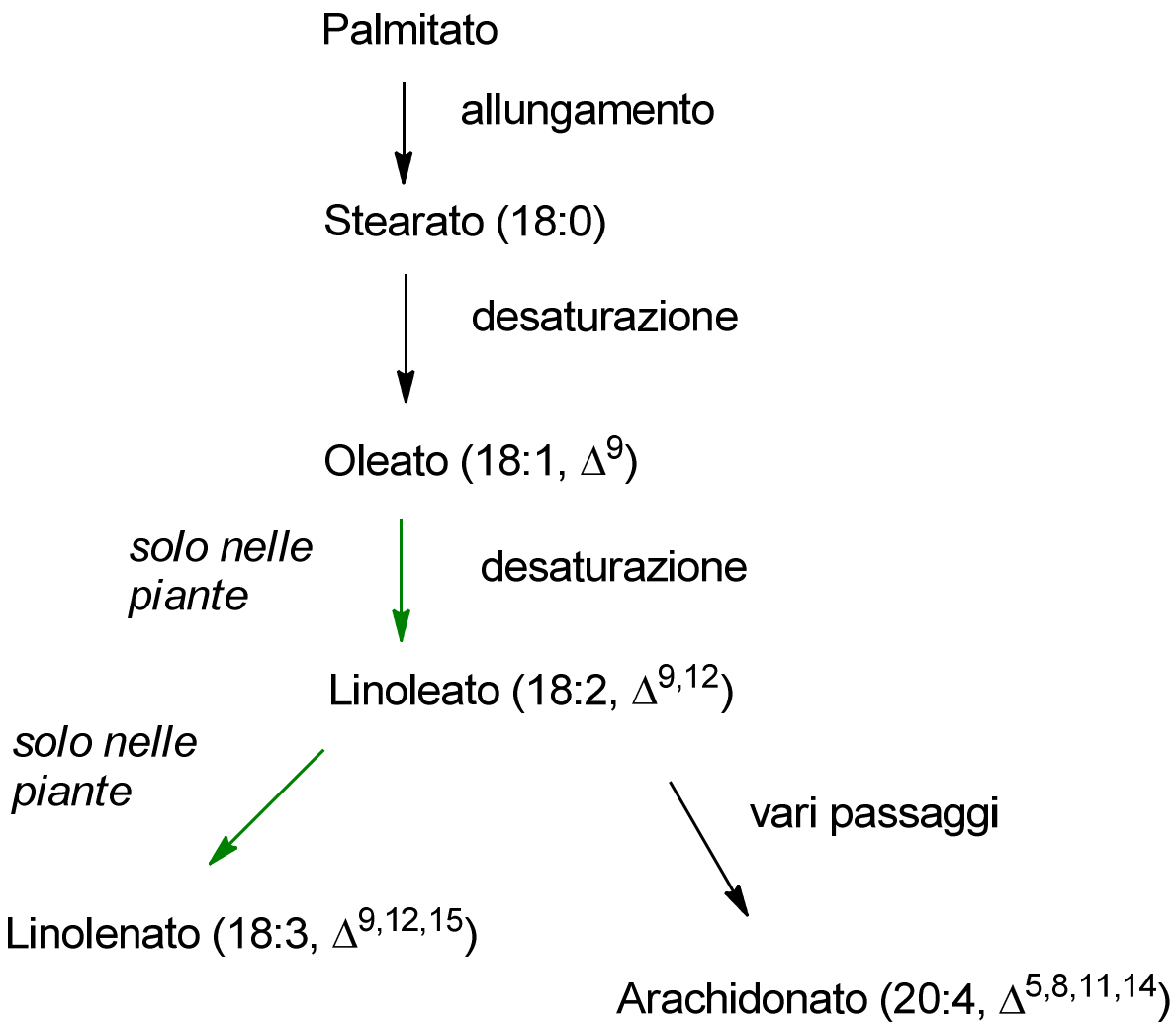
citrato

ATP citrato sintasi
(citrato liasi)


citrato
ATP
ADP
ATP citrato sintasi
(citrato liasi)
CoA-SH
Pi
H+
H+
SCoA


GLUCOSIO
AMINOACIDI
acetil-CoA
citrato
CoA-SH
ossalacetato
NADH
NAD+
malato
ADP + Pi
ATP
CO2
piruvato
citrato
CoA-SH
ATP
ADP + Pi
Acetil-CoA
BIOSINTESI
ACIDI GRASSI
ossalacetato
NADH
NAD+
malato
NADP+
NADPH
CO2
piruvato
mitocondrio
citosol

Allungamento e desaturazione. Avviene sul reticolo endoplasmatico rugoso, ma solo nelle piante sono presenti tutte le reazioni

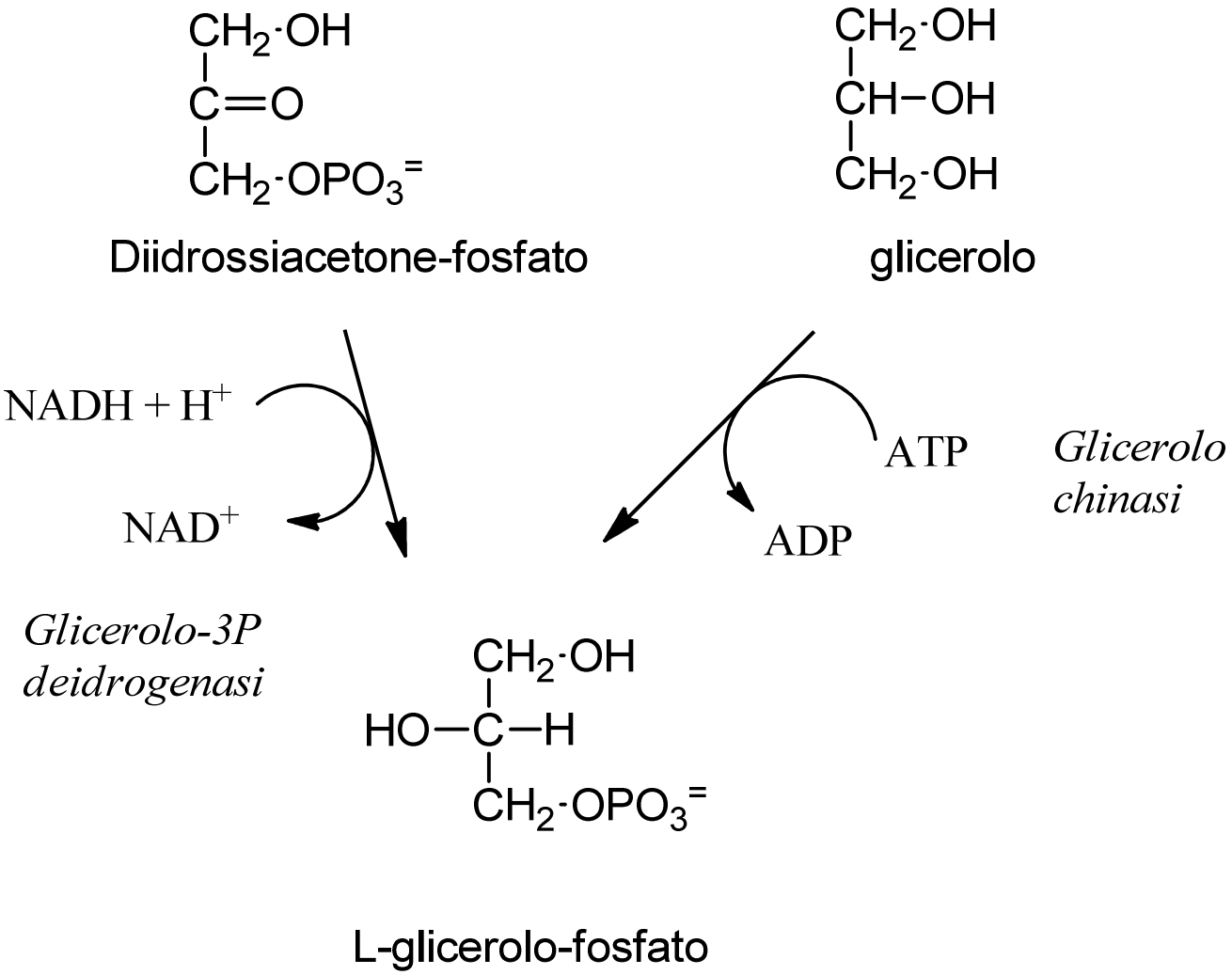


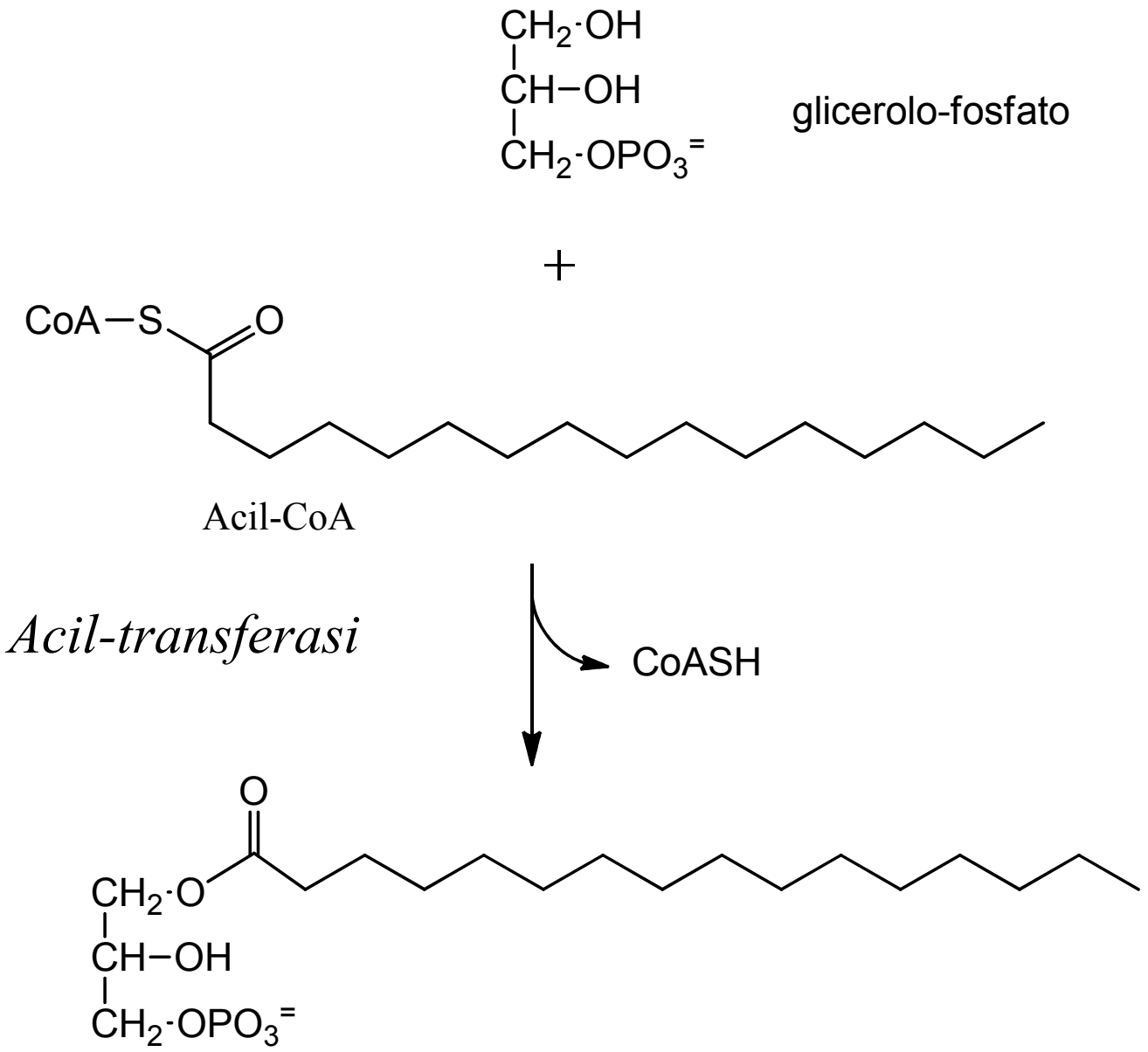
Funzioni degli acidi grassi

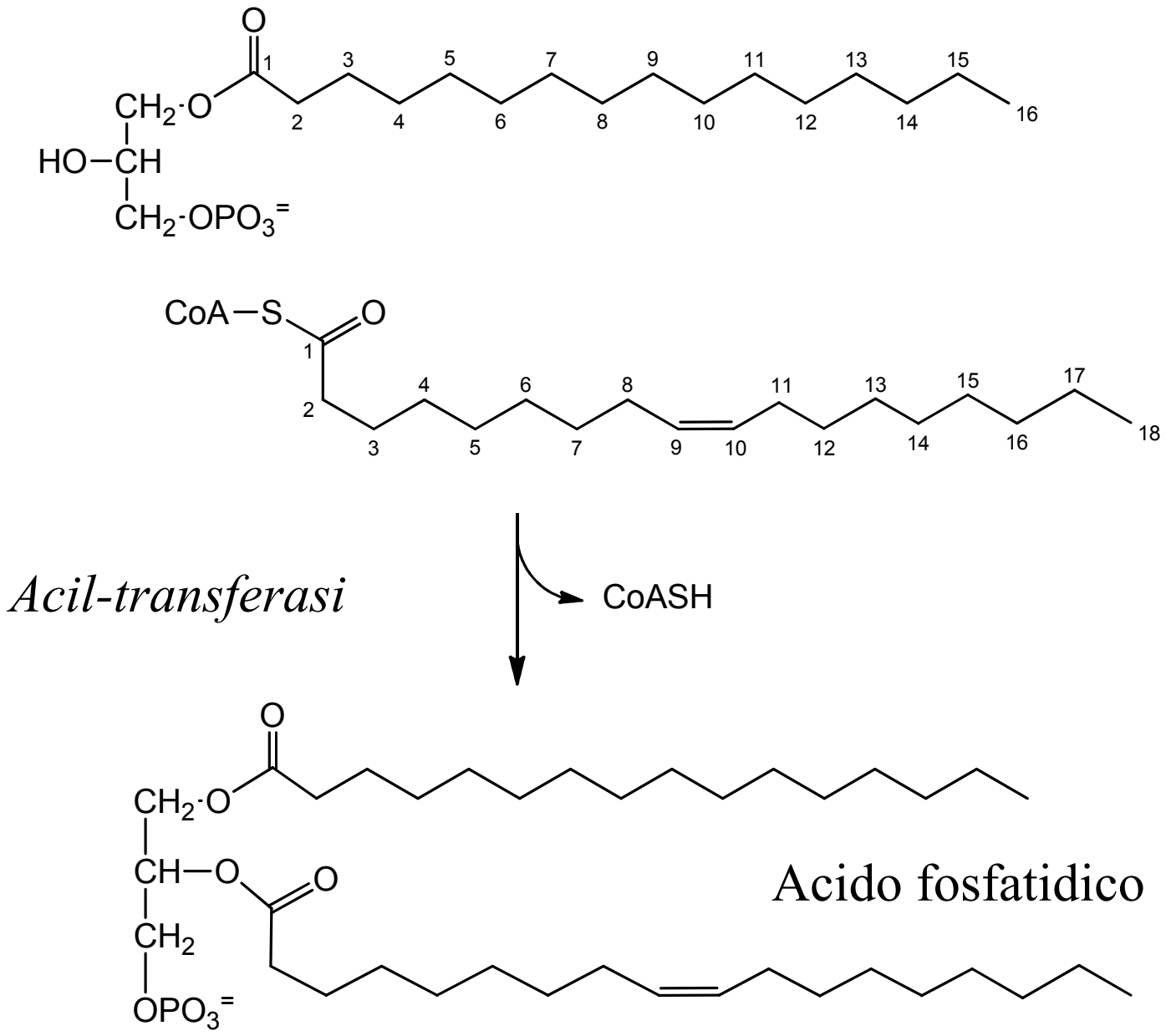
- Riserva energetica, come tracilgliceroli
- Strutturale, come fosfolipidi di membrana
- Precursori di sostanze ad azione ormonale

che regolano varie funzioni negli animali (secrezione gastrica, dolore, infiammazione, aggregazione piastrinica, etc...)

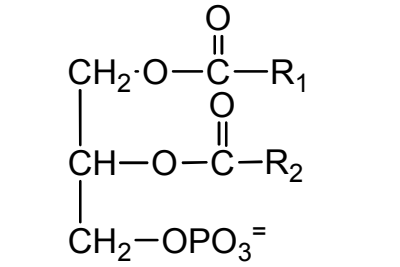
Biosintesi di triacilgliceroli e fosfolipidi

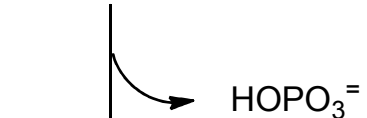


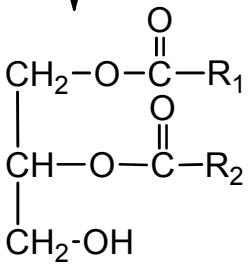

CH2·OH
CH–OH
CH2·OPO3=
glicerolo-fosfato
+
CoA–S
O
Acil-CoA
Acil-transferasi
CoASH
O
CH2·O
CH–OH
CH2·OPO3=

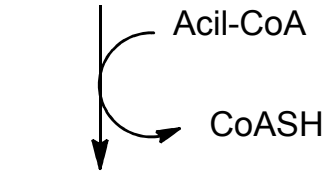

CH2·O
HO—CH
CH2·OPO3=
CoA—S
CoASH
Acil-transferasi
Acido fosfatidico

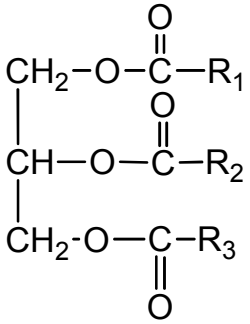
Destino dell’acido fosfatidico. 1





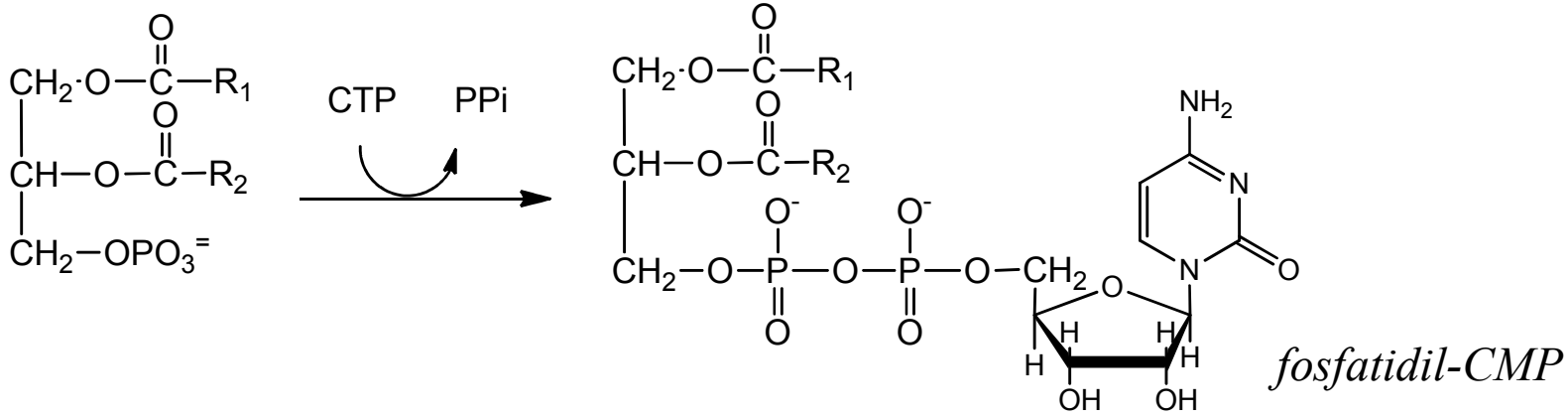




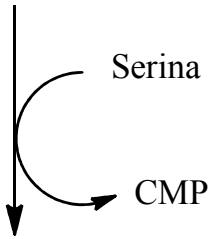


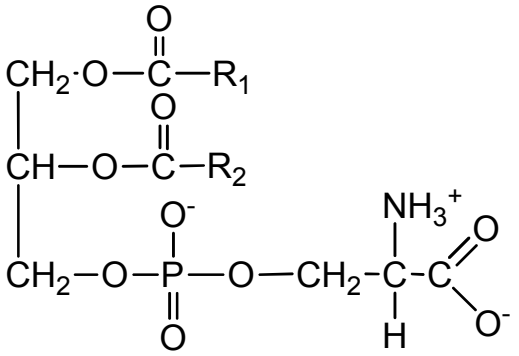
Triacilglicerolo

Destino dell'acido fosfatidico. 2

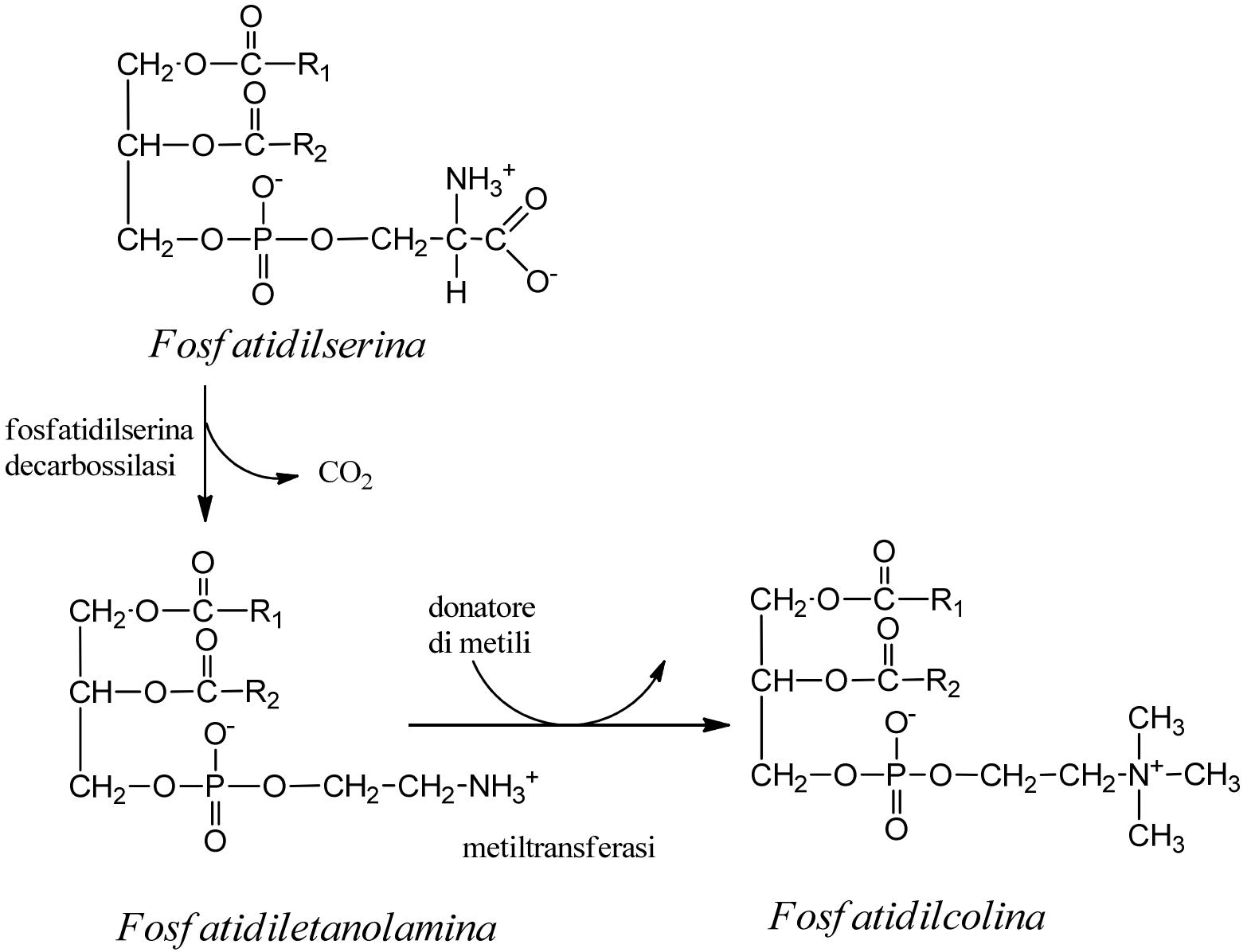


fosfatidil-CMP





Fosfatidilserina

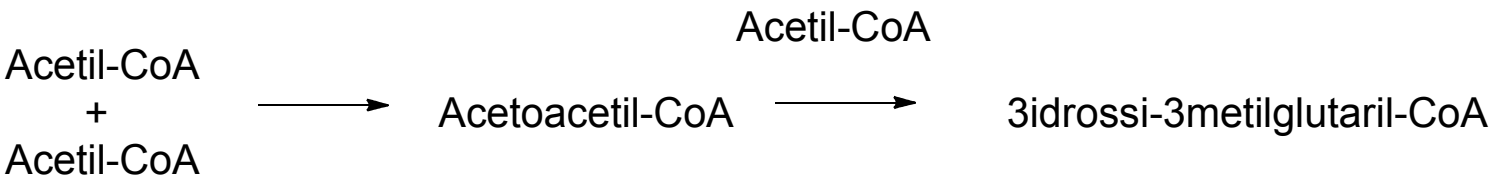


Fosfatidilserina

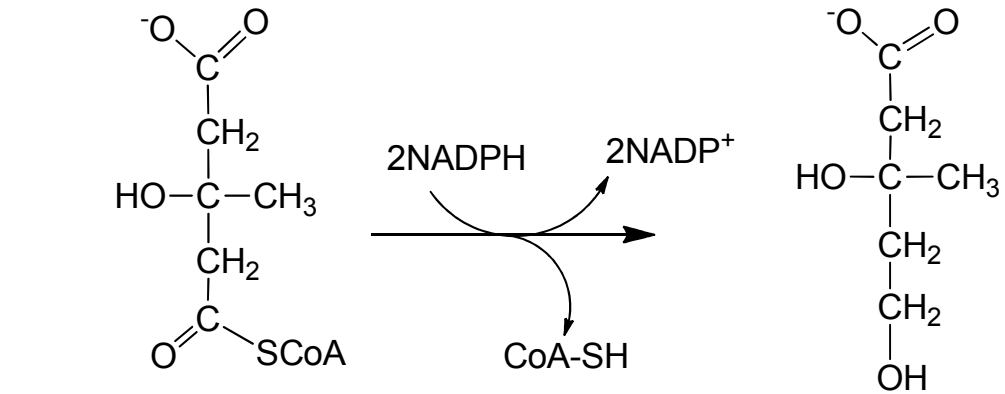
Fosfatidiletanolamina

Fosfatidilcolina

Biosintesi del colesterolo



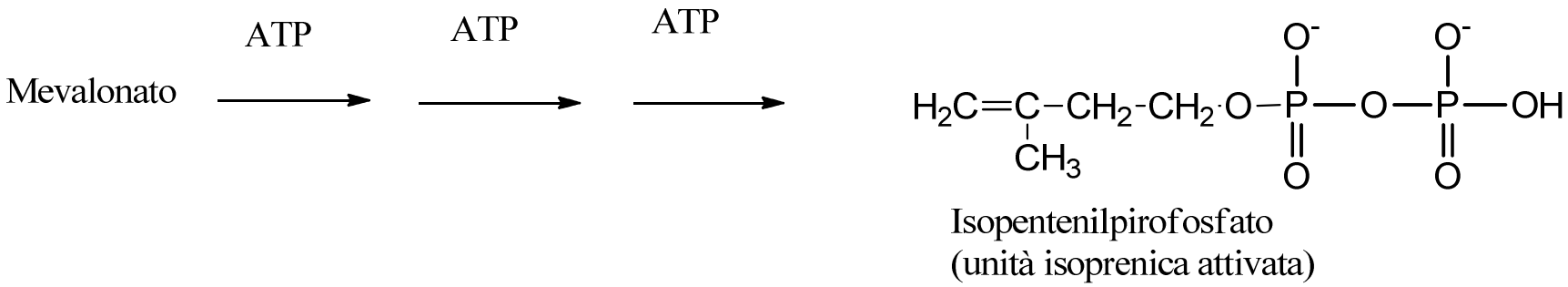
HMG-CoA sintasi

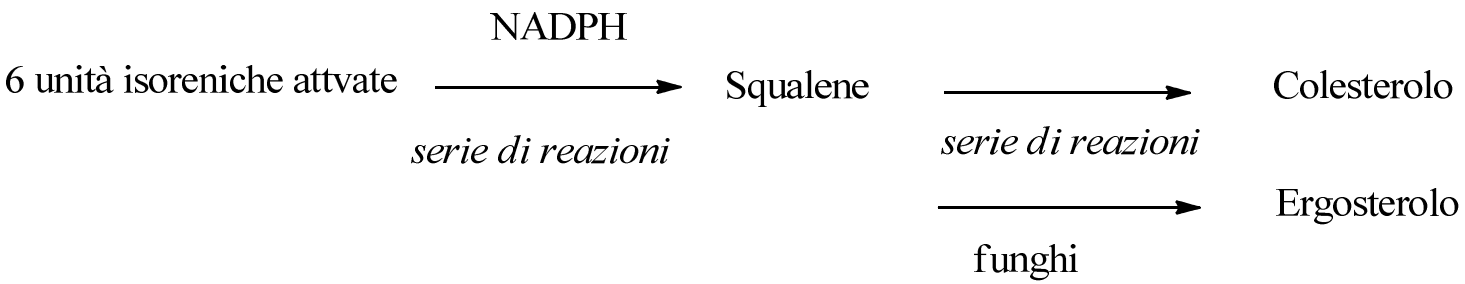


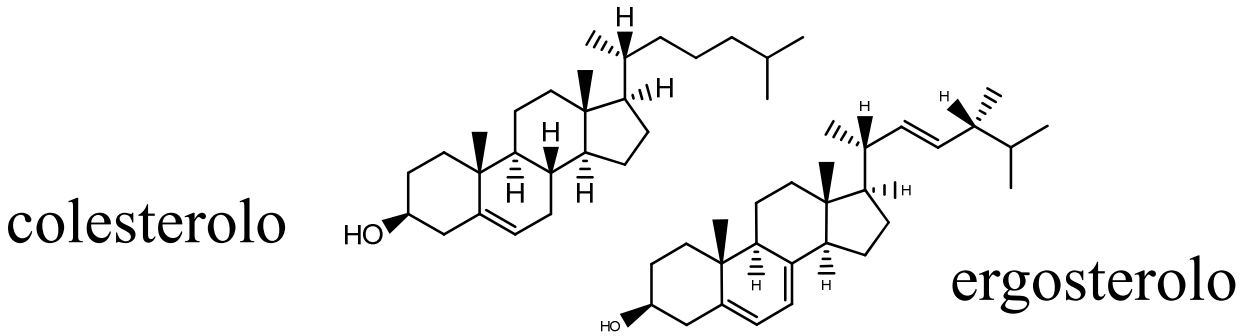
3-idrossi-3metilglutaril-CoA

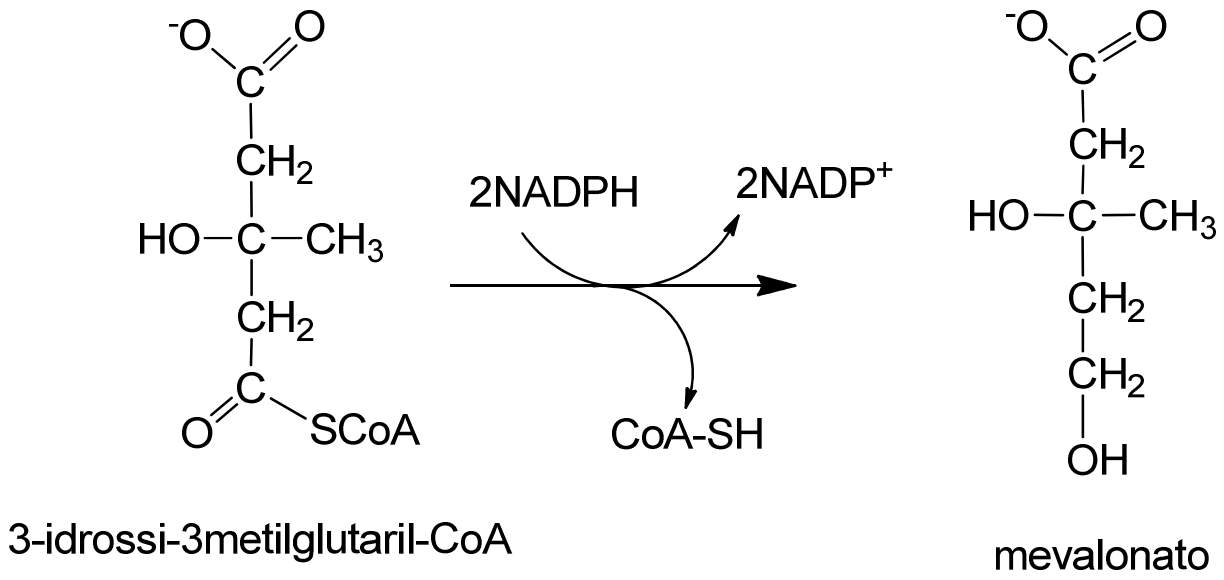
mevalonato

HMG-CoA reduttasi


ATP
ATP
ATP
Mevalonato
Isopentenilpirofosfato
(unità isoprenica attivata)

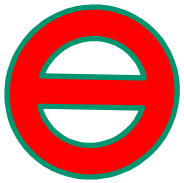

NADPH
6 unità isoreniche attvate
Squalene
Colesterolo
serie di reazioni
serie di reazioni
Ergosterolo
funghi


colesterolo
ergosterolo

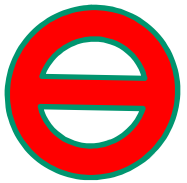


HMG-CoA reduttasi

Insulina

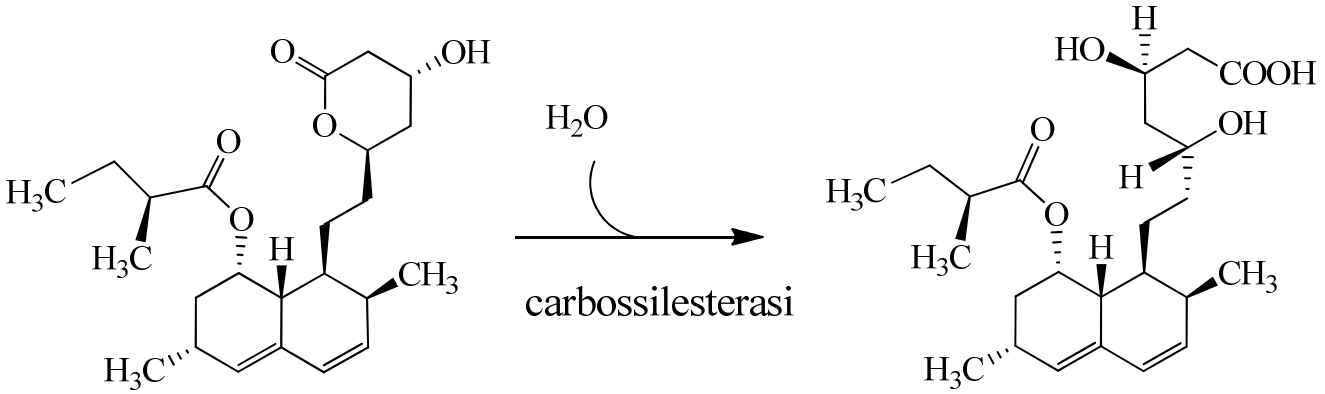


Colesterolo

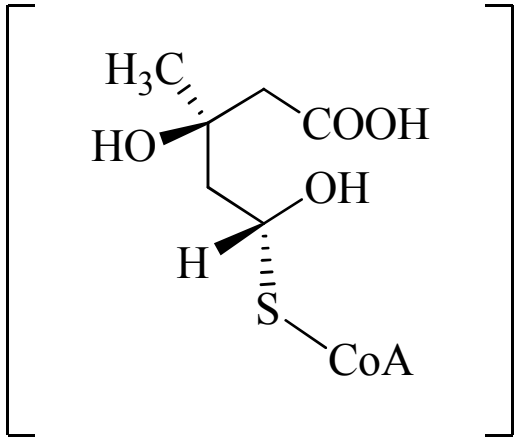


Glucagone

Statine, prodotti naturali inibitori dell'HMG-CoA reduttasi



lovastatin



intermedio della reazione di sintesi del mevalonato