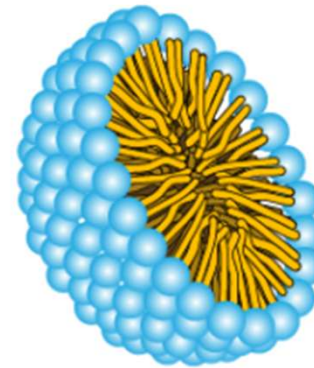




LIPIDI

Lipidi su biomakromolekuli



Hydrophilic medium (water)

Hydrophilic head



Hydrophobic tail

- slabo rastvorni u vodi, a rastvorni u organskim rastvaračima
- imaju važnu fiziološku ulogu



Podela lipida

1. prosti

- masti i ulja
- voskovi
- steroidi

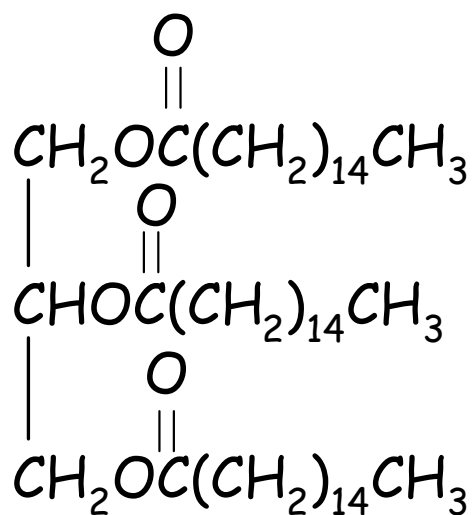
2. složeni

- fosfolipidi
- sfingolipidi
- glikolipidi
- sulfolipidi, glikolipidi
- vitamini rastvorljivi u uljima i mastima

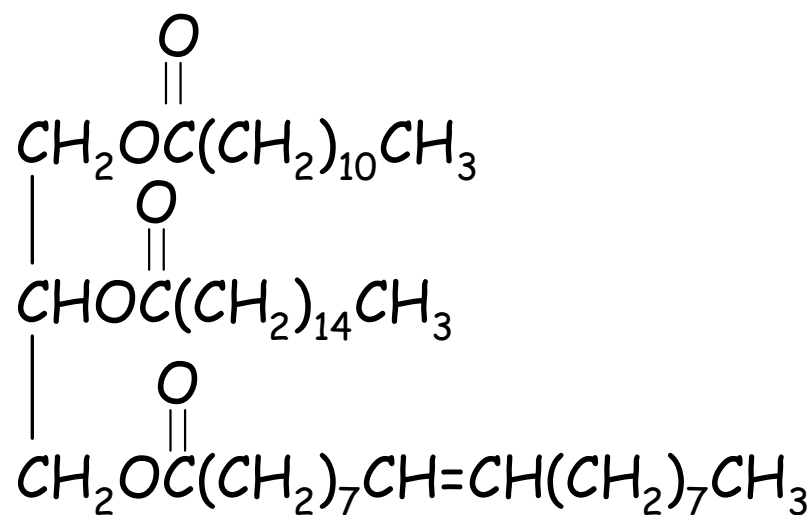
3. prostaglandini

Trigliceridi (triacilgliceroli)

- Estri glicerola i viših masnih kiselina
- Životinjske masti i biljna ulja



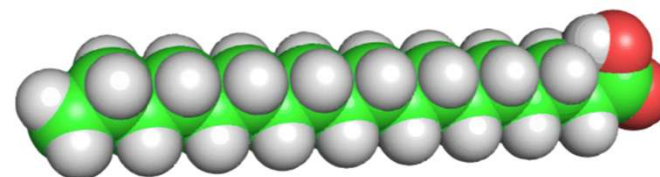
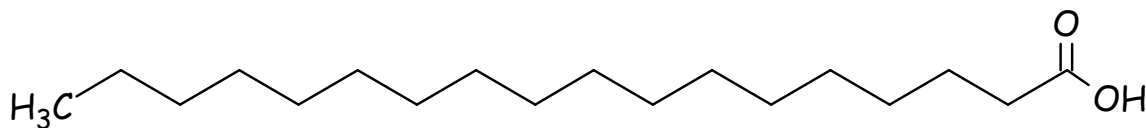
tripalmitoglicerat



laurilpalmitooleat

Masne kiseline

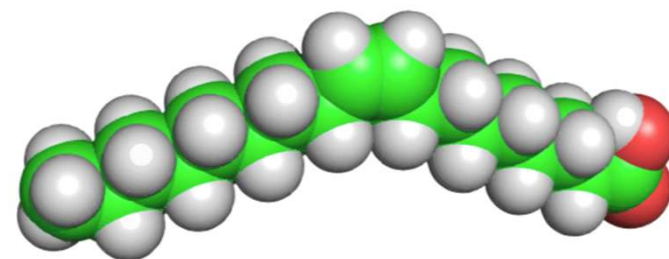
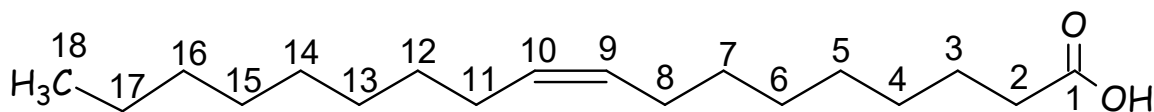
Zasićene masne kiseline



Stearinska kiselina

Broj C-atoma : broj = veza	Trivijalni naziv kiselina	Sistemi naziv kiselina	Racionalne formule kiselina
12 : 0	Laurinska	Dodekanska	$\text{CH}_3(\text{CH}_2)_{10}\text{COOH}$
14 : 0	Miristinska	Tetradekanska	$\text{CH}_3(\text{CH}_2)_{12}\text{COOH}$
16 : 0	Palmitinska	Heksadekanska	$\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$
18 : 0	Stearinska	Oktadekanska	$\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$
20 : 0	Arahidna	Eikozanska	$\text{CH}_3(\text{CH}_2)_{18}\text{COOH}$
22 : 0	Behenska	Dokozanska	$\text{CH}_3(\text{CH}_2)_{20}\text{COOH}$
24 : 0	Lignocerinska	Tetrakozanska	$\text{CH}_3(\text{CH}_2)_{22}\text{COOH}$

Nezasićene masne kiseline



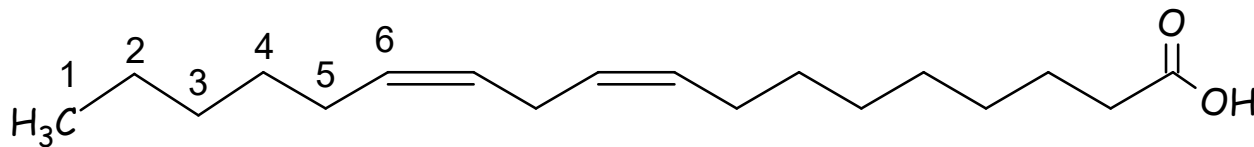
Oleinska kiselina

cis izomeri

Broj C-atoma : broj = veza	Trivijalni naziv kiselina	Sistemi naziv kiselina	Racionalne formule kiselina
16 : 1	Palmitooleinska	9-heksadecenska	$\text{CH}_3(\text{CH}_2)_5\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$
18 : 1	Oleinska	9-oktadecenska	$\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$
18 : 2	Linolna	9,12- oktadekadienska	$\text{CH}_3(\text{CH}_2)_5\text{CH}=\text{CH}$ $\text{CH}_2\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$
18 : 3	α -linolenska	9,12,15- oktadekadienska	$\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}$ $\text{CH}_2\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$
18 : 3	γ -linolenska	6,9,12- oktadekadienska	$\text{CH}_3(\text{CH}_2)_4\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}$ $\text{CH}_2\text{CH}=\text{CH}(\text{CH}_2)_4\text{COOH}$
20 : 4	Arahidonska	5,8,11,14- eikozotetraenska	$\text{CH}_3(\text{CH}_2)_4\text{CH}=\text{CHCH}_2\text{CH}=\text{CHCH}_2$ $\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}(\text{CH}_2)_3\text{COOH}$

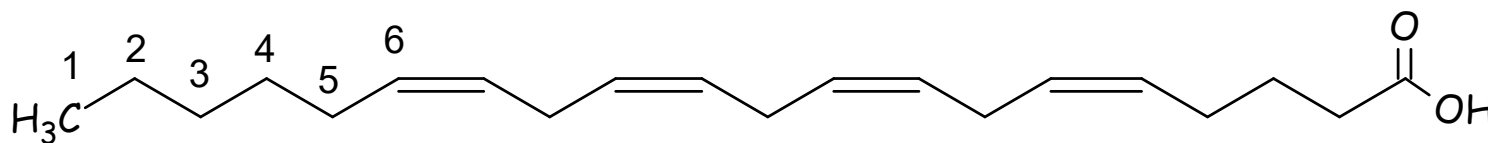
ω -3 i ω -6 masne kiseline

ω -6



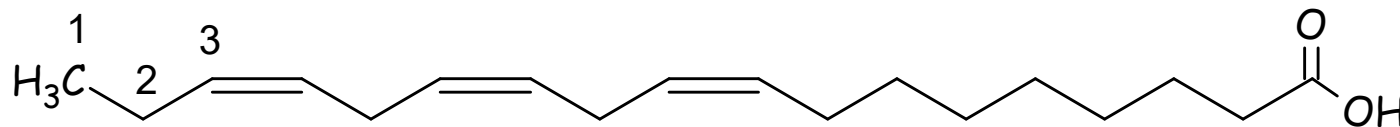
Linolna kiselina C 18:2

ω -6



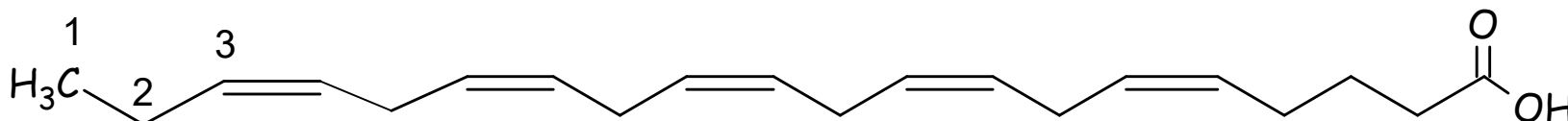
Arahidonska kiselina C 20:4

ω -3



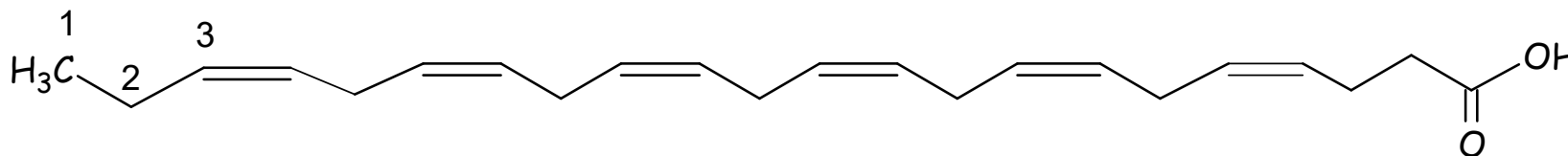
α -Linolenska kiselina C 18:3

ω -3



EPA C 20:5

ω -3



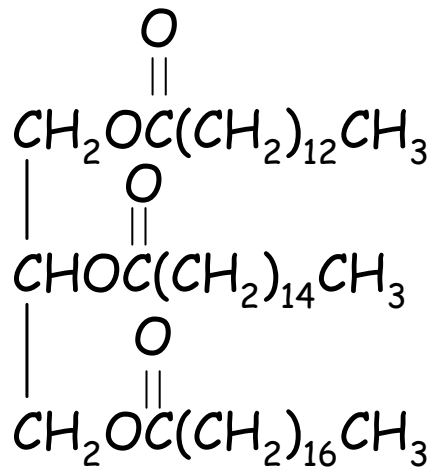
DHA C 22:6

Hemijska svojstva triglicerida

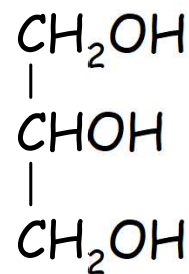
1. Adicija

2. Oksidacija

3. Saponifikacija

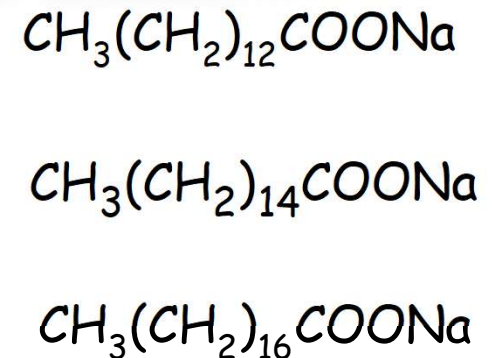


laurilpalmitostearat



glicerol

+

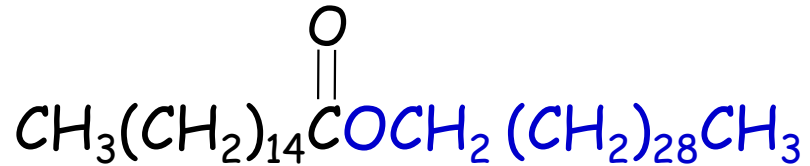


Sapun

Voskovi ili ceridi

- Estri viših monohidroksilnih alkohola i viših masnih kiselina

Miricil alkohol u sastavu pčelinjeg voska $\text{CH}_3(\text{CH}_2)_{28}\text{CH}_2\text{OH}$

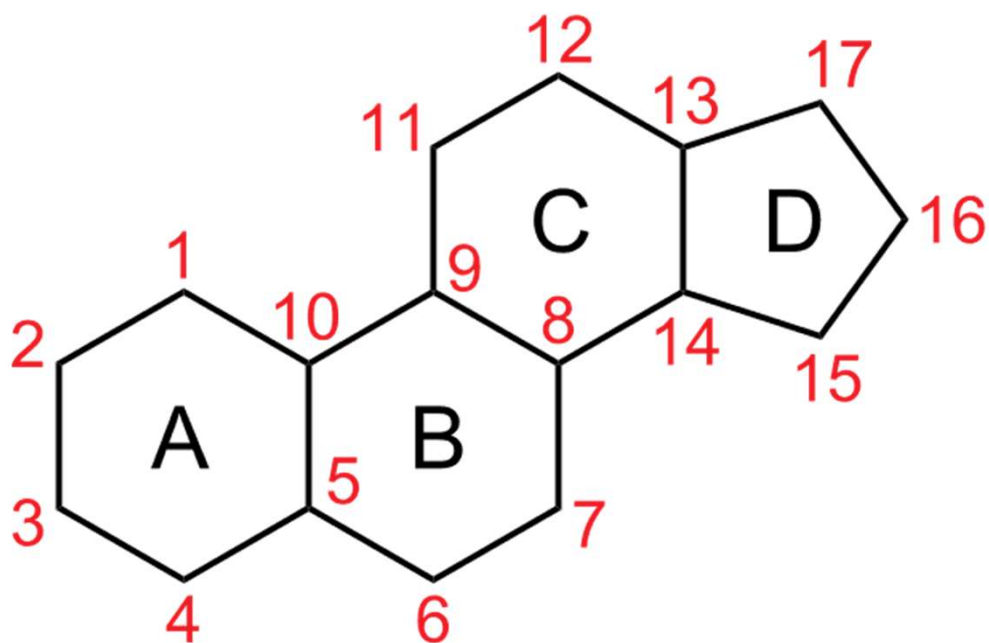


Pčelinji vosak



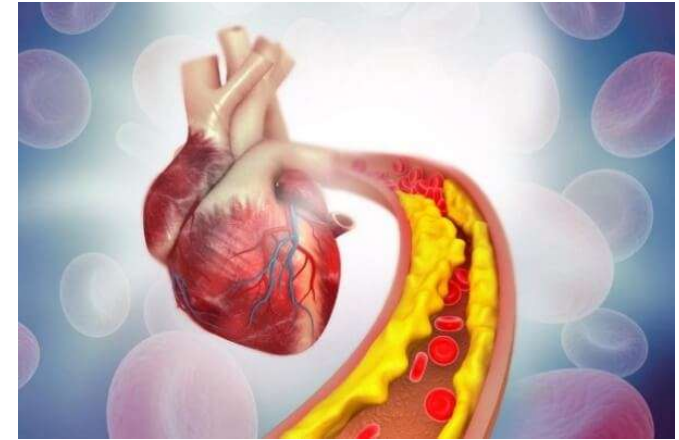
Steroidi

U steroide spadaju: holesterol, žučne kiseline, muški i ženski polni hormoni, vitamini D grupe

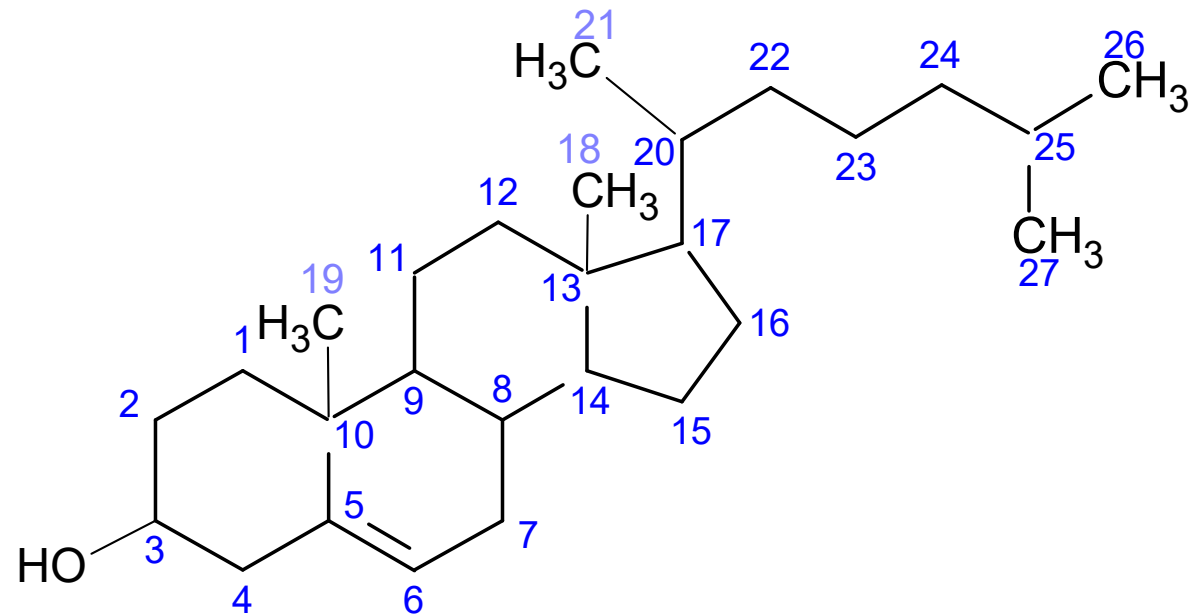


Ciklopentanoperhidrofenantrenski prsten - STERAN

Holesterol

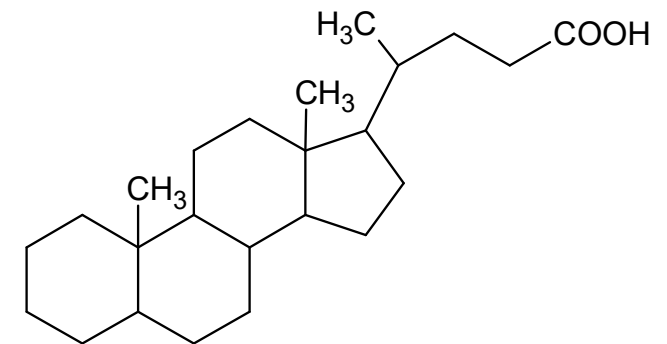


- najvažniji sterol životinjskog porekla
- ima ulogu u sintezama ostalih steroidnih jedinjenja u organizmu, transportu liposolubilnih vitamina
- u slobodnom i esterifikovanom obliku
- normalne vrednosti u krvi 3,10 - 5,5 mmol/l



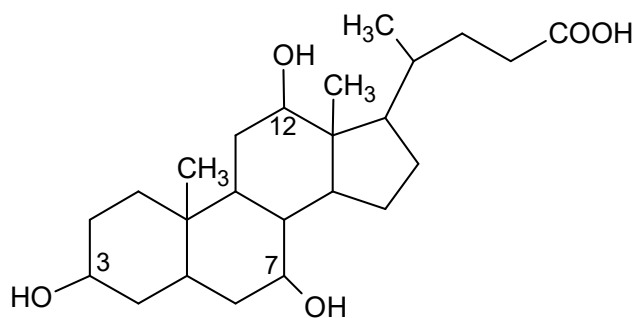


Žučne kiseline

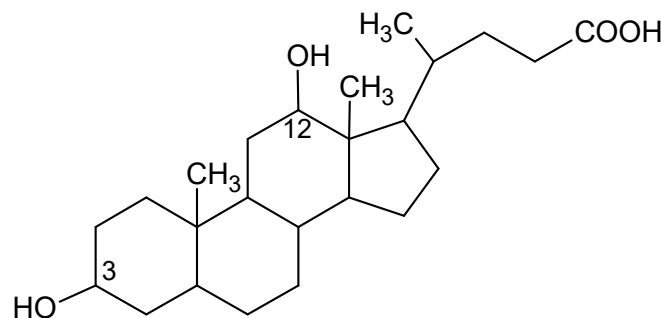


Holanska kiselina

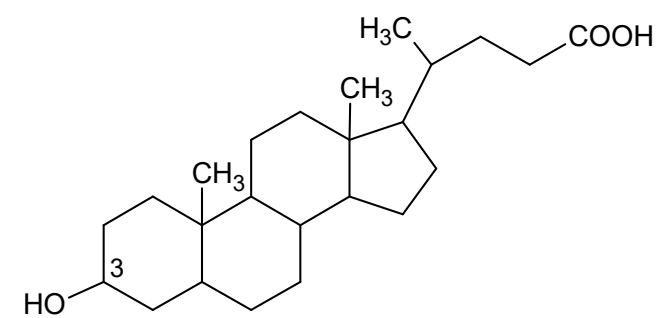
- učestvuju u resorpciji masti u crevima
- nastaju u jetri iz holesterola, i dalje izlučuju u žuč
- u obliku su soli
- mogu da se vežu peptidnom vezom sa taurinom i glicinom



Holna kiselina



Dezoksiholna kiselina



Litoholna kiselina

Ženski polni hormoni

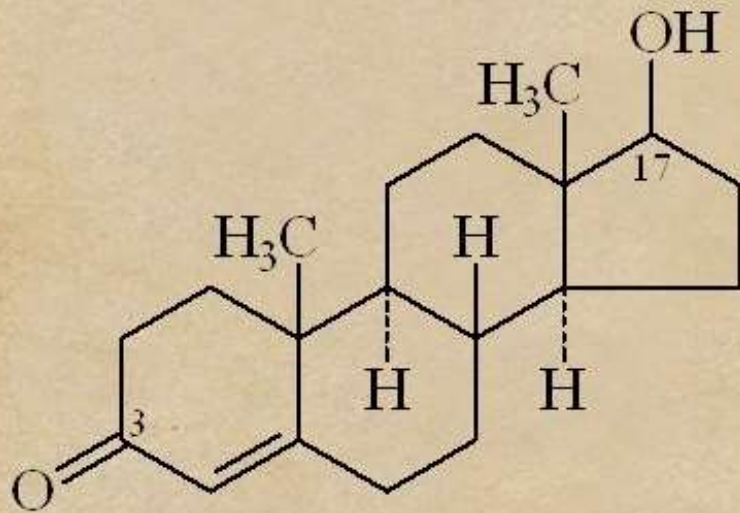


<https://www.google.com/url?sa=i&url=https%3A%2F%2Fs4be.cochrane.org%2Fblog%2F2023%2F02%2F22%2Festrogen-neural-function%2F&psig=AOvVaw26Frb-5pFZdZy8R-JP2Ga0&ust=1748604502518000&source=images&cd=vfe&opi=89978449&ved=0CBQQjRxqFwoTKCC09TJyI0DFQAAAAAAdAAAAABAE>

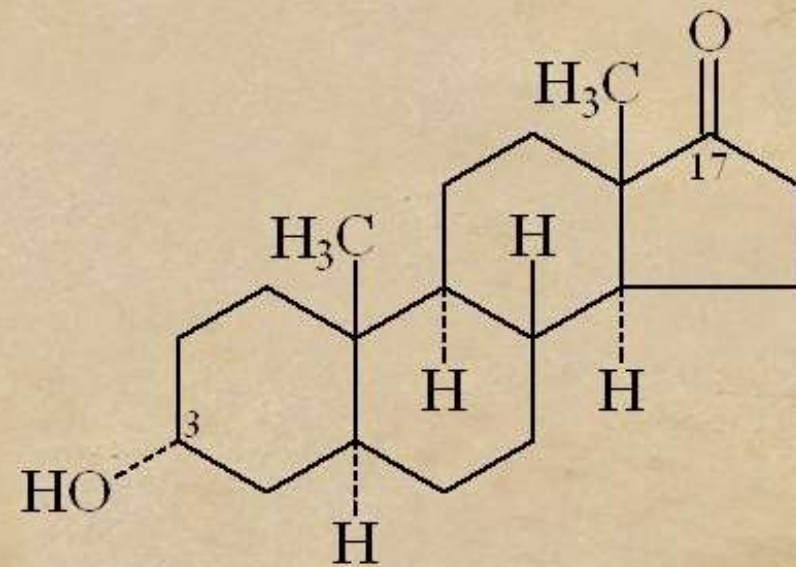


https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.saragottfriedmd.com%2Fthe-solution-is-nuanced-the-gottfried-protocol-for-low-progesterone%25E2%2580%25A8%2F&psig=AOvVaw0RrW3N1Leskcd6MNm_wyB&ust=1748604590181000&source=images&cd=vfe&opi=89978449&ved=0CBQQjRxqFwoTCIjd_XJyI0DFQAAAAAAdAAAAABAE

Muški polni hormoni

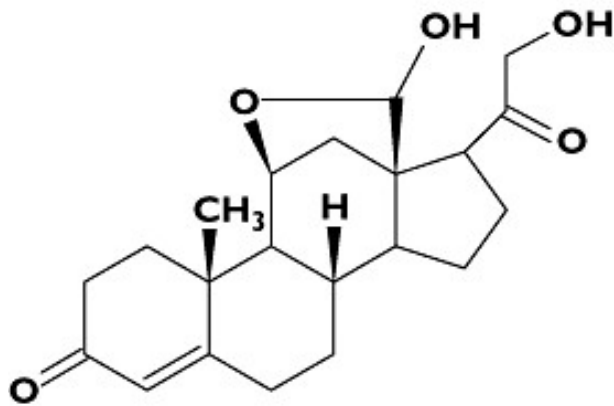


Testosteron



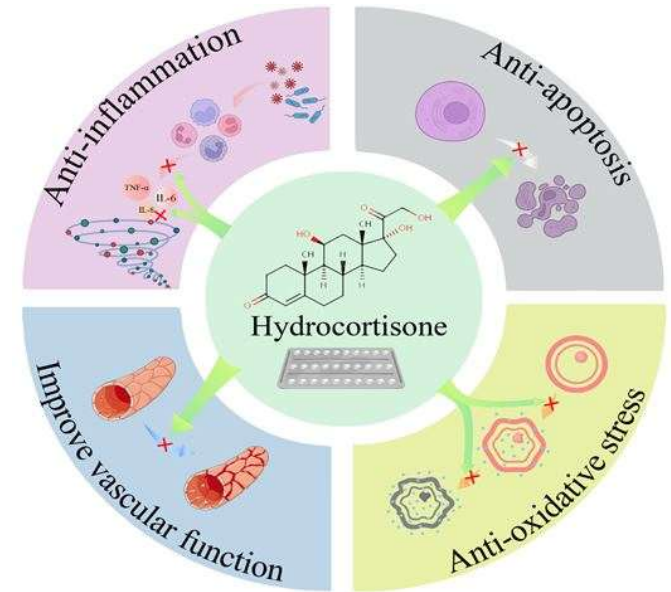
Androsteron

Steroidi kore nadbubrežne žlezde

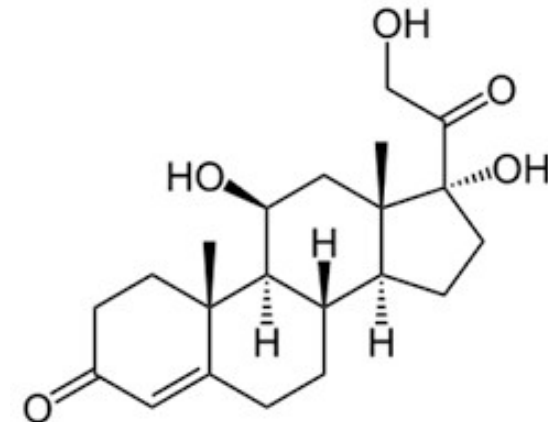


Aldosteron

U regulaciji metabolizma minerala



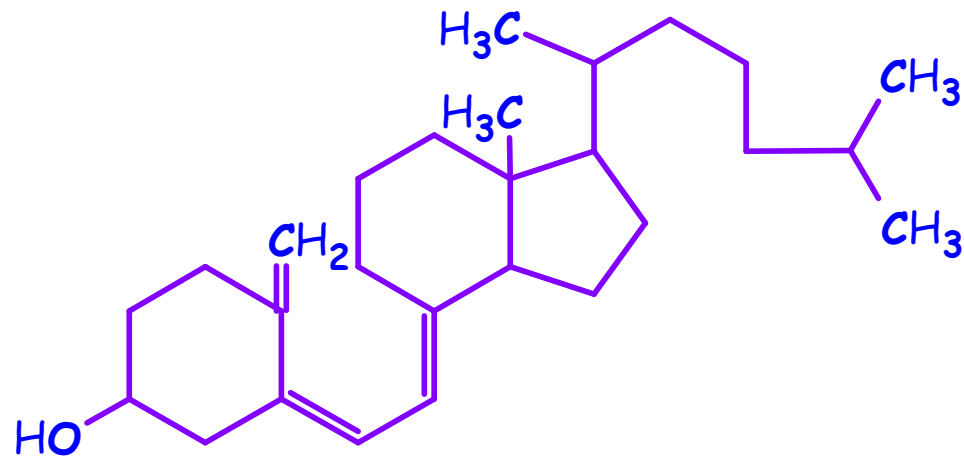
<https://www.cmbr-journal.com/data/cmbr/coversheet/331679552244.jpg>



Hidrokortizon

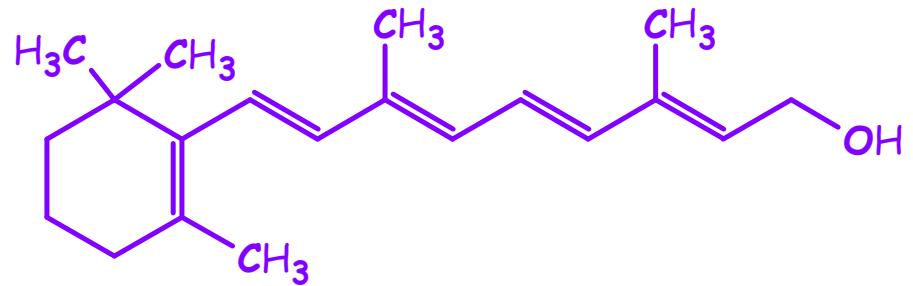
U regulaciji metabolizma ugljenih hidrata

Vitamiini D grupe

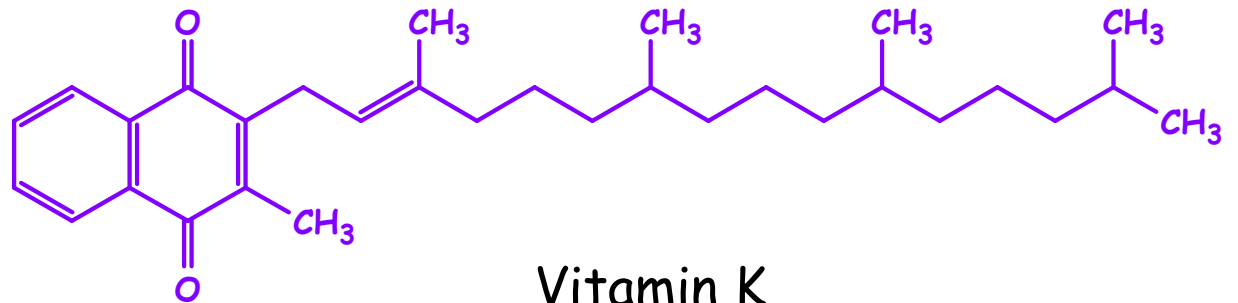


Vitamin D₃
Holekalciferol

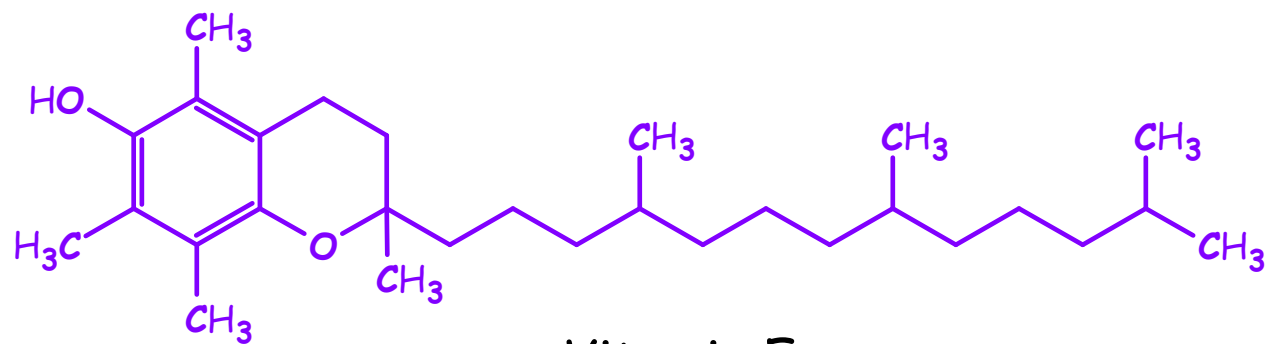




Vitamin A
Retinol



Vitamin K



Vitamin E
α-tokoferol

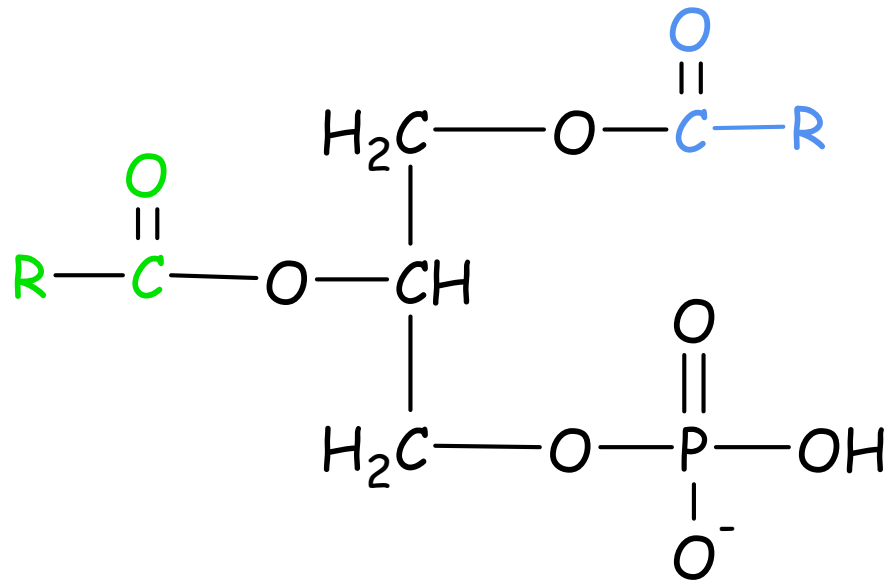
Fosfolipidi

- zastupljeni u ćelijskim membranama (biljke, životinje..)
- sadrže alkoholnu komponentu, više masne kiseline i ostatak fosforne kiseline

Dele se na:

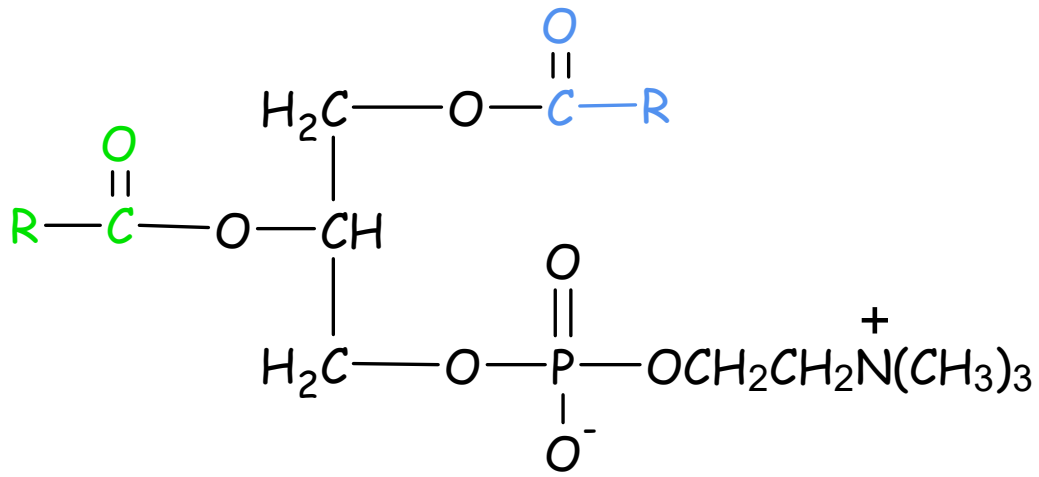
1. glicerofosfolipide ili fosfogliceride
2. sfingolipide ili fosfosfingozine

1. Fosfogliceridi



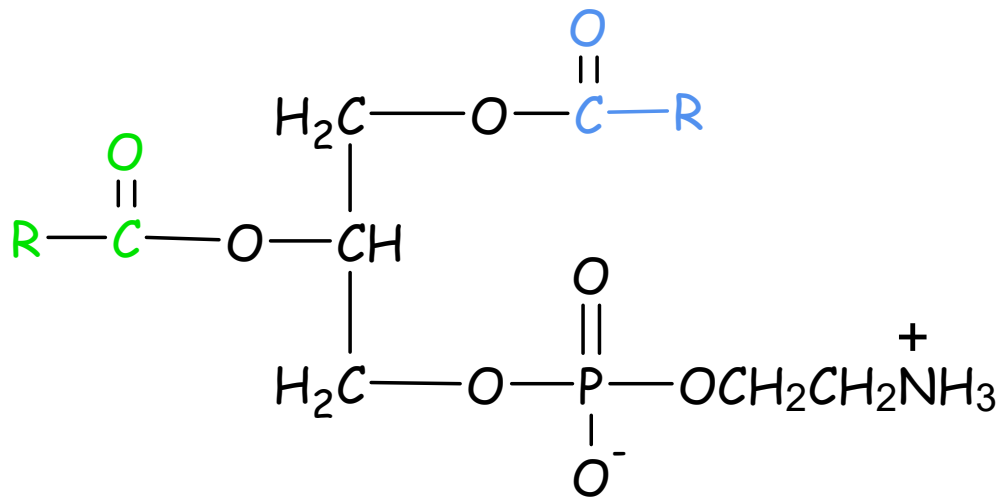
Opšta formula fosfatidne kiseline

Sastav: alkoholna komponenta - glicerol esterifikovan sa 2 više masne kiseline i fosforom kiselinom



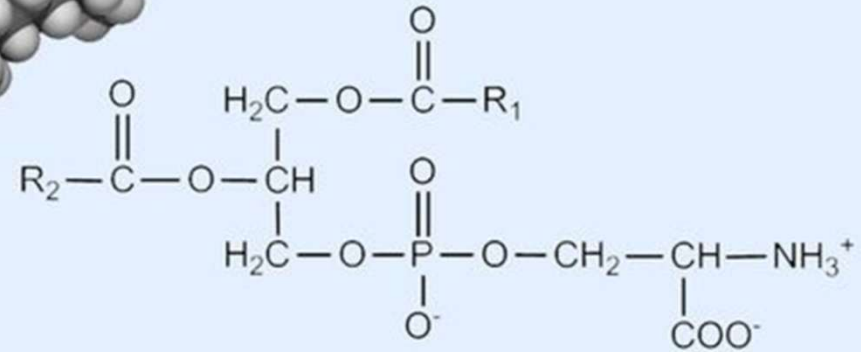
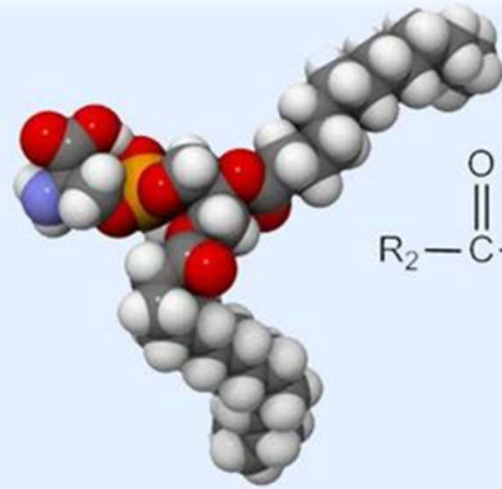
Fosfatidilholin (lecitin)

- U sastavu bioloških membrana
- Izolovan iz semena soje, pamuka, suncokreta, ali i mleka, jaja
- Upotrebljava se kao dodatak hrani

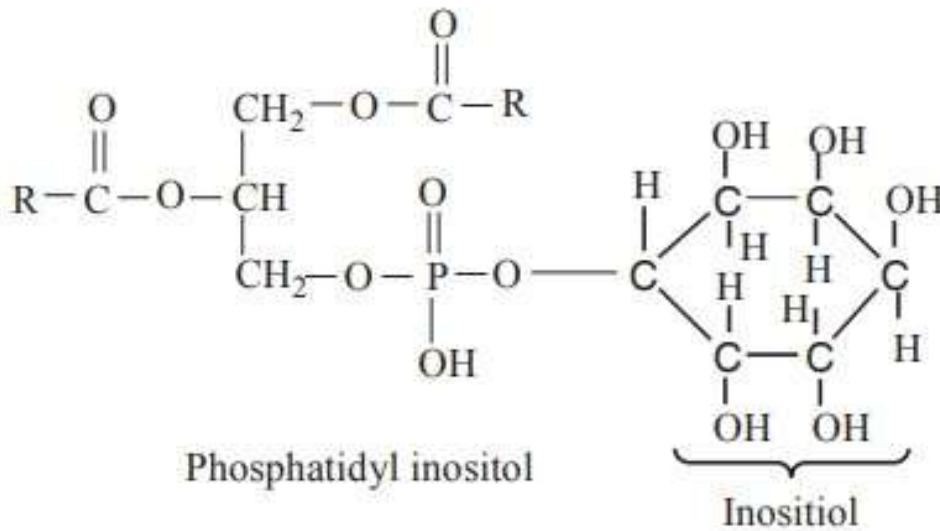


Fosfatidiletanolamin (kefalin)

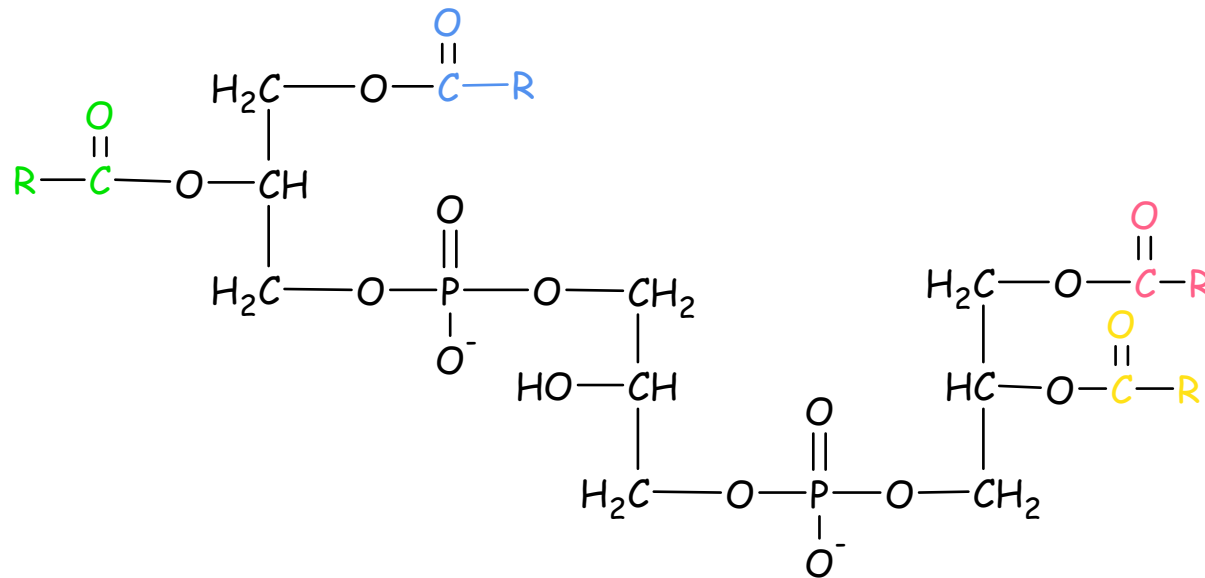
- U sastavu bioloških membrana
- Nalazi se u nervnom i moždanom tkivu
- Zastupljen sa oko 25% svih lipida u ćelijama



Fosfatidilserin



Fosfatidilinozitol

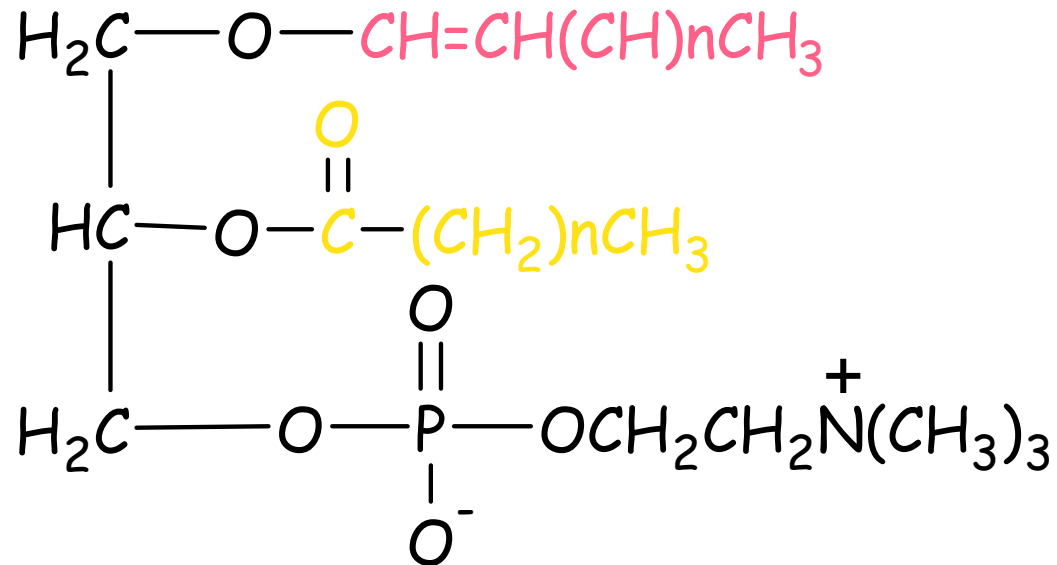


Kardiolipin

- izolovan iz srčanog mišića
- sastavni deo mitohondrijalne membrane, ali i membrana mnogih bakterija

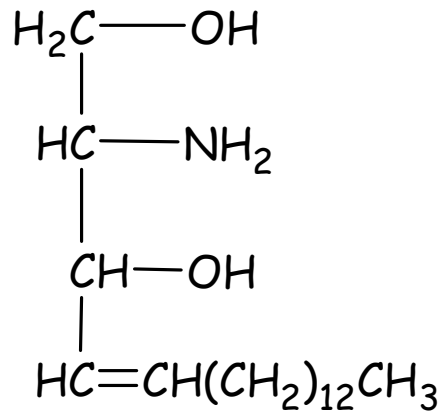
Plazmalogeni

- Strukturna uloga - u sastavu ćelijske membrane
- Imaju ulogu kao endogeni antioksidansi
- Učestvuju u ćelijskoj signalizaciji



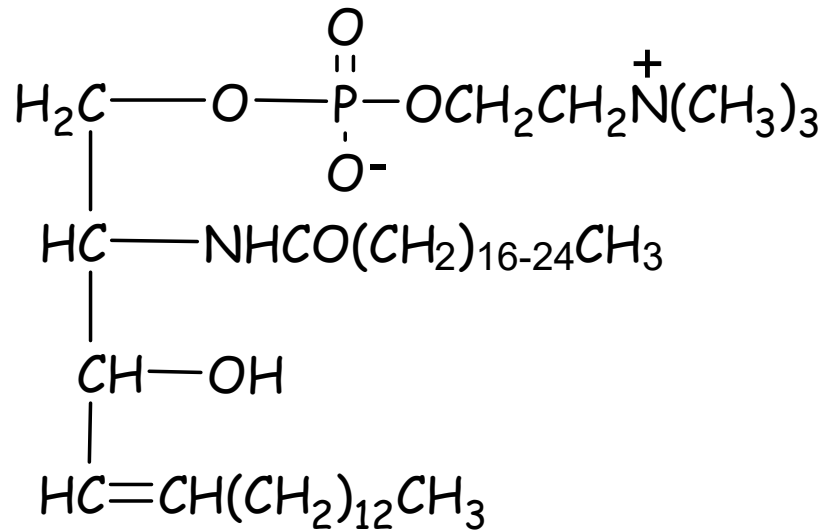
- izolovani iz krvne plazme
- sadrže vinil-estarsku vezu kao i estarski vezane masne kiseline

2. Sfingolipidi



sfingoizin

- alkoholna komponenta je **sfingoizin**
- sfingolipidi se nalaze u nervnom i moždanom tkivu i u ćelijskim membranama

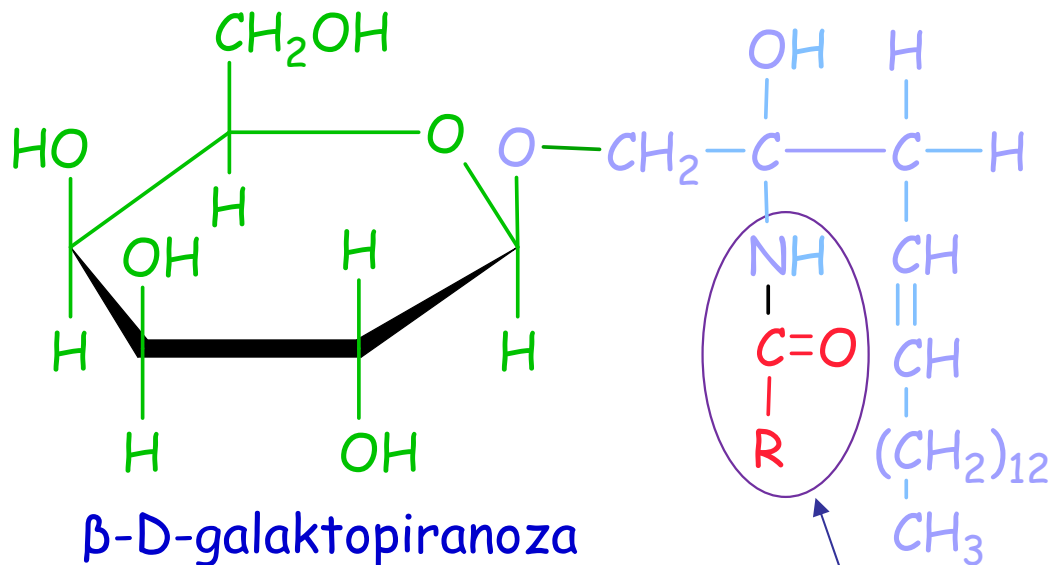


sfingomijelin

- nalazi se u mijelinskim omotačima nervnih završetaka
- mas.kiselina najčešće -lignocerinska

Glikolipidi

- sadrže sfingozin vezan ostatkom monosaharida galaktoze i masne kiseline vezane amidnom vezom za sfingozin, najčešće dugolančane lignocerinsku, cerebronsku, nervonsku
- nalazi se u nervnom tkivu, beloj moždanoj masi



β -D-galaktopiranoza

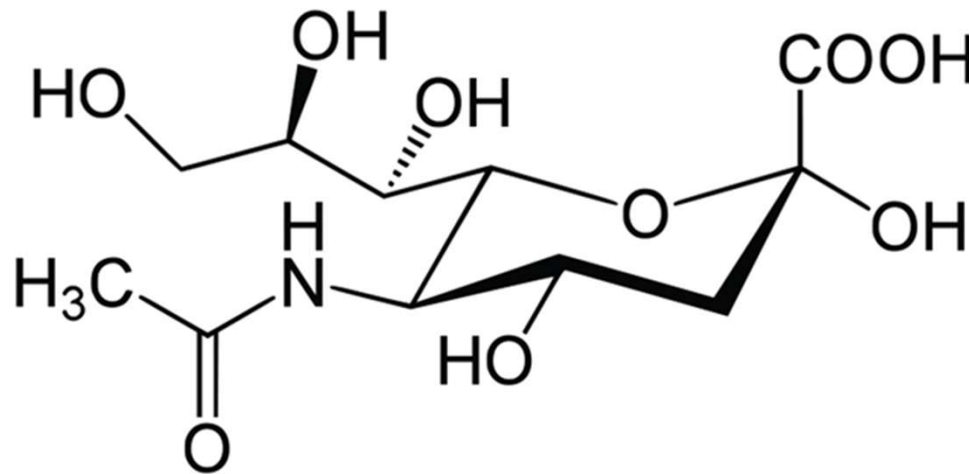
Cerebrozid

Sulfolipidi - estarski vezan ostatak sumporne kiseline za C-atom monosaharida

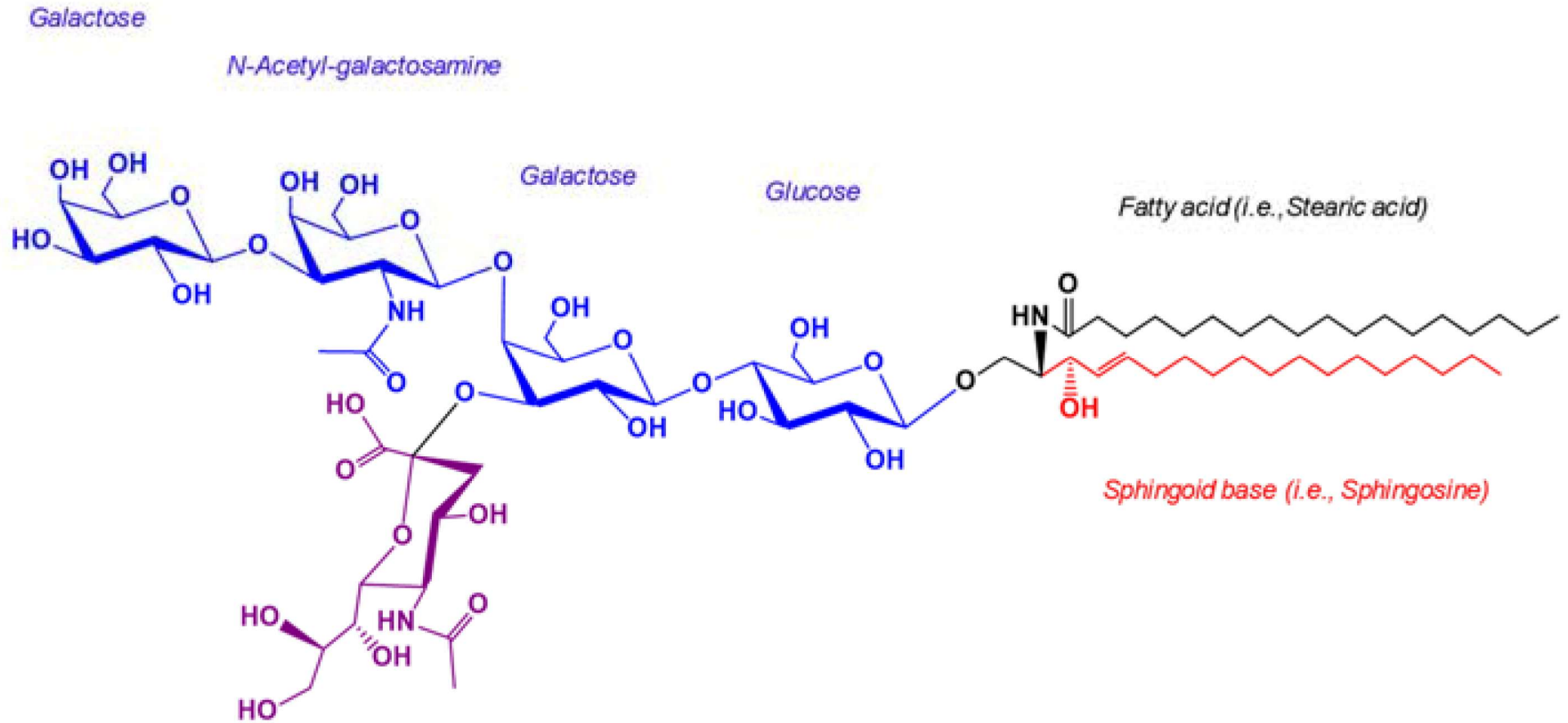
masna kiselina vezana amidnom vezom

Gangliozi

- Spadaju u glikosfingolipide
- Monosaharidne jedinice (glukoza, galaktoza, N-acetilovan galaktozamin) i sijalinske kiseline (najčešće N-acetilneuraminska kiselina - NANA)
- Nalaze se i u ćelijskim membranama i sivoj moždanoj masi



N-acetilneuraminska kiselina - NANA

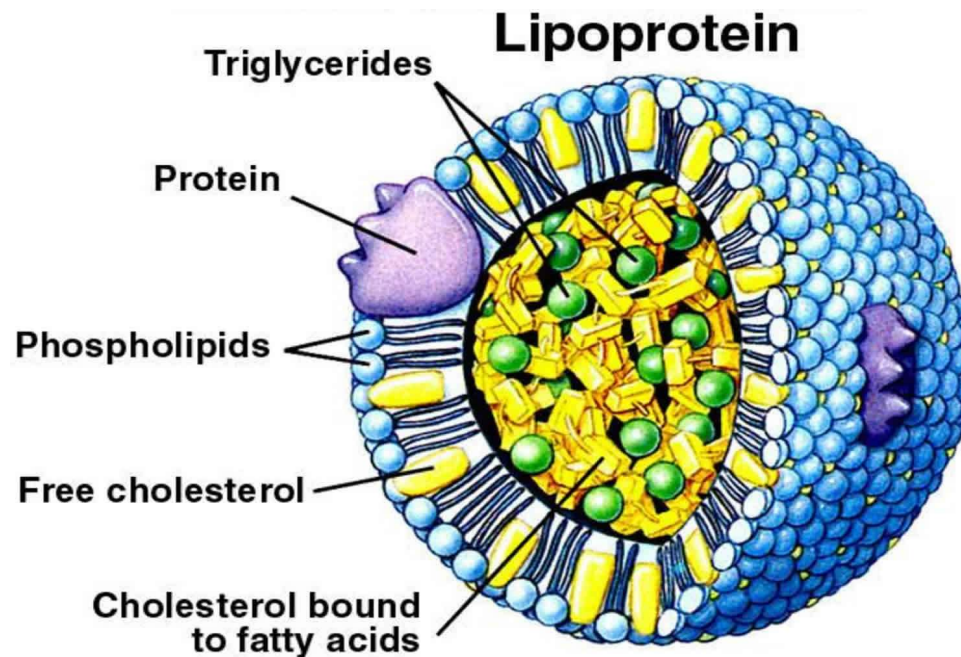


Gangliosid GM1

Lipoproteini

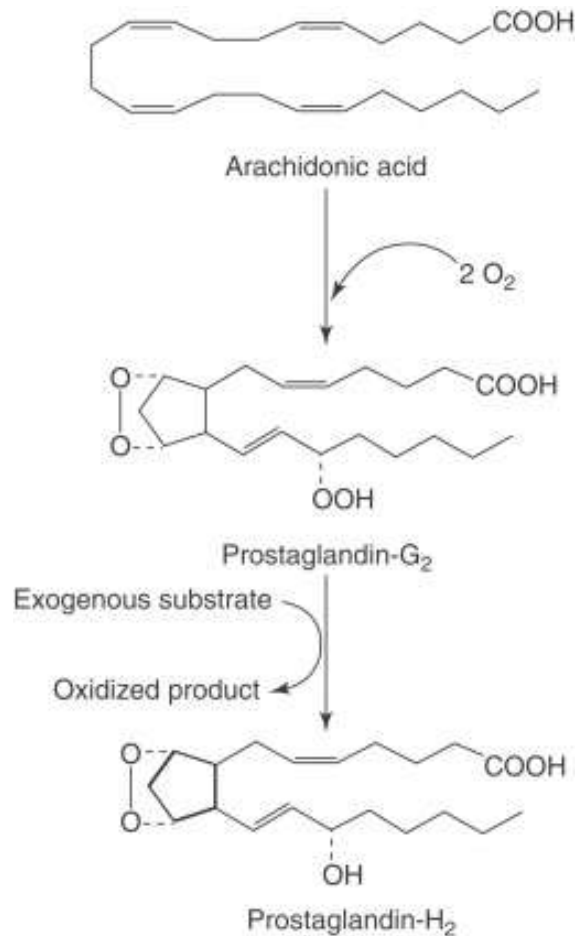
-Sadrže lipidnu i proteinsku frakciju

-Hilomikroni, lipoproteini veoma male gustine (VLDL), lipoproteini male gustine (LDL) i lipoproteini velike gustine (HDL),



Prostaglandini

- Nastajajo iz polinezasičenih masnih kiselin, svrstavajo se u lipide



-Imaju različite vloge u organizmu, slično hormonima

- intermedijeri, izlučuju se na mestu delovanja

- imaju ulogu vazodilatatora gladke muskulature, inflamatornom odgovoru, bronhodilataciji...