ÓLEOS E GORDURAS

1- Introdução
2 – Produção e comércio mundiais de óleos e gorduras
3- Caracterização geral de diferentes óleos vegetais
4 – Lípidos
4.1 - Definição
4.2 – Classificação
4.3 – Caracterização de alguns grupos lipídicos
4.3 – Caracterização de alguns óleos e gorduras alimentares
5 – Processamento e alteração dos lípidos. Exemplos

colza

girassol

azeitona

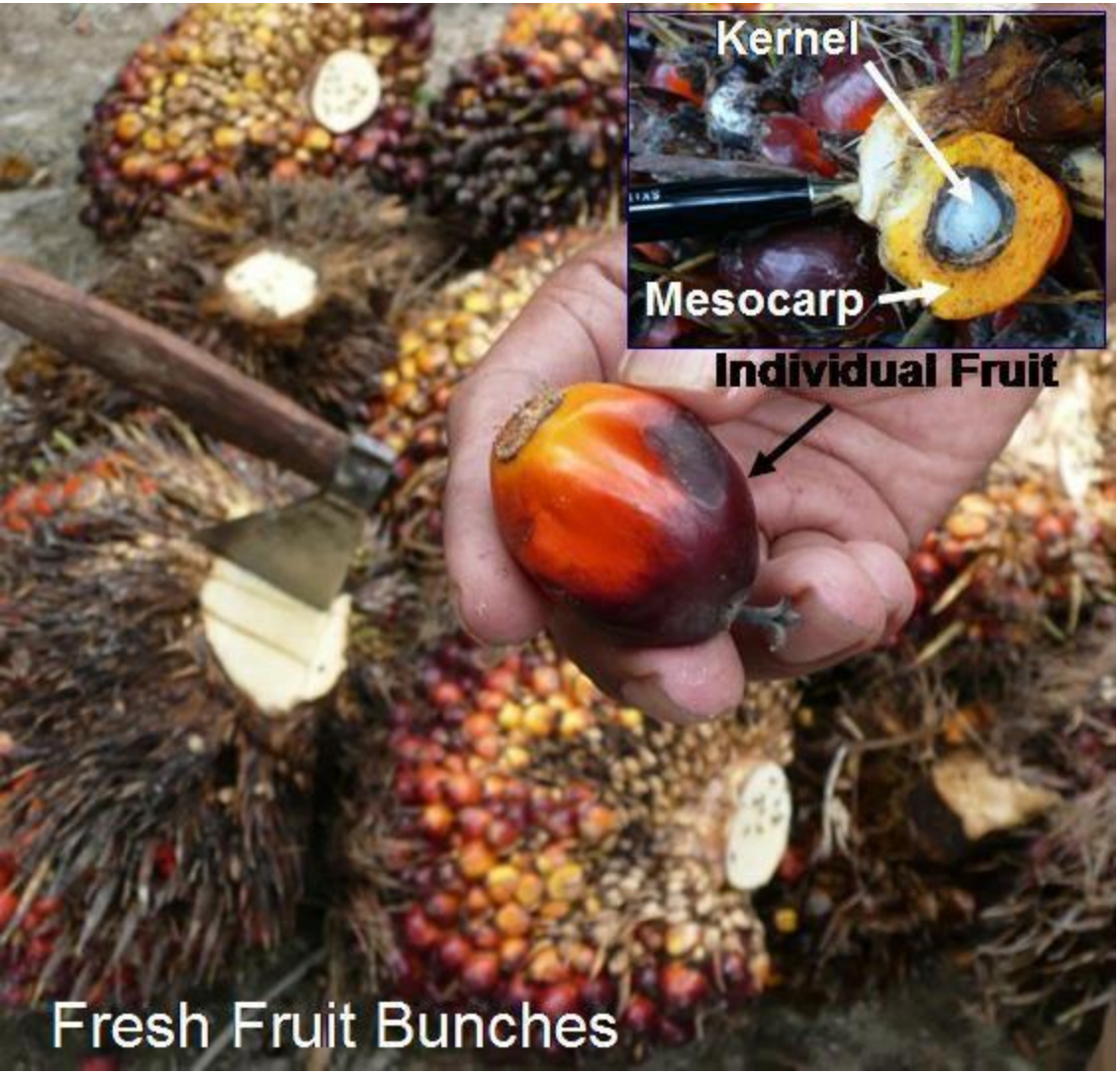
http://www.esab.ipbeja.pt/

cardo

purgueira

algodão

rícino



Palma e coconote

http://www.unicarepharma.com

copra

http://www.bighams.com/dynamic/image_library/cropped/TB_Beans_408pixels.jpg

soja

http://www.botanik.uni-karlsruhe.de/garten/fotos-knoc

amendoim

linho

gergelim

//www.uni-graz.at/~katzer/engl/Sesa_ind.html

ÓLEOS VEGETAIS

PRODUTO	% ÓLEO	UTILIZAÇÕES PRINCIPAIS
SEMENTES OLEAGINOSAS:		
RÍCINO	35-55	- PINTURAS; LUBRIFICANTES; MEDICINA
ALGODÃO	15-25	- ÓLEO COMESTÍVEL; SABÃO
LINHO	35-44	- PINTURAS, VERNIZES
COLZA/MOSTARDA	40-45	- ÓLEO COMESTÍVEL
GERGELIM	35-50	- ÓLEO COMESTÍVEL
GIRASSOL	25-40	- ÓLEO COMESTÍVEL; SABÃO
FRUTOS COM "CASCA":	38-50	
AMENDOIM	46-57	- ÓLEO COMESTÍVEL; SABÃO
PALMISTE = COCONOTE		- ÓLEO COMESTÍVEL; SABÃO; CREME CORPORAL/CAPILAR
COCO (copra seca)	67%	- ÓLEO COMESTÍVEL; SABÃO; CREME
(albumen fresco)	35	CORPORAL/CAPILAR
MESOCARPO		
PALMEIRA DO DENDÉM (polpa fresca)	56	- ÓLEO COMESTÍVEL; SABÃO

* SÓ O ÓLEO DE RÍCINO FABRICADO POR UMA TÉCNICA SOFISTICADA PODE SER UTILIZADO PARA FINS MEDICINAIS

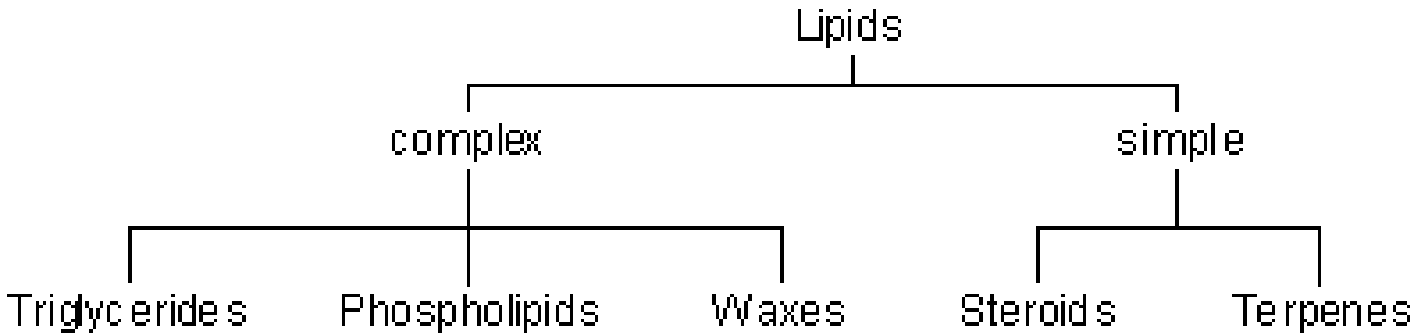
Retirado de: UNIFEM - Extraction des huiles, New York, 1979.

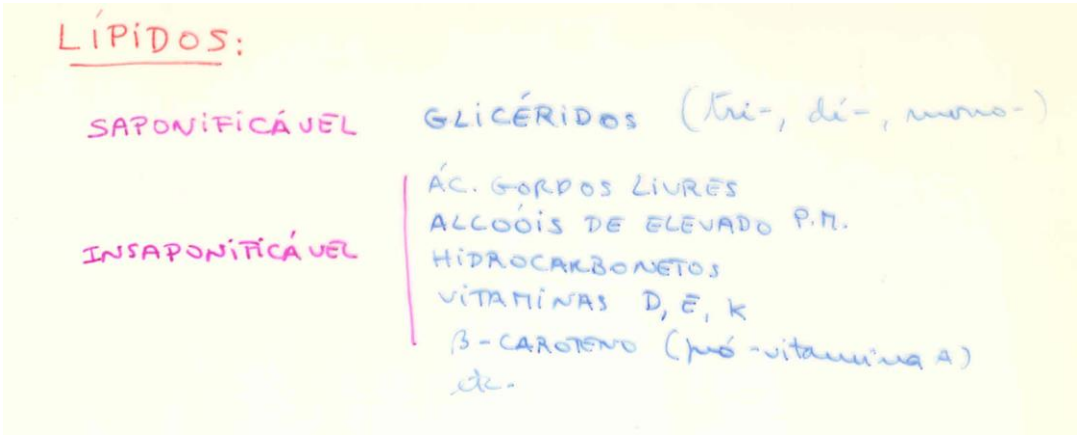
	Moisture content (%)	Oil/fat content (%)	Yield of oil (%)	Uses for by-products
Seeds and beans				
Cotton	5	15-25	-	Animal feed
Rape	9	40-45	25	Animal feed (needs
Mustard	7	25-45	-	detoxifying)
Sesame	5	25-50	45	-
Sunflower	5	25-50	20-30*	Animal feed
Safflower	5	30	-	Hulls used for chicken litter, presscake for animal feed
				Animal feed
Nuts				
Coconut (fresh)	40-50	35-40	55-62	See Figure 8
Copra	3 – 4.5	64-70	-	-
Groundnut (shelled)	4	28-55	40*	Food, snacks, soup
Palm kernel nuts	-	-	45-49	Animal feed
(shelled)	-	46-57	47-51	Animal feed, fuel (shells)
Shea nut	-	34-44	15-45*	Fuel
Shea nut	-	-	60	
Fruits				
Oil palm	-	56	11-20	Fuel, lighting
Avocado	69	11-28	40-44	-
Olive	50-70	-	25	Animal feed, fuel

Table 1: Sources of oil. *Traditional methods

http://www.itdg.org/docs/technical_information_service/oil_extraction.pdf

LÍPIDOS
- Compostos hidrofóbicos
-constituídos por C, H e O
- Classificações:





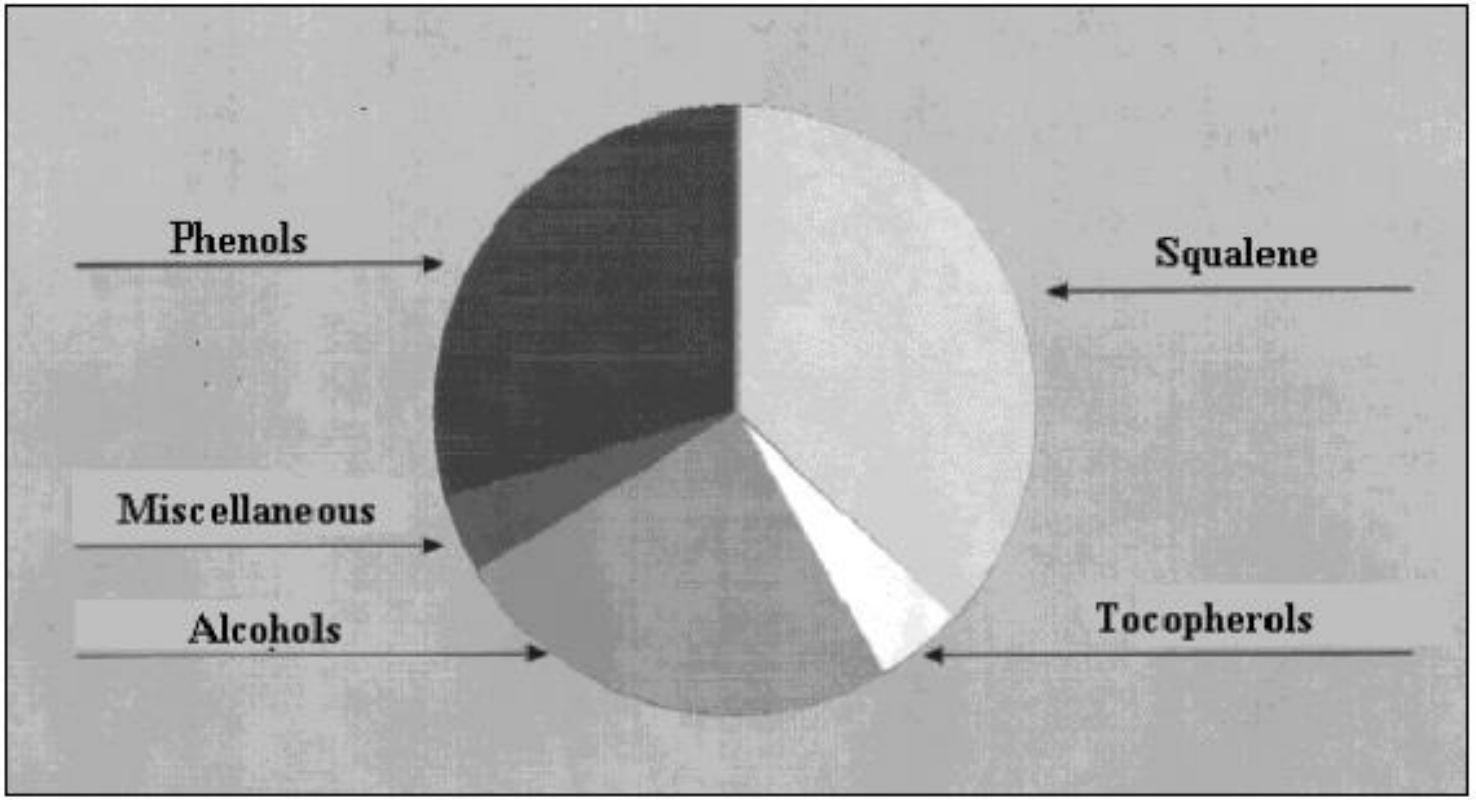
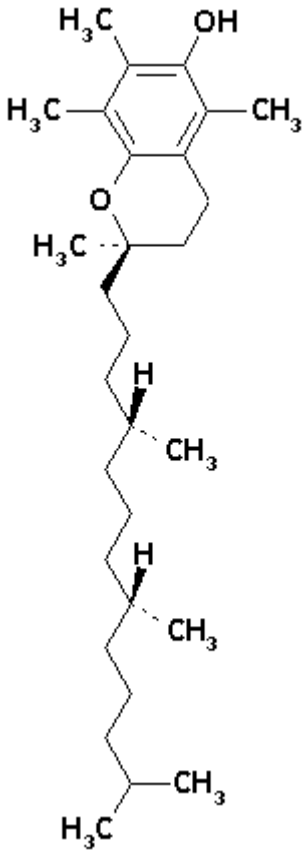
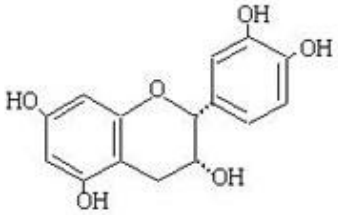


Figure 1: Unsaponifiable components of olive oil.

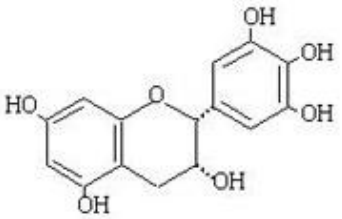
Kiritsakis (2006)



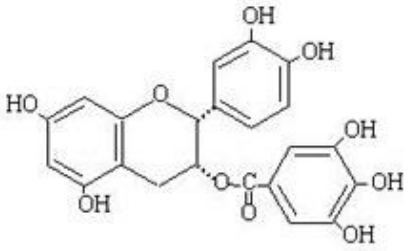
α-Tocopherol (Vitamin E)



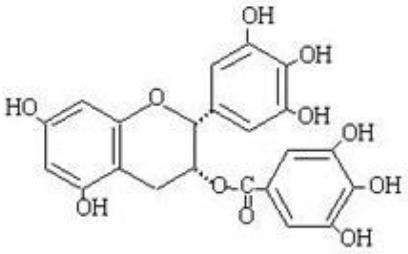
(-)-Epicatechin



(-)-Epigallocatechin

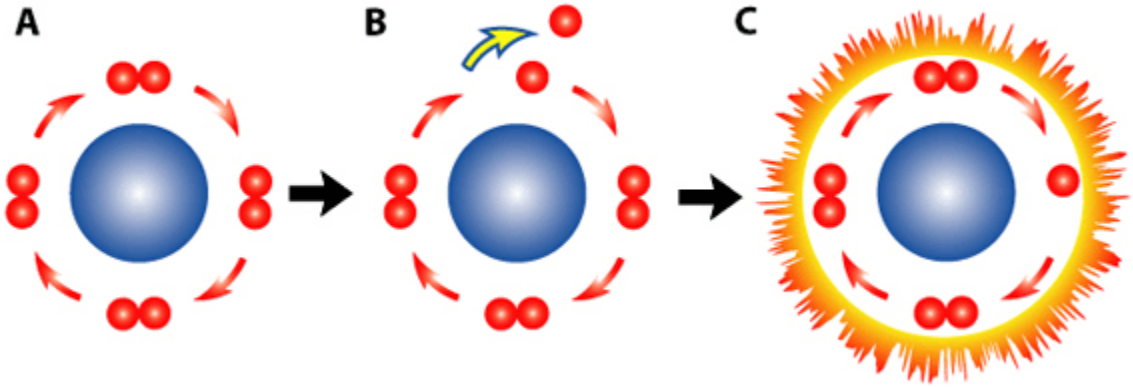


(-)-Epicatechin gallate

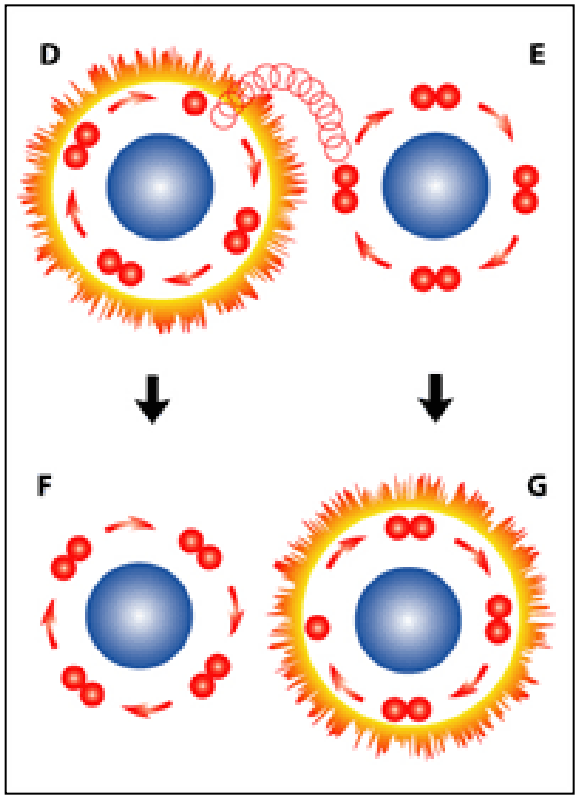


(-)-Epigallocatechin gallate

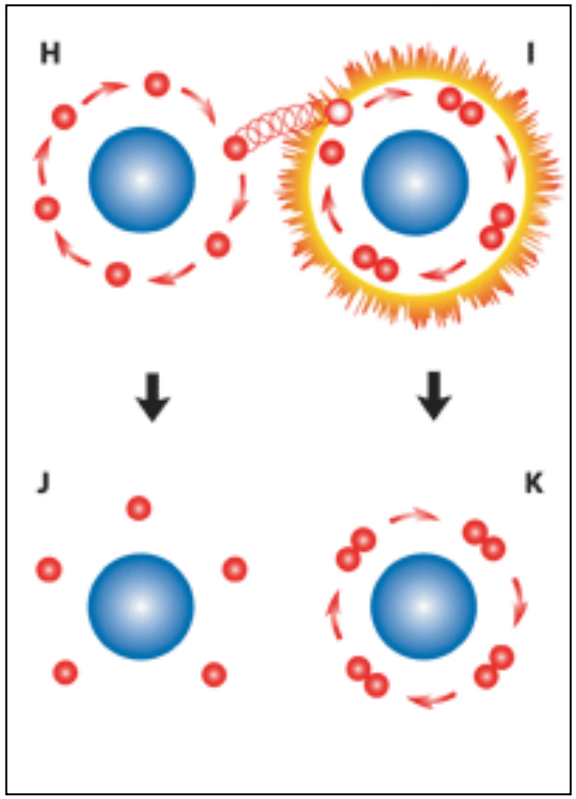
http://www.cerefolin.com/OxyStress.php



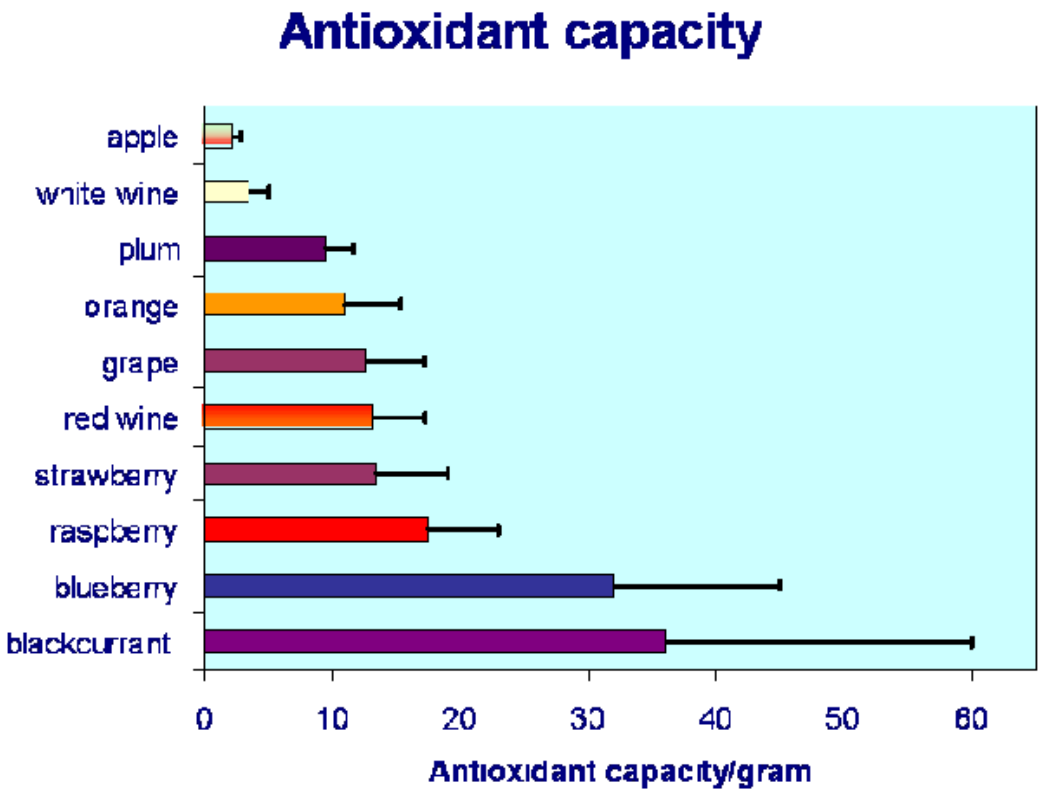
Radical livre



Radicais livres lesam as moléculas estáveis



Antioxidantes neutralizam Radicais livres



http://www.fruitnutrition.co.uk/berries_and_nutrition.asp

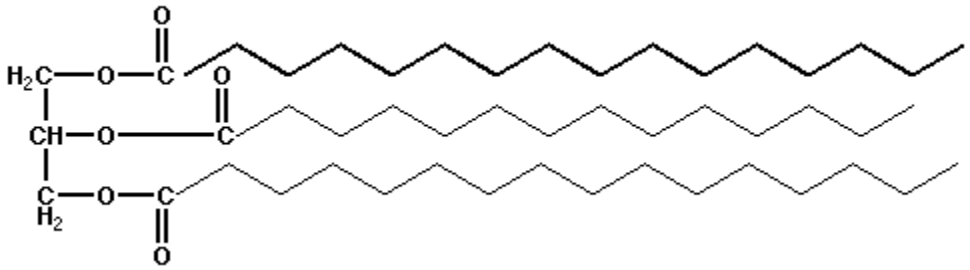
ORAC* Values of Top Antioxidant Foods	
Unprocessed Cocoa Powder	26,000
Açai Berry	18,500*
Dark Chocolate	13,120
Prunes	5,770
Raisins	2,830
Blueberries	2,400
Blackberries	2,036
Strawberries	1,540
Spinach, Raw	1,260
Broccoli Florets	890
Red Grapes	739
Cherries	670

Source: Data from U.S. Department of Agriculture and the Journal of the American Chemical Society.
* Source: Brunswick Laboratories

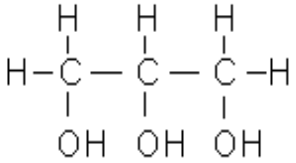
http://www.whyxocai.com/oracscale-inset.jpg

ACILGLICERÓIS (MONO-, DI- OU TRI-)

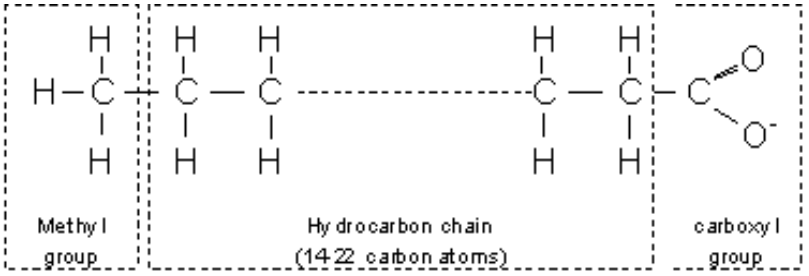
(= GLICÉRIDOS)



Glycerol is a small, 3-carbon molecule with three hydroxyl groups.



Fatty acids are long molecules with a polar, hydrophilic end and a non-polar, hydrophobic "tail". The hydrocarbon chain can be from 14 to 22 CH2 units long. The hydrocarbon chain is sometimes called an R group, so the formula of a fatty acid can be written as R-COOH.



ÁCIDOS GORDOS mais comuns

N. COMUM	N. SISTEMÁTICO	C:D.L.	PF
SATURADOS			
(fórmula geral: H3 C(CH2)n COOH			
butírico	butanóico	4:0	-7,9
capróico	hexanóico	6:0	-3,4
caprílico	octanóico	8:0	16,7
cáprico	decanóico	10:0	31,6
láurico	dodecanóico	12:0	44,2
mirístico	tetradecanóico	14:0	54,4
palmítico	hexadecanóico	16:0	62,9
Esteárico	octadecanóico	18:0	69,6
araquídico	eicosanoico	20:0	75,4
beénico	docosanóico	22:0	80,0
INSATURADOS			
caproleico	9-decenóico	10:1	-
lauroleico	9-dodecenóico	12:1	-
miristoleico	9-tetradecenóico	14:1	18,5
palmitoleico	9-hexadecenóico	16:1	-
oleico	9-octadecenóico	18:1	16,3
elaídico	9-octadecenóico	18:1	43,7
vacénico	11-octadecenóico	18:1	44,0
linoleico	9,12-octadecadienóico	18:2	-6,5
linolénico	9,12,15-octadecatrienóico	18:3	-12,8
gradoleico	9-eicosenóico	20:1	-
araquidónico	5,8,11,14-eicosatetraenóico	20:4	-49,5
-	5,8,11,14,17-eicosapentaenóico	20:5	-
erúcico	13-docosenóico	22:1	33,4
-	4,7,10,13,16,19-docosahexaenóico	22:6	-

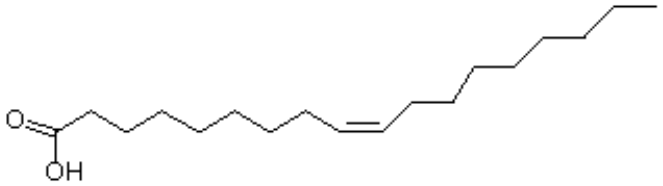
NOTA: Todas as duplas ligações estão na configuração cis, excepto para o ácido elaídico e vacénico que estão na trans.

Saturated fats - These are considered the most detrimental to your health. They usually are solid at room temperature and are derived from animal products. When looking at their molecular structure, saturated fats contain the maximum number of hydrogen atoms (hence "saturated" with hydrogen atoms).

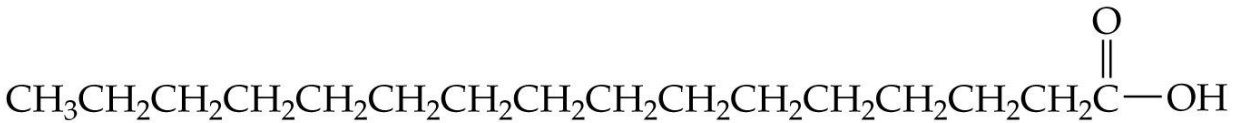
•**Monounsaturated fats** - This type of lipid lowers "bad cholesterol", LDL, and leaves the "good cholesterol" HDL levels the same. These are usually liquid at room temperature. When looking at their molecular structure, there are two hydrogen atoms missing with a double bond between two carbon atoms replacing them. Monounsaturated fats include canola oil and olive oil.

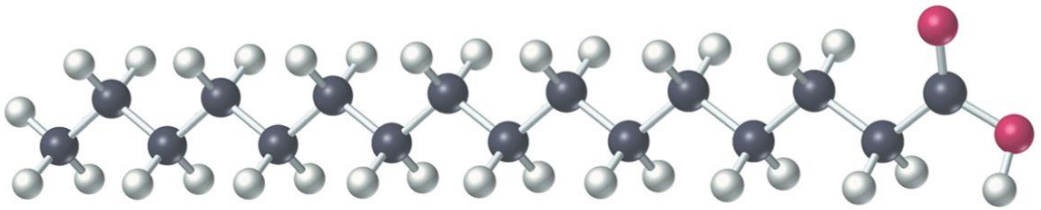
•**Polyunsaturated fats** - This type of fat tends to lower both LDL and HDL levels (remember--we want to keep high levels of HDL). These are liquid at room temperature and typically have more than two hydrogen atoms missing. Polyunsaturated fats include safflower oil, sunflower oil and corn oil.

Esteárico

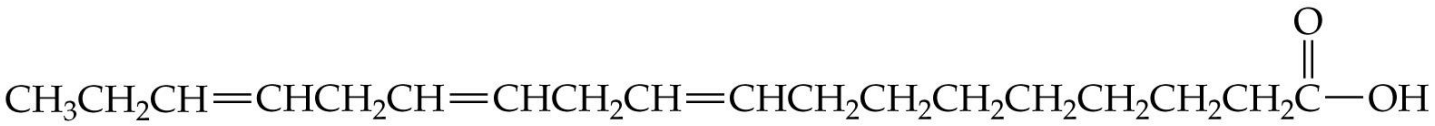


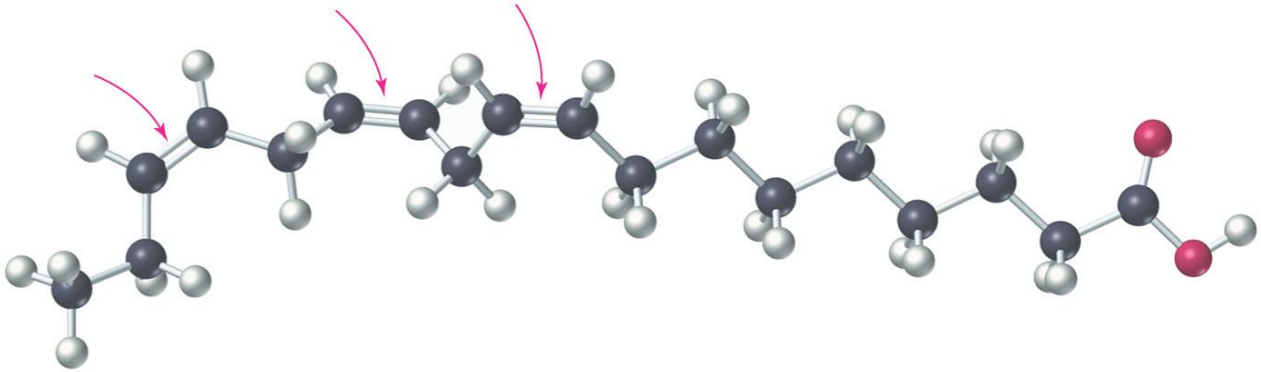
oleico





A saturated fatty acid
(palmitic acid)

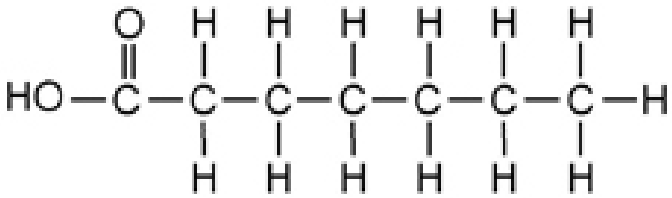




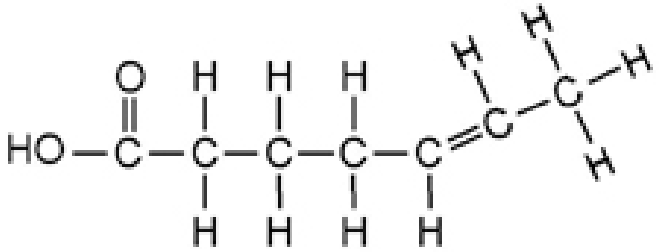
A *cis* unsaturated fatty acid
(linolenic acid)

If there are no C=C double bonds in the hydrocarbon chain, then it is a saturated fatty acid (i.e. saturated with hydrogen). These fatty acids form straight chains, and have a high melting point.

•If there are C=C double bonds in the hydrocarbon chain, then it is an unsaturated fatty acid (i.e. unsaturated with hydrogen). These fatty acids form bent chains, and have a low melting point. Fatty acids with more than one double bond are called poly-unsaturated fatty acids (PUFAs).



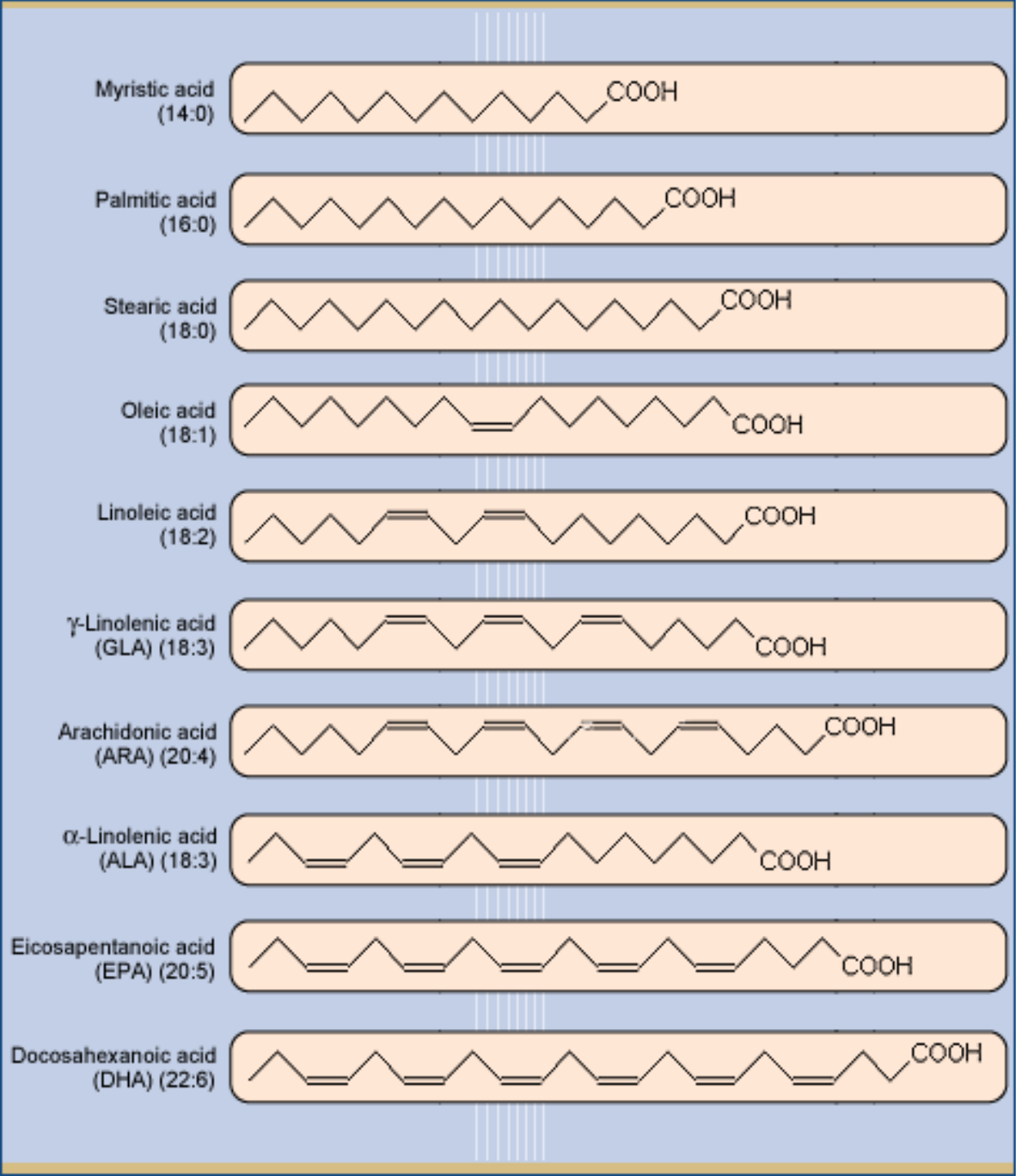
Saturated fatty acid



Unsaturated fatty acid

Triglycerides containing saturated fatty acids have a high melting point and tend to be found in warm-blooded animals. At room temperature they are solids (fats), e.g. butter, lard.

Triglycerides containing unsaturated fatty acids have a low melting point and tend to be found in cold-blooded animals and plants. At room temperature they are liquids (oils), e.g. fish oil, vegetable oils.



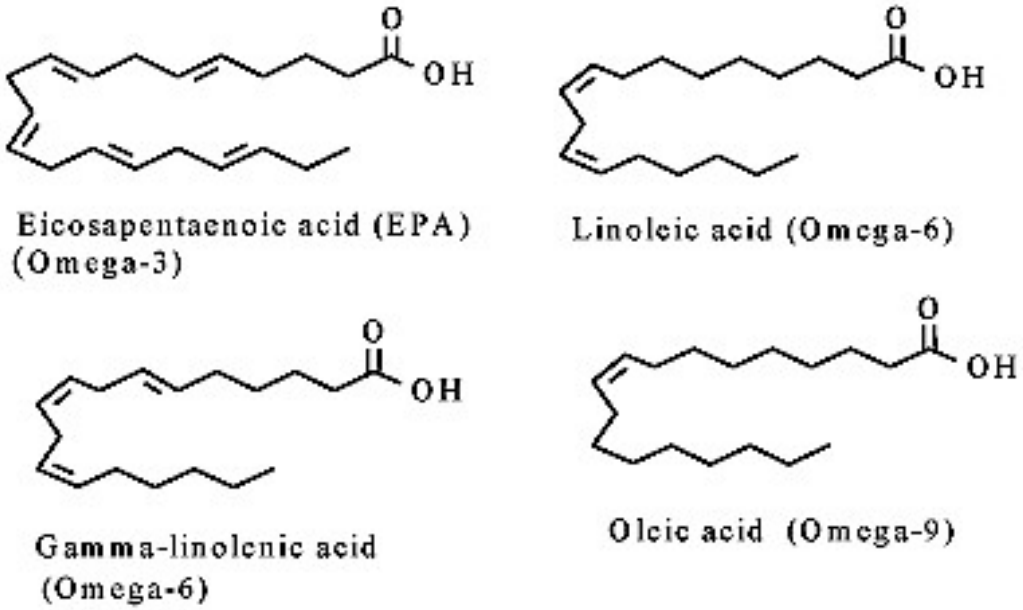
http://www.biovita.fi

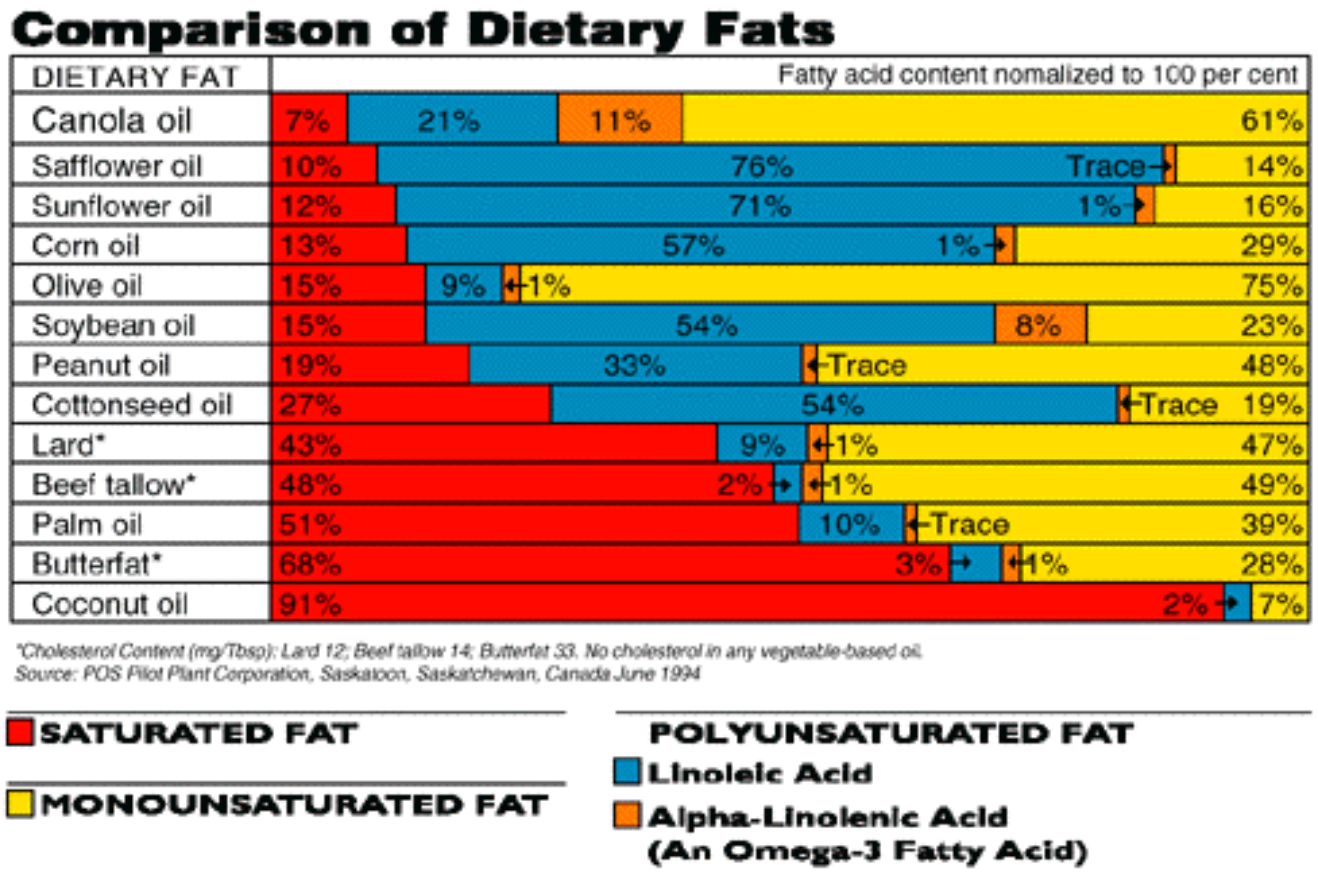
Table 1. Iodin Numbers of Common Fats*	
Fat or Oil	**Iodin number**
Linseed oil	173 - 201
Tung Oil	170.6
Menhaden oil	139 - 173
Whale oil	121 - 146.6
Soy bean oil	137 - 143
Sunflower oil	119 - 135
Corn oil	111 - 130
Cottonseed oil	108 - 110
Sesame oil	103 - 108
Rapeseed oil	94 - 102
Peanut oil (arachis)	83 - 100
Olive oil	79 - 88
Horse oil	71 - 86
Lard	46 - 70
Palm oil	51.5 - 57
Milk fat	26 - 50
Beef tallow	38 - 46
Mutton tallow	35 - 46
Cacao butter	32 - 41
Palm kernel oil	13 - 17
Coconut oil	8 - 10

http://journeytoforever.org/biofuel_library/fatsoils/fatsoils2.html

J. Lewkowitsch, *Chemical Technology and Analysis of Oils, Fats, and Waxes*, pp. 419-24.

•**Essential fatty acids** - These include omega-6 and omega-3 fatty acids, which have been linked to lowering triglyceride levels. Common sources of essential fatty acids include vegetable oils, fish, grains, seeds, and vegetables.

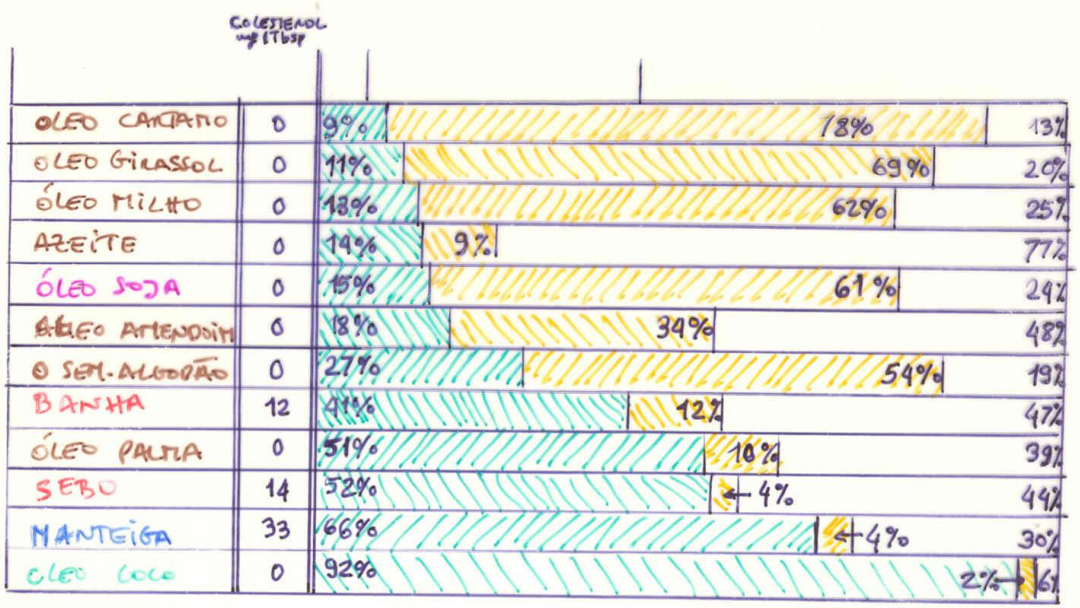




http://www.oliveoil.co.za/health2.html

COMPARAÇÃO ENTRE GORDURAS E ÓLEOS ALIMENTARES

GORDURA SATURADA | GORDURA POLINSATURADA | GORDURA MONOINSATURADA



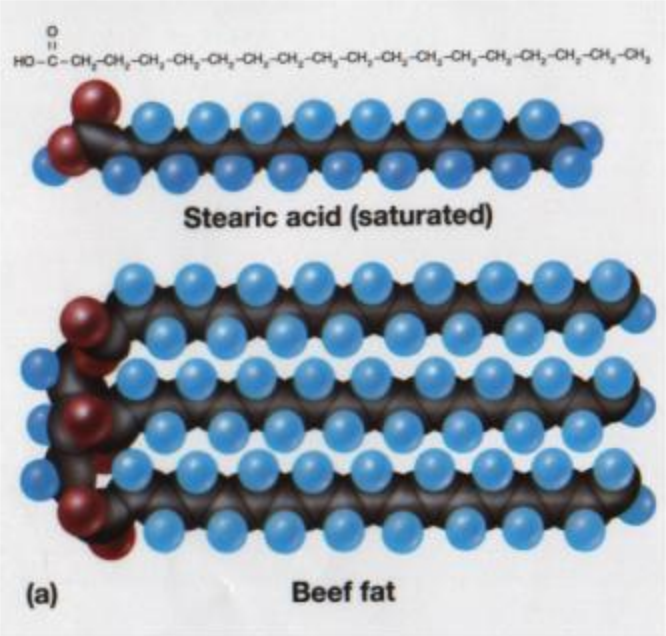
CLASSIFICAÇÃO DAS GORDURAS E ÓLEOS ALIMENTARES:
(critério: origem e composição)

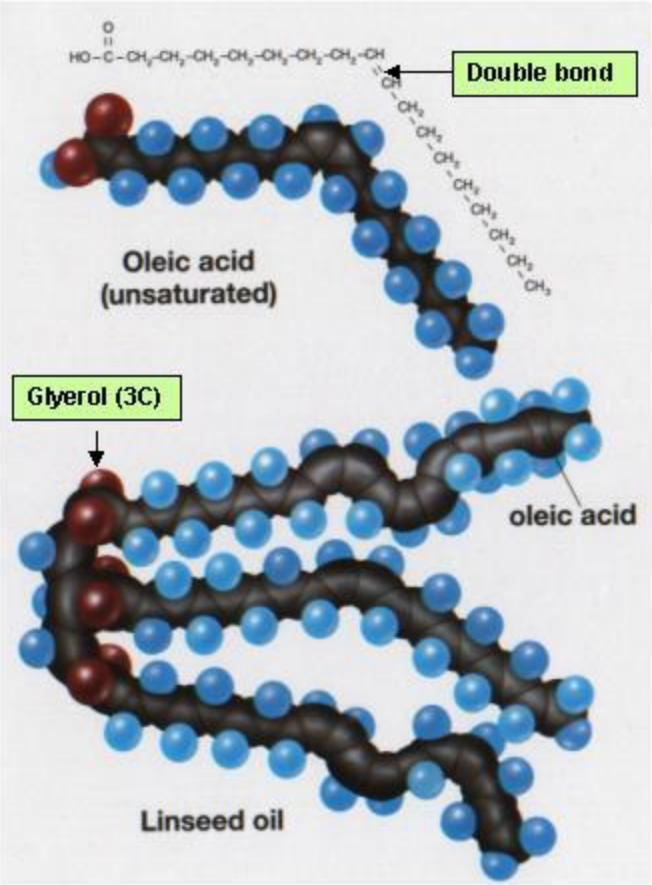
- origem vegetal: grupo do ácido linolênico
  grupo do ác. oleico-linoleico
  grupo do ác. láurico
  grupo do ác. erúcico
  "gordura" vegetal

- origem animal: gordura de leite
  gordura adiposa animal
  óleos de origem marinha

Lipid Structures

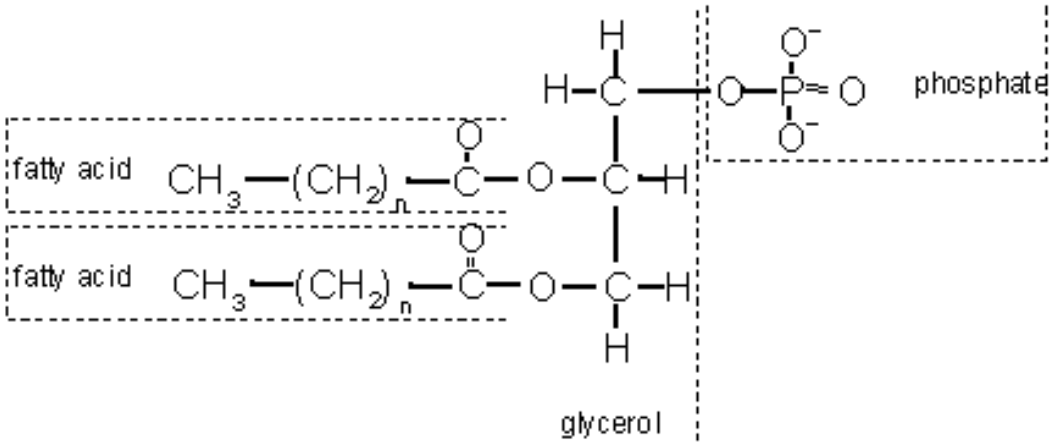
- Fatty acids
- Triglycerides

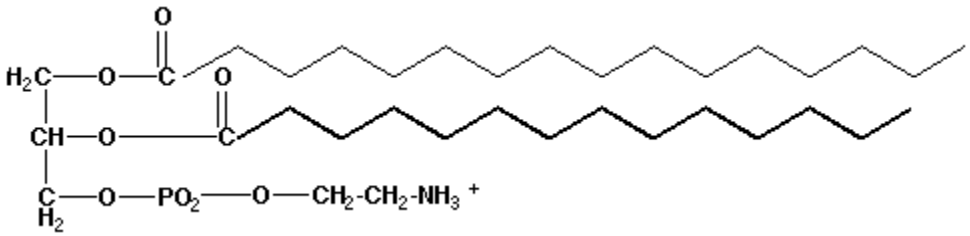


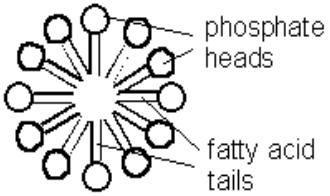


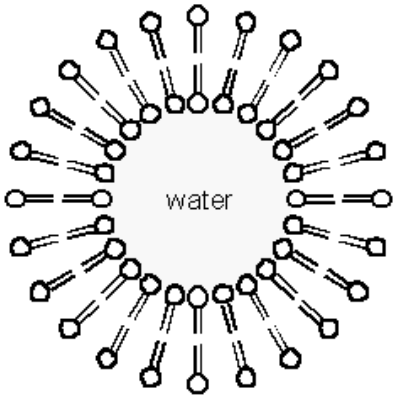
http://www.ualr.edu/botany/fattyacids.jpg

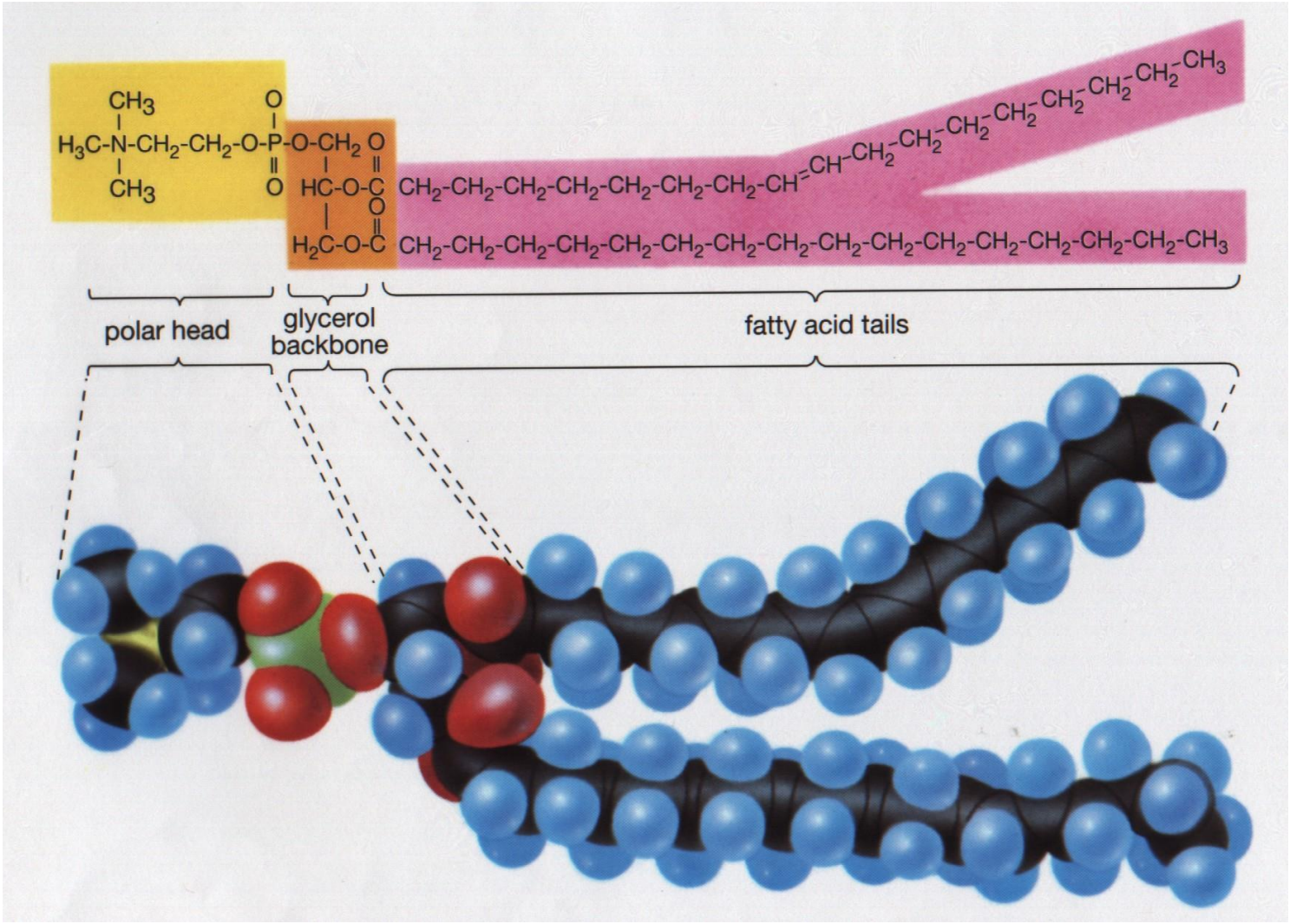
FOSFOLÍPIDOS





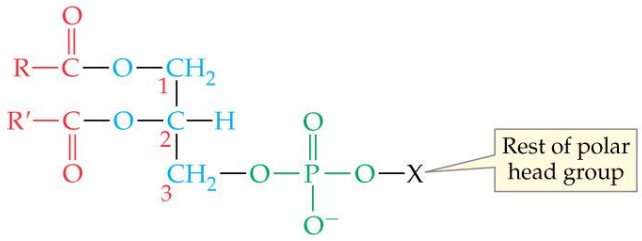


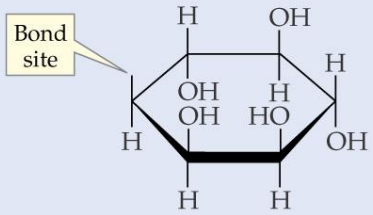


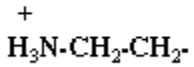
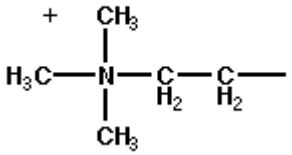
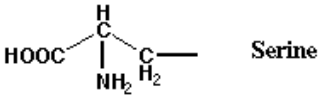
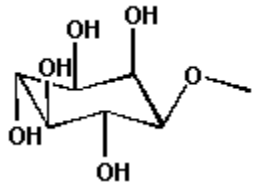


http://www.ualr.edu/botany/fattyacids.jpg

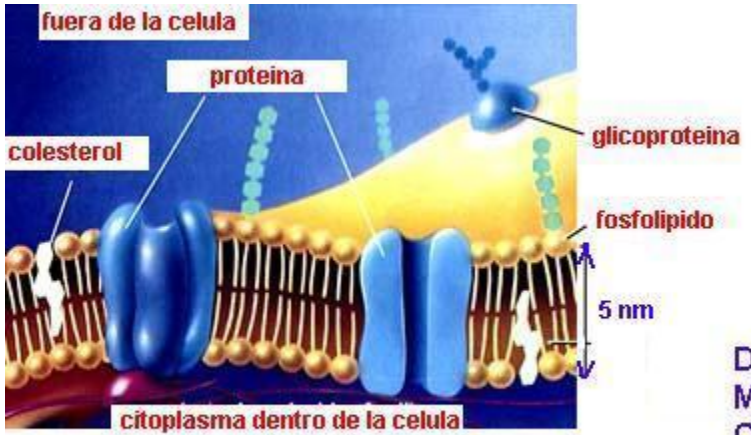
TABLE 24.3 Some Glycerophospholipids



Precursor of X (HO–X)	Formula of X	Name of Resulting Glycerophospholipid Family	Function
Water	—H	Phosphatidate	Basic structure of glycerophospholipids
Choline	$-CH_2CH_2\overset{+}{N}(CH_3)_3$	Phosphatidylcholine	Basic structure of lecithins; most abundant membrane phospholipids
Ethanolamine	$-CH_2CH_2\overset{+}{N}H_3$	Phosphatidylethanolamine	Membrane lipids
Serine	$-CH_2-CH(\overset{+}{N}H_3)-COO^-$	Phosphatidylserine	Present in most tissues; abundant in brain
myo-Inositol		Phosphatidylinositol	Relays chemical signals across cell membranes

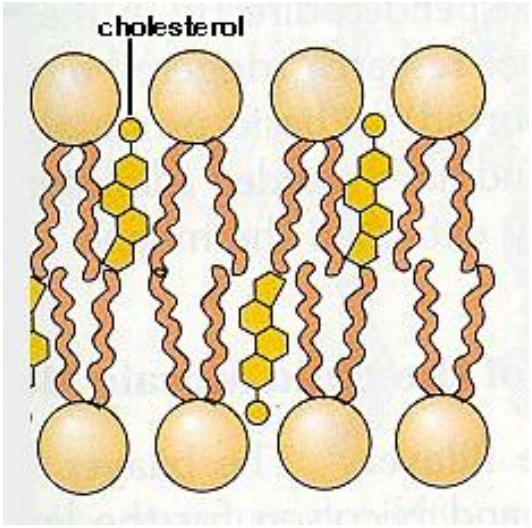
X-Structure	Name	Type
H2O	Water	Phosphatidic Acid
	Ethanolamine	Phosphatidylethanolamine
	Choline	Phosphatidylcholine
	Serine	Phosphatidylserine
	Inositol	Phosphatidylinositol

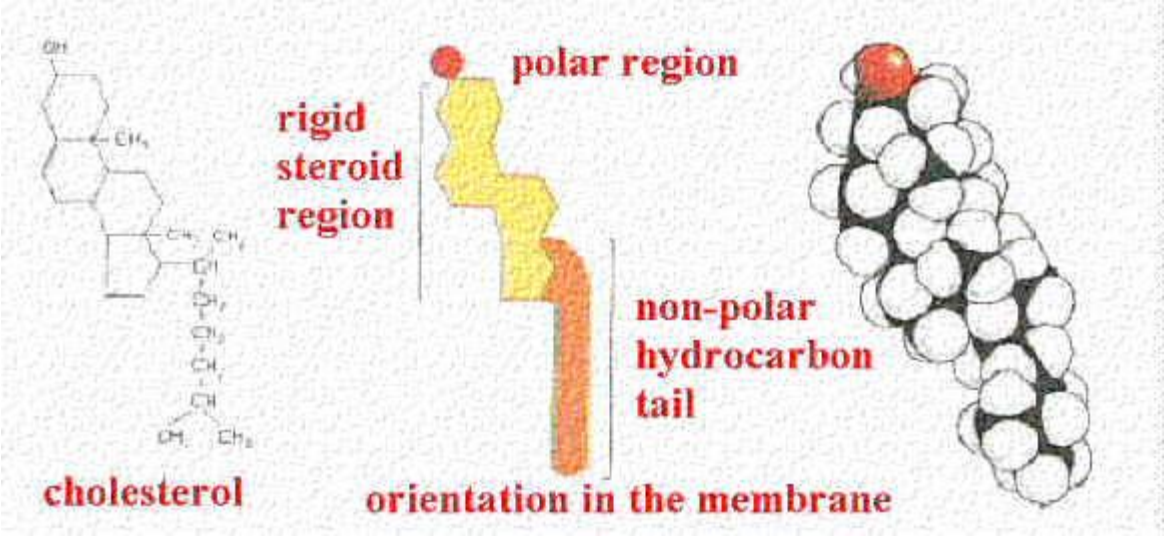
COLESTEROL



DIBUJO DE LA MEMBRANA CELULAR

http://ar.geocities.com/moni2201/membrana_celular.htm



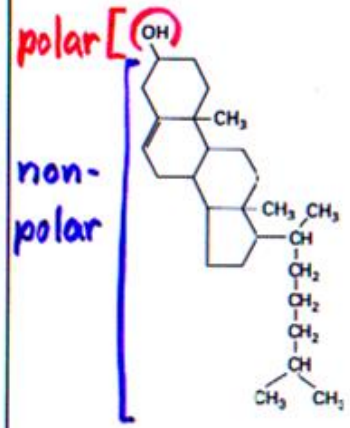


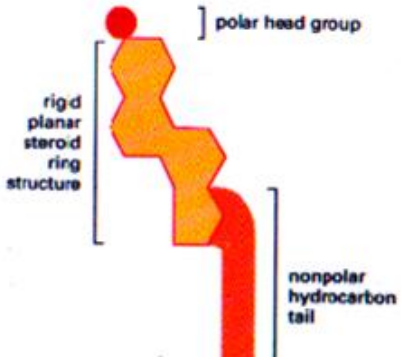
http://cellbio.utmb.edu

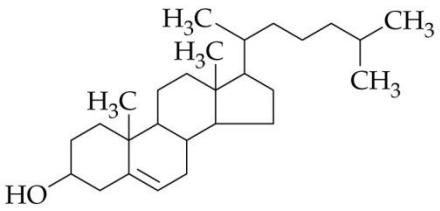
Cholesterol

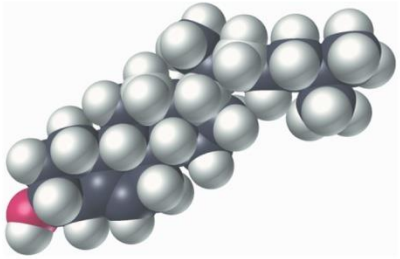
polar

non-polar

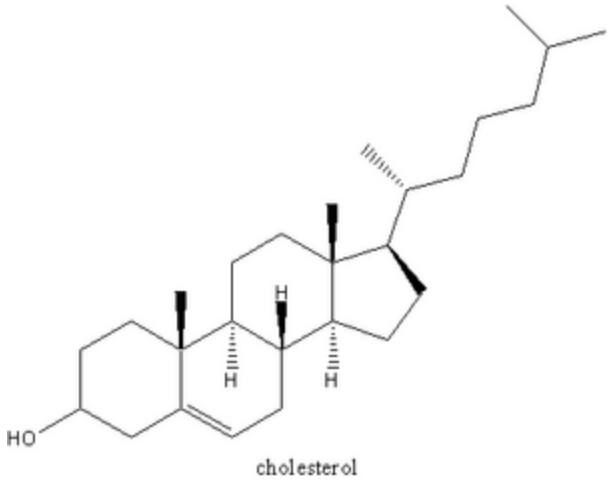








The cholesterol molecule is a steroid lipid, found in the cell membranes of all body tissues, and transported in the blood plasma, of all animals. Most cholesterol is produced internally, not dietary in origin. It is present in higher concentrations in tissues which either produce more or have more densely packed membranes; for example the liver, spinal cord, brain and atheroma. Cholesterol plays a central role in many biochemical processes, but is best known for the association of cardiovascular disease with various lipoprotein cholesterol transport patterns in the blood.
The name originates from the Greek chole- (bile) and stereos (solid), as researchers first identified cholesterol in solid form in gallstones.



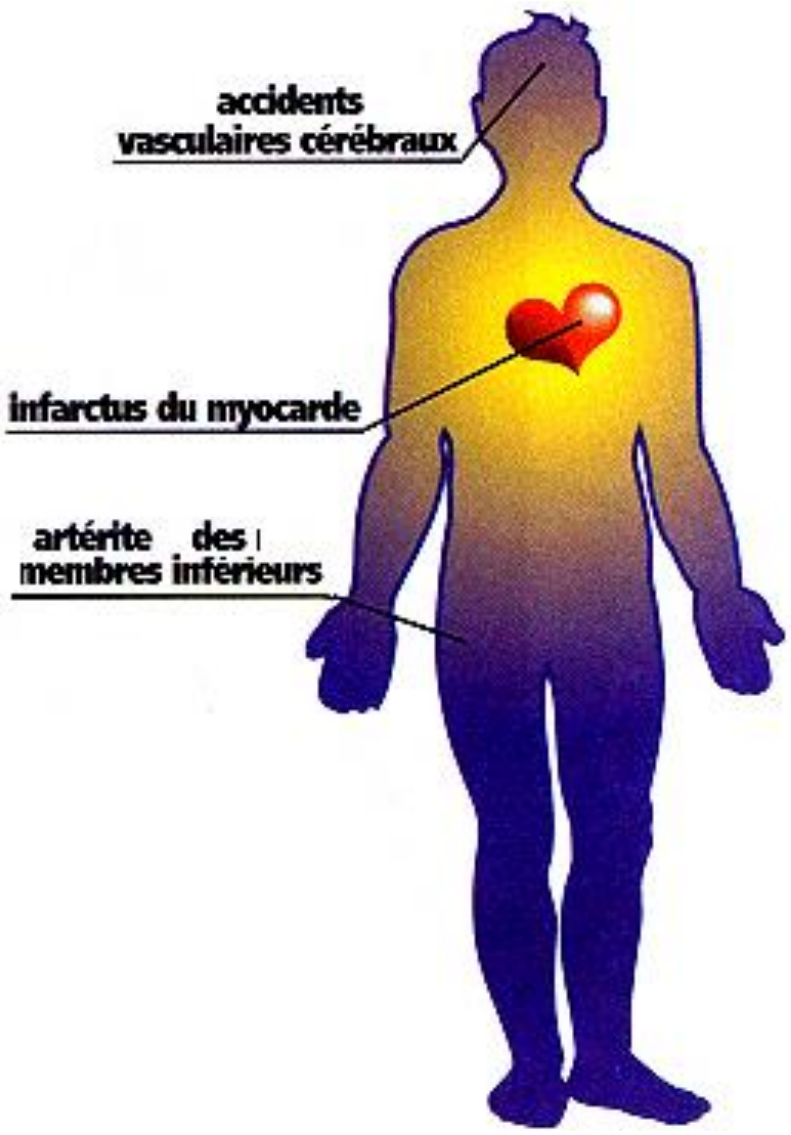
cholesterol

http://www.worldofmolecules.com/disease/cholesterol.htm

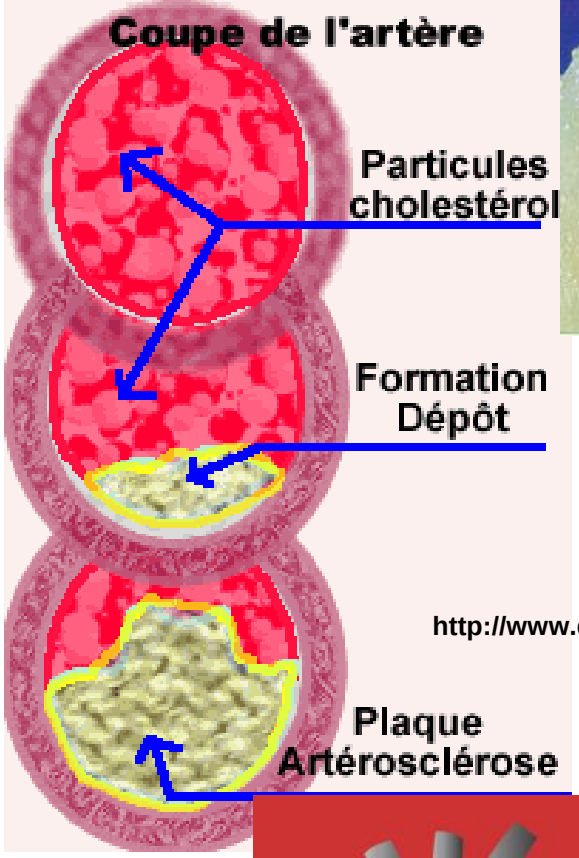
Function
The cholesterol molecule is an important component of the membranes of cells, providing stability. It is the major precursor for the synthesis of vitamin D, of the various steroid hormones, including cortisol, cortisone, and aldosterone in the adrenal glands, and of the sex hormones progesterone, estrogen, and testosterone. Further recent research show that cholesterol molecules have an important role for the brain synapses as well as in the immune system.

Excretion
Cholesterol is excreted from the liver in bile and reabsorbed from the intestines. Under certain circumstances, when more concentrated, as in the the gallbladder, it crystallises and is the major constituent of most gallstones, although lecitin and bilirubin gallstones also occur less frequently.

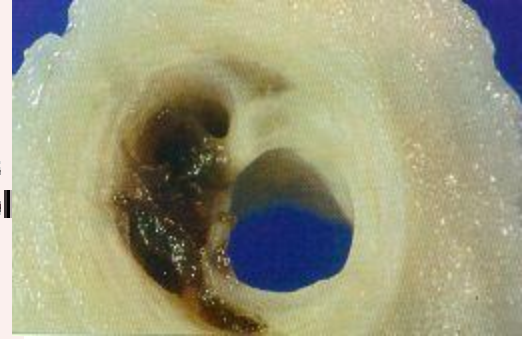
Role in disease
In conditions featuring elevated LDL, cholesterol molecules often promote atheroma plaque deposits in the walls of arteries, a condition known as atherosclerosis, which is a major contributor to coronary heart disease and other forms of cardiovascular disease. However, as today's testing methods determine LDL ("bad") and HDL ("good") cholesterol separetely, this simplistic view has become somewhat outdated. The desirable LDL level is considered to be 75-130 mg/dl (1.9-3.3 mmol/L), and a ratio of total cholesterol to HDL—arguably the most useful measure—of less than 5:1 is thought to be healthy. Increasing clinical evidence has strongly supported the greater predictive value of still more sophistical testing which directly measures both LDL and HDL particle concentrations and size as opposed to the more usual estimates or measures of the total cholesterol within LDL particles or the total HDL concentration. The real key is cholesterol transport which is determined by both the proteins which form the lipoprotein particles and the proteins on cell curfaces with which they interact.



http://www.prevention.ch/cholesterol.htm

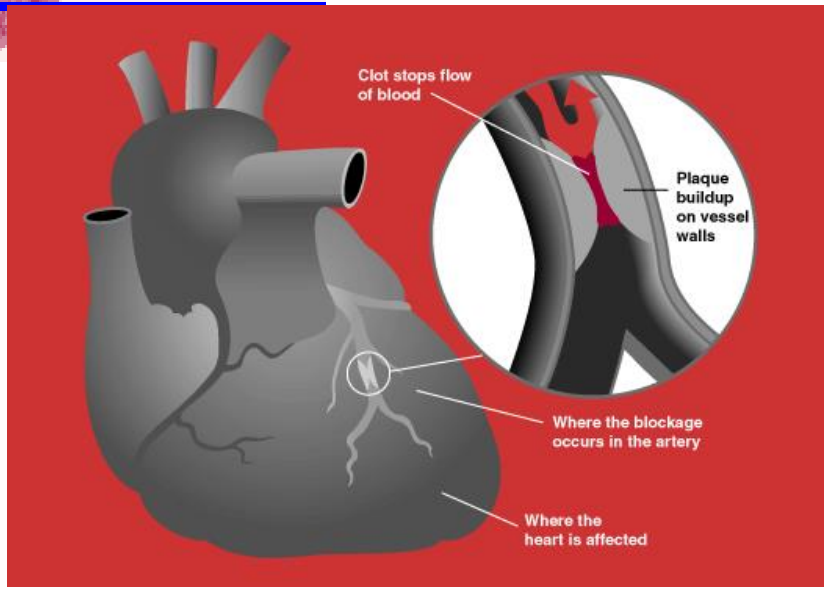


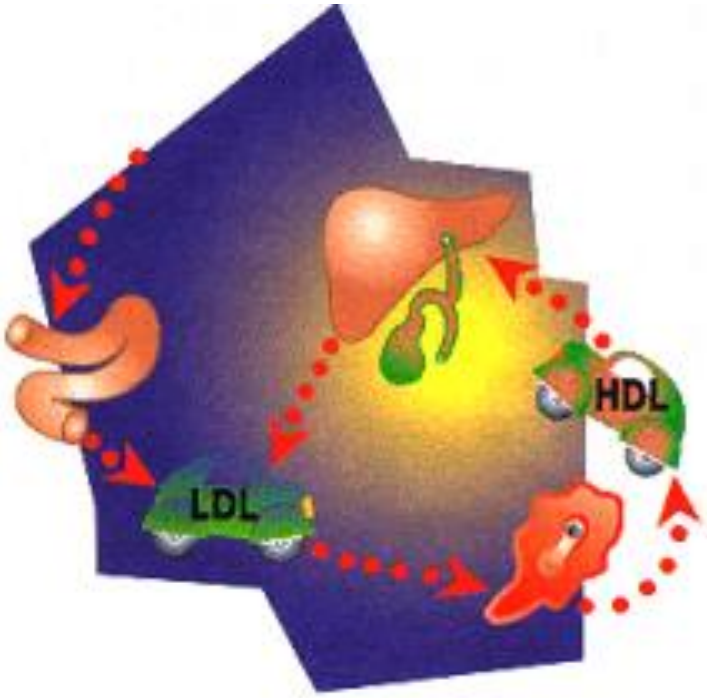
http://www.dhea-sante.com



ARTERIOSCLEROSE

http://www.tusalud.com.mx/





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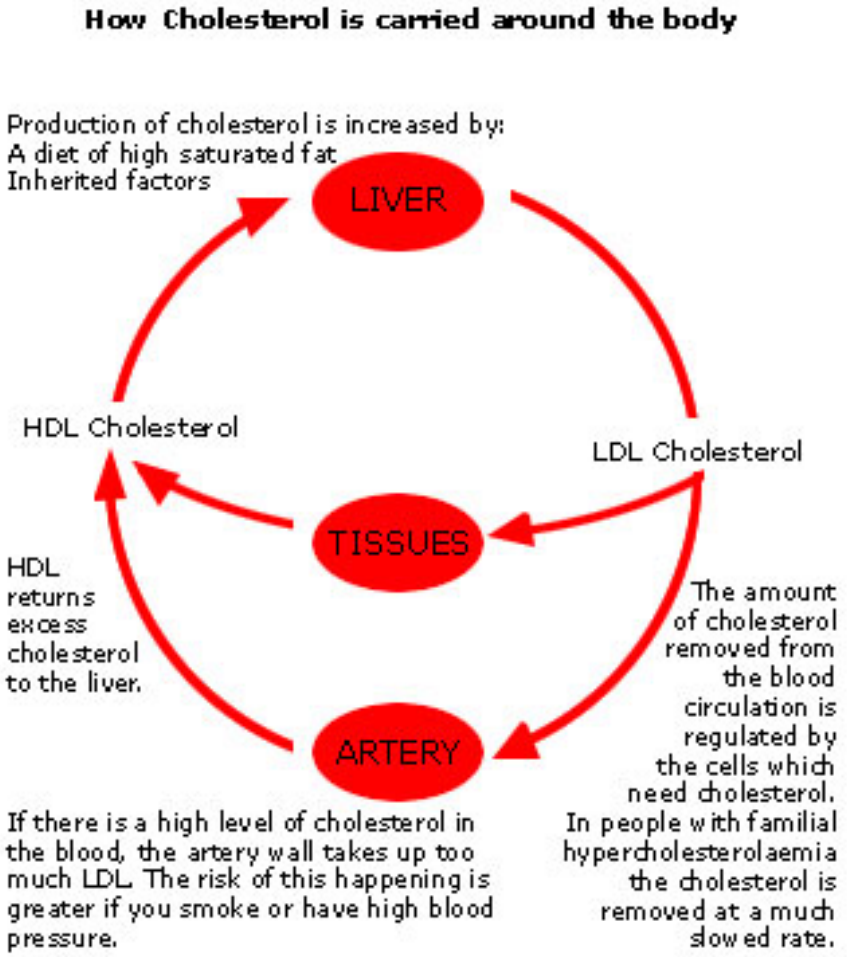


Lipoproteins

There are two main forms of lipoproteins.

• Low density lipoproteins (LDL), which carry cholesterol from the liver to the cells.

• High density lipoproteins (HDL), which return the extra cholesterol that isn't needed to the liver.

Blood lipids

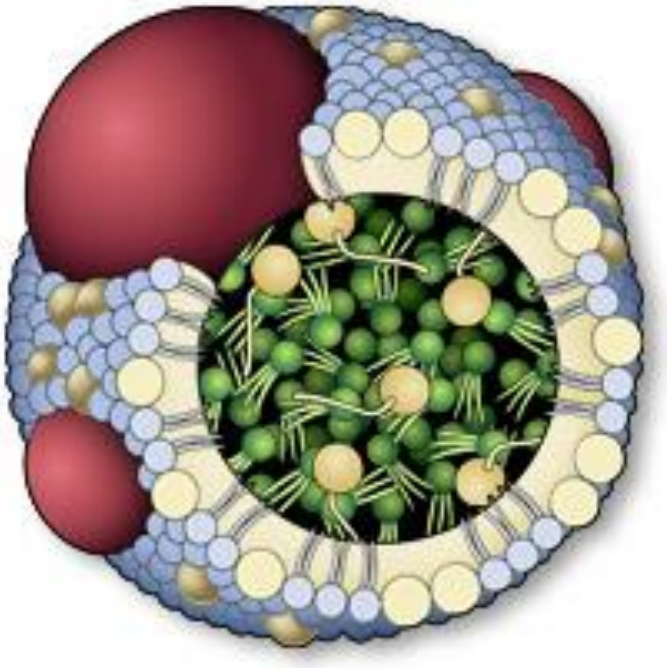
You may also have heard the term 'blood lipids'. This is a name for all the fatty substances in the blood, including HDL cholesterol, LDL cholesterol and triglycerides.

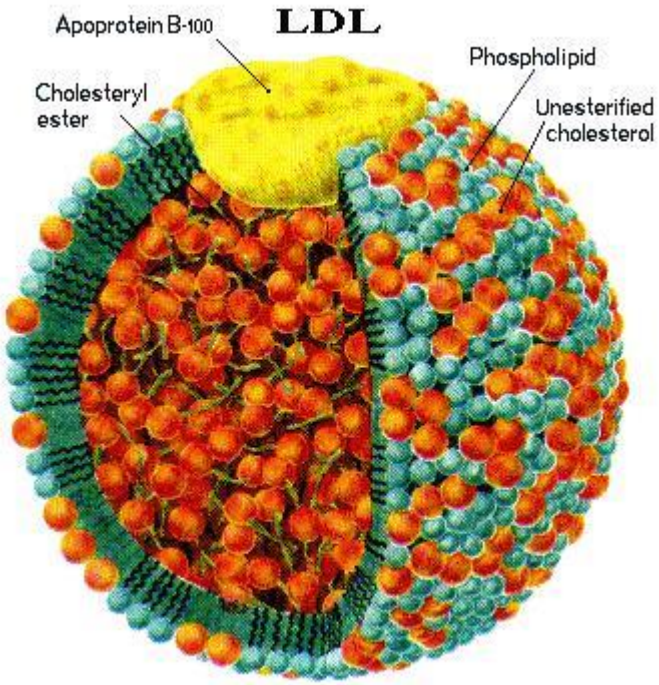
If you have high levels of both triglycerides and blood cholesterol, you run a greater risk of coronary heart disease. The risk is particularly high if you also have a low level of HDL cholesterol and a high level of LDL cholesterol. (See illustration). A high level of triglycerides also increases the risk of coronary heart disease and stroke.

Lipoprotein classification

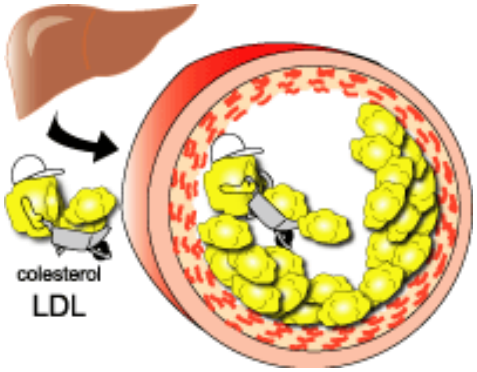
Lipoprotein	full name	density
VLDL	very low density lipoprotein	<1.006 g/ml
LDL	low density lipoprotein	1.006-1.062 g/ml
HDL	high density lipoprotein	1.063-1.20 g/ml
VHDL	very high density lipoprotein	>1.20 g/ml

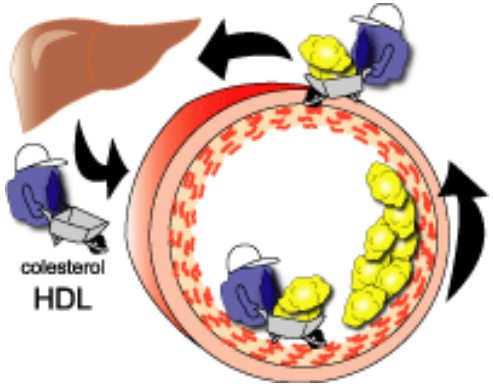
HDL

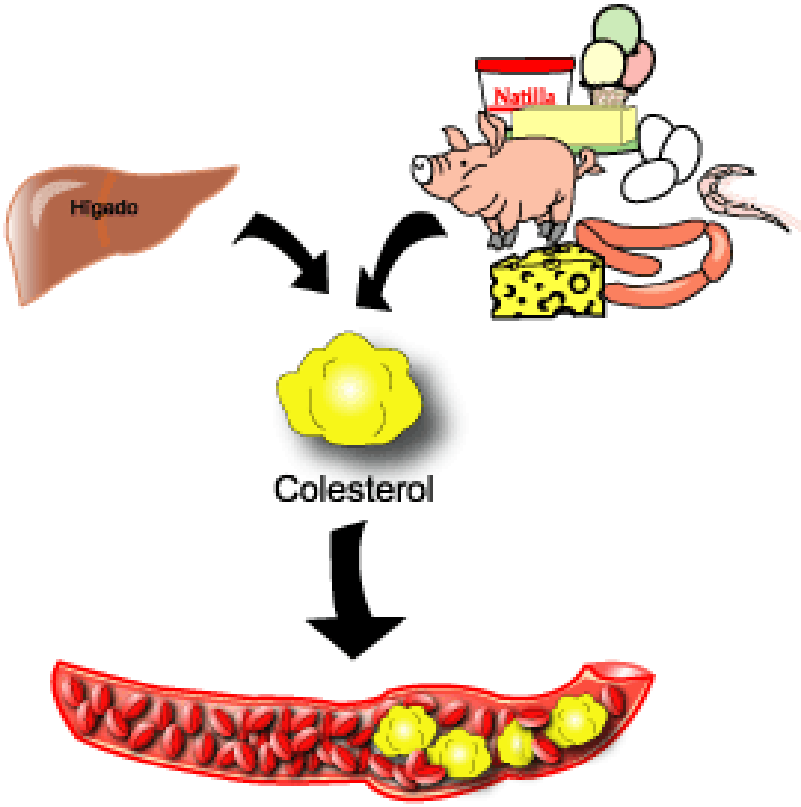




http://wichita.kumc.edu/edtech/medill.html

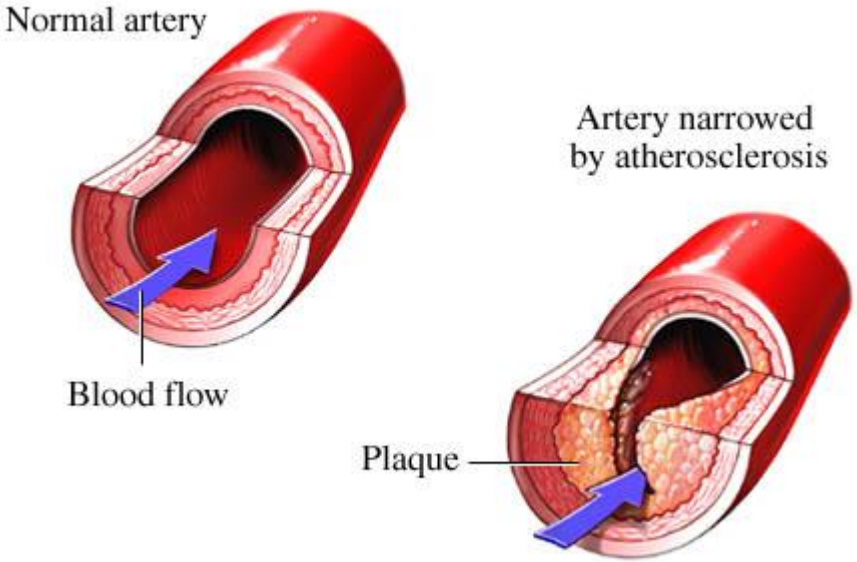




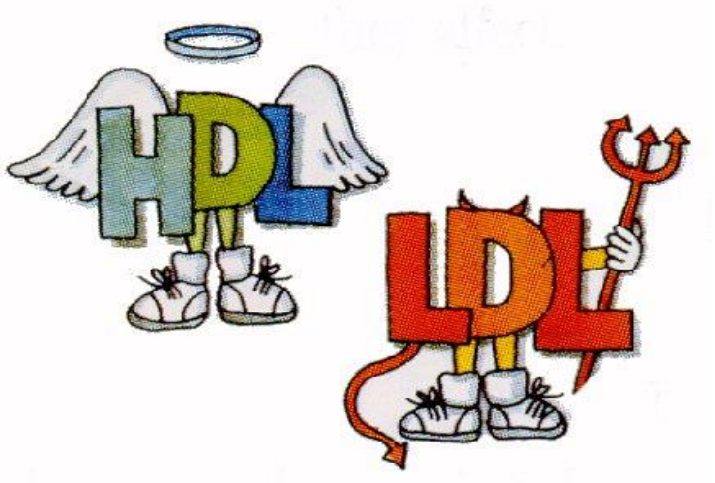


http://www.medicosdeoriente.com.ve

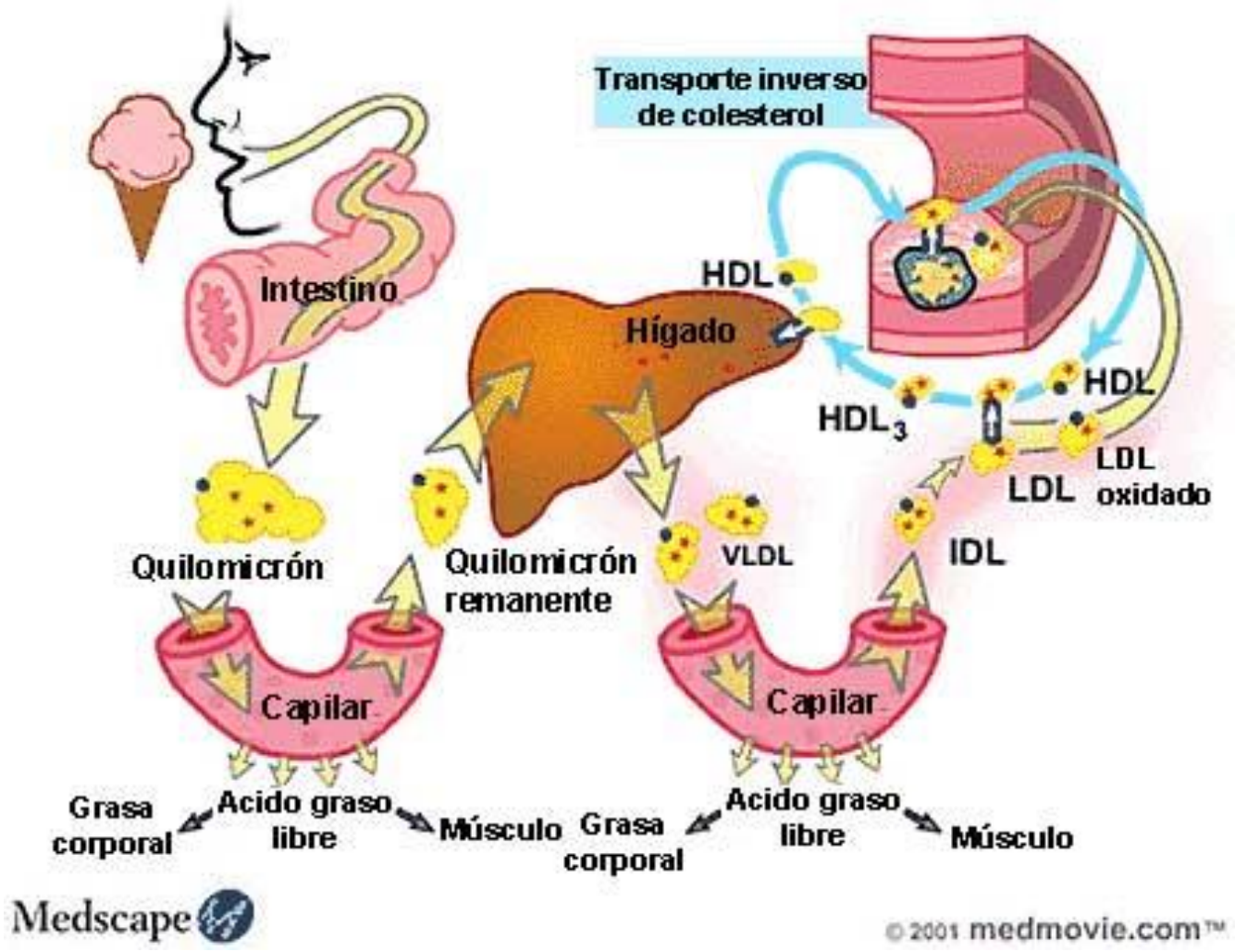
http://www.nutricion.co.cr/paginas/rincon_nutric/colesterol/colesterol.htm



http://www.virtualsciencefair.org

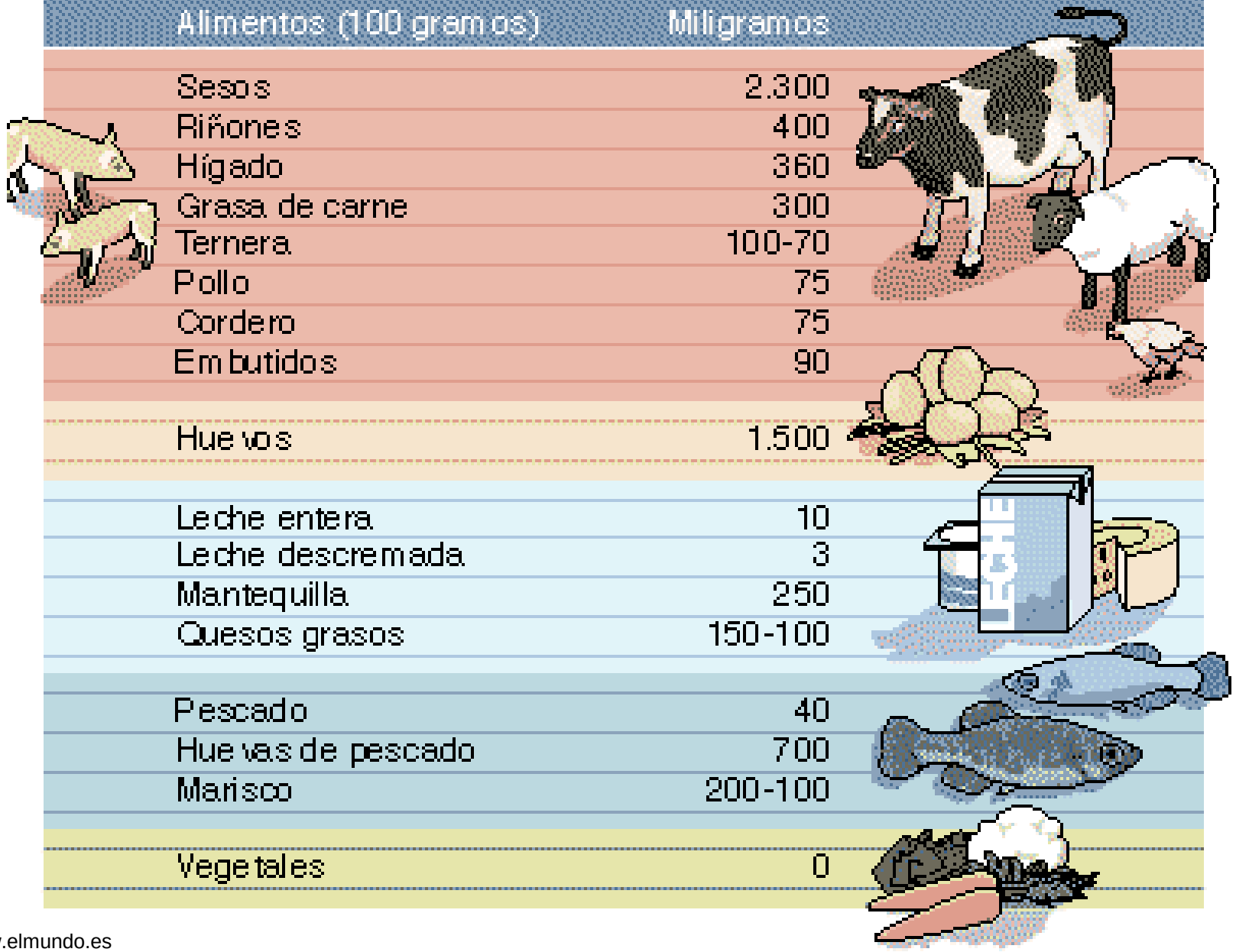


http://www.calmainefoods.com/eggsgoodhealth.htm


Transporte inverso de colesterol
Intestino
HDL
Hígado
HDL
HDL3
LDL
LDL oxidado
Quilomicrón
Quilomicrón remanente
VLDL
IDL
Capilar
Capilar
Grasa corporal
Acido graso libre
Músculo
Grasa corporal
Acido graso libre
Músculo
Medscape
© 2001 medmovie.com™

Colesterol contenido en alimentos de uso corriente

Alimentos (100 gramos)	Miligramos
Sesos	2.300
Riñones	400
Hígado	360
Grasa de carne	300
Ternera	100-70
Pollo	75
Cordero	75
Embutidos	90
Huevos	1.500
Leche entera	10
Leche descremada	3
Mantequilla	250
Quesos grasos	150-100
Pescado	40
Huevas de pescado	700
Marisco	200-100
Vegetales	0



http://www.elmundo.es

NORMA PORTUGUESA

NP 964
1988

Gorduras e óleos comestíveis
Obtenção

Graisses et huiles comestibles
Obtention

Edible fats and oils
Obtention

CDU
665.2/665.3

Descritores
Gorduras; óleos comestíveis; extracção; definições; especificações do processo

Correspondência

Homologação
Diário da República, III Série, N.º 110, de 1988-05-12

A presente Norma resultou da revisão da NP 964(1980)
Gr 4 **Elaborado por**
CT39 (IQA)

Edição
Outubro de 1988

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Telex 12522 QUALIT P
Telefax (01) 53 33 33

3. Definições

3.1. Gordura - Substância constituída principalmente por ésteres de ácidos gordos e glicerol, ou seja, os glicéridos (triglicéridos, diglicéridos e monoglicéridos).

3.2. Óleo - Gordura líquida à temperatura de 20°C.

3.3. Gordura e óleo naturais - Gordura e óleo provenientes de reserva nutritiva de seres vivos constituída por uma mistura complexa de triglicéridos, que tem dissolvidos, geralmente em pequenas quantidades, outros lípidos, como diglicéridos, monoglicéridos e fosfatídios, os ácidos gordos libertados pela hidrólise e também diversas substâncias insaponificáveis.

3.4. Gordura e óleos comestíveis - Gordura e óleo naturais utilizáveis como género alimentício.

3.5. Extracção - Processo para retirar a gordura ou óleo da matéria-prima onde se contêm.

3.6. Depuração - Processo para separar impurezas insolúveis ou em suspensão na gordura ou no óleo.

3.7. Fraccionamento - Processo para separar glicéridos de diversas temperaturas de solidificação, da gordura ou do óleo, bem como ceras e certas substâncias insaponificáveis.

3.8. Refinação - Processo para purificar ou beneficiar uma gordura ou um óleo separando impurezas lipossolúveis e componentes indesejáveis, sem, contudo, provocar considerável modificação molecular e de estrutura glicerídica.

3.9. Hidrogenação - Saturação pelo hidrogénio de duplas ligações livres dos radicais de ácidos gordos insaturados nas moléculas dos glicéridos.

3.10. Interesterificação - Permuta de radicais de ácidos gordos nas moléculas dos glicéridos, processada numa só gordura ou num só óleo.

3.11. Transesterificação - Permuta de radicais de ácidos gordos nas moléculas dos glicéridos processada numa mistura de gorduras ou óleos.

5. Processos de obtenção

Os processos admitidos na obtenção das gorduras e dos óleos comestíveis são os seguintes: extracção, depuração, fraccionamento, refinação e também, em certos casos, a modificação molecular e de estrutura glicerídica mediante hidrogenação, interesterificação ou transesterificação.

Todas as operações devem decorrer a temperaturas que não alterem a gordura ou o óleo, utilizando-se, quando necessário, pressão reduzida.

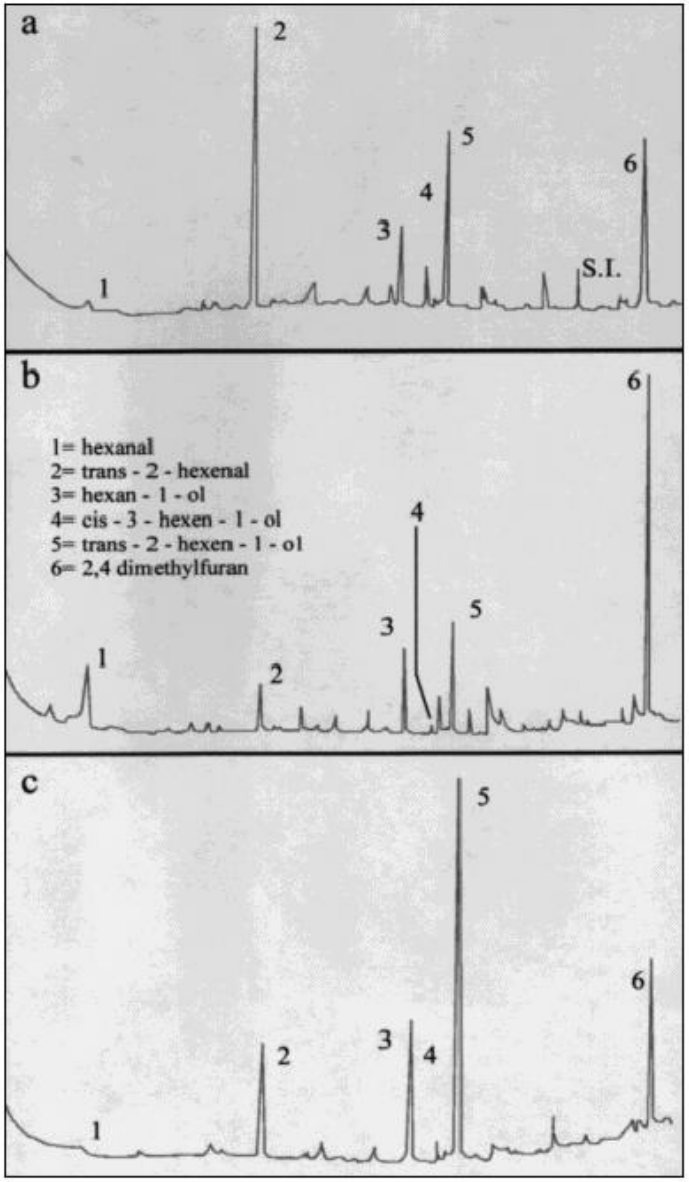
5.1. A extracção efectua-se apenas por processos físicos, mediante fusão, acção mecânica, tensão superficial ou dissolução.

5.2. A depuração efectua-se, uma ou mais vezes, durante a obtenção, mediante operações de decantação, lavagem, filtração, centrifugação e desmucilaginização.

5.3. O fraccionamento efectua-se por operações de arrefecimento ou aquecimento a determinadas temperaturas e por cristalização fraccionada em dissolvente apropriado. Pode dar, ou não, lugar a transformação da gordura ou óleo.

5.4. A refinação efectua-se mediante operações de neutralização dos ácidos gordos livres com soluções alcalinas ou de separação desses ácidos por destilação em ambiente rarefeito, bem como de descoloração com adsorventes inócuos e de desodorização pela passagem do vapor de água em ambiente rarefeito.

5.5. A modificação molecular e de estrutura glicerídica, com subsequente eliminação do catalisador utilizado, tem lugar, apenas, na obtenção de gorduras transformadas mediante operações do processo de hidrogenação, bem como de interesterificação ou de transesterificação, mas nunca por esterificação em que haja adição de glicerol ou de outros álcoois.

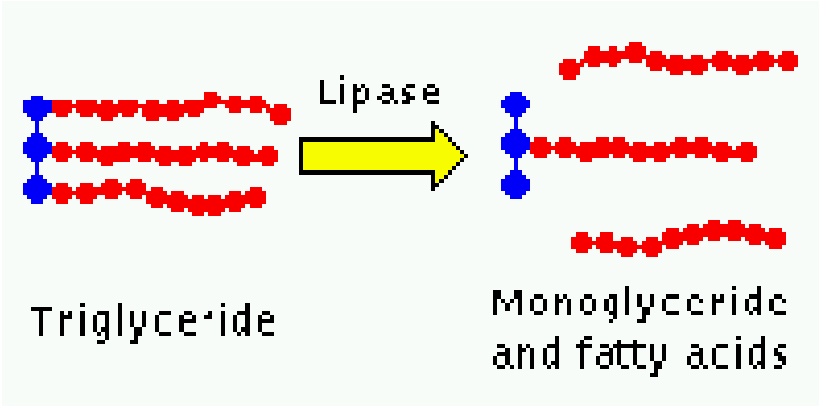


Kiritsakis (2006)

Figure 2: Gas chromatography mass spectroscopy analysis of the flavor components of three samples of olive oil (a: fruity flavor, b and c: with defects) (Tateo et al., 1993).

ALTERAÇÕES NOS ÓLEOS E GORDURAS

-Hidrólise



-Oxidação

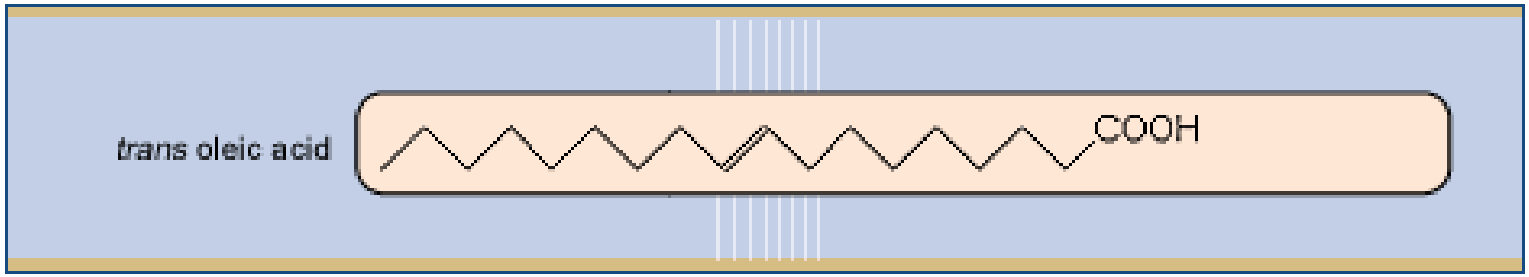
-Reversão do *flavour*

PROCESSAMENTO DOS ÓLEOS

Refinação	Neutralização Branqueamento desodorização
Modificação	Hidrogenação Interesterificação Fraccionamento

•**Hydrogenated fats** - During hydrogenation, hydrogen atoms are added back to polyunsaturated or monounsaturated fats to protect against rancidity from bacteria or air exposure. As a consequence, this process causes hydrogenated fats to become saturated fats. If a food label states the words **partially hydrogenated oils** among its first ingredients, that means that it contains a lot of trans-fatty acids and saturated fats.

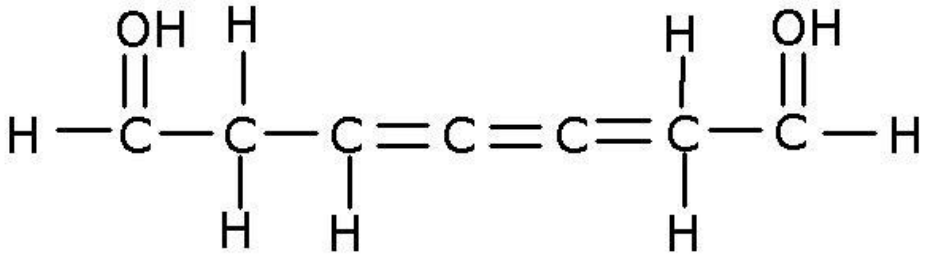
•**Trans-fatty acids** - In nature, most unsaturated fats are cis-fatty acids. During hydrogenation, the molecular structure changes from cis- to trans-fatty acids. These fats increase LDL levels and decrease HDL levels, which may increase your risk of heart disease.


trans oleic acid
COOH

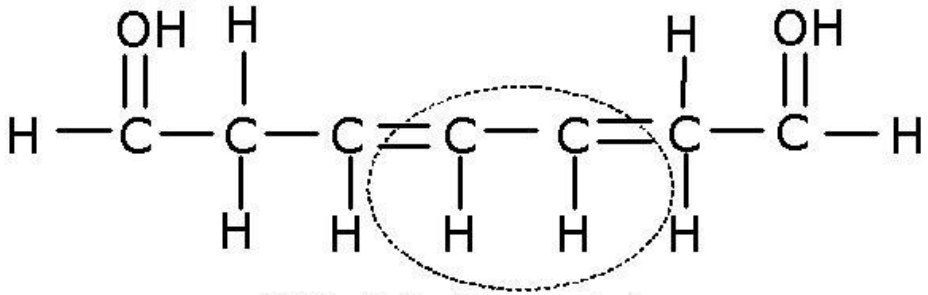

TRANS
FATS


OIL
HYDROGEN
MARGARINE

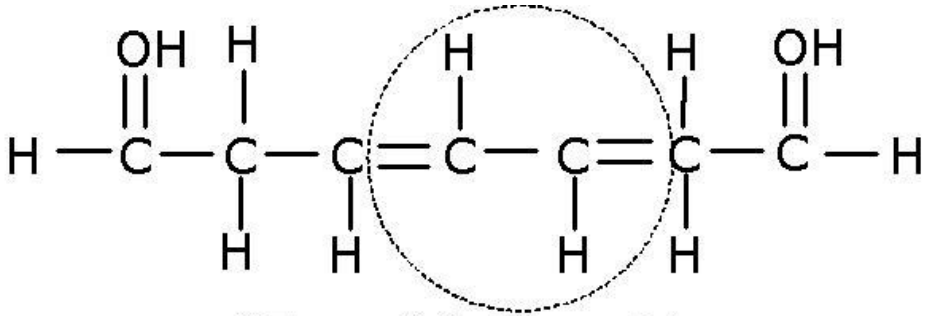
http://www.natural-health-information-centre.com/trans-fats.html



Polyunsaturated fatty acid



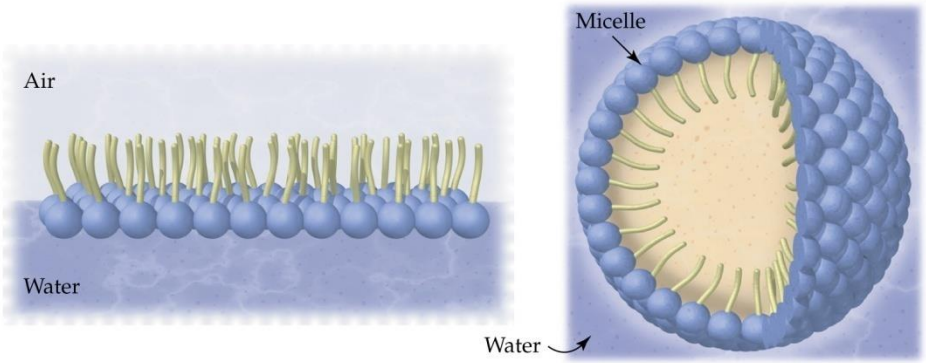
"Cis" fatty acid

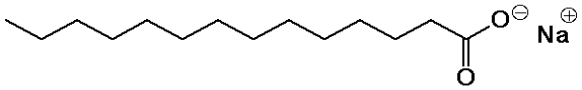


"Trans" fatty acid

Referências bibliográficas

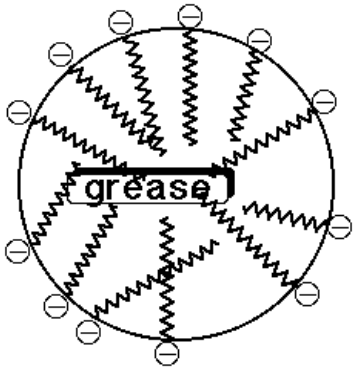
Composition of olive oil and its nutritional and health effect
Apostolos K. Kiritsakis In: http://www.regional.org.au (22/10/2006)

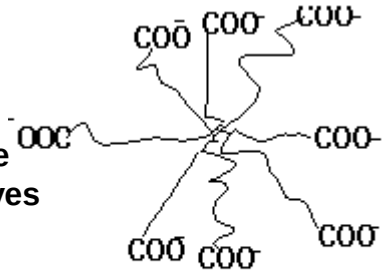




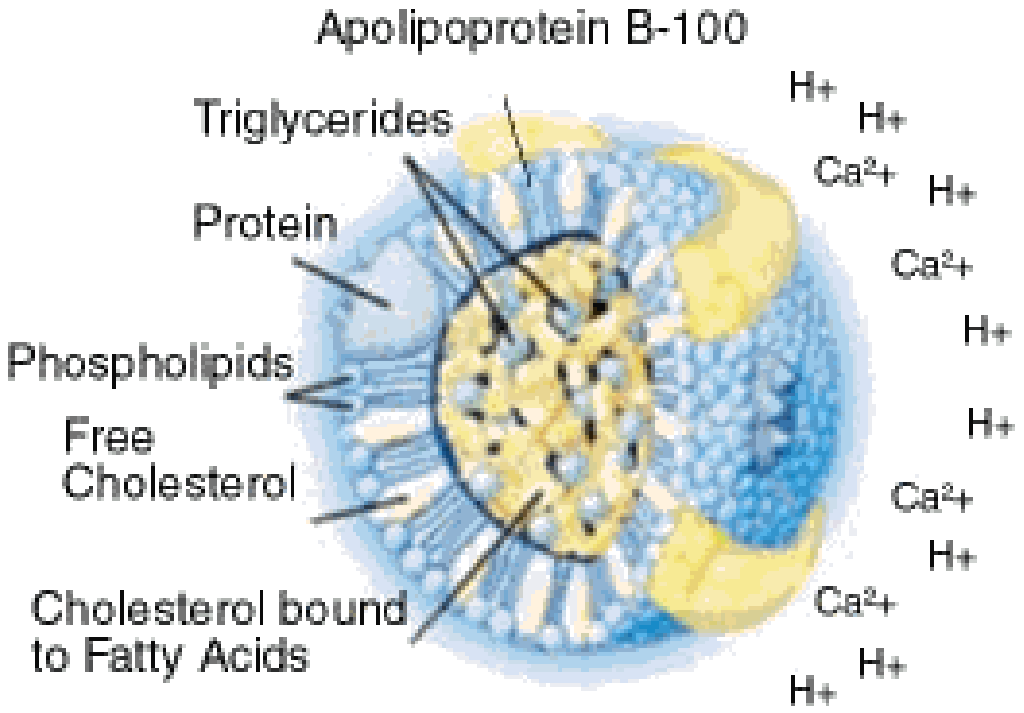
•basic hydrolysis of fats (saponification) generates soaps (the sodium salts of fatty acids)

•the ionic head group is water-soluble, the nonpolar tail insoluble
•soaps tend to aggregate in micelles, where nonpolar dirt dissolves



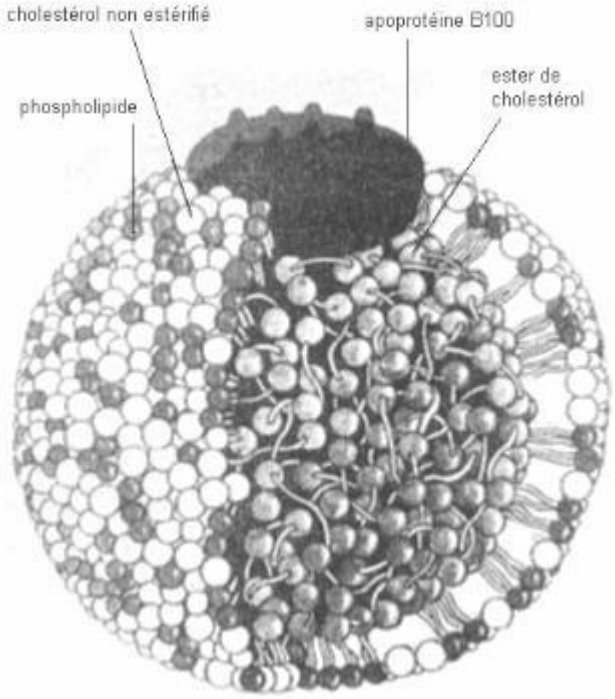


A Micelle (Soap)



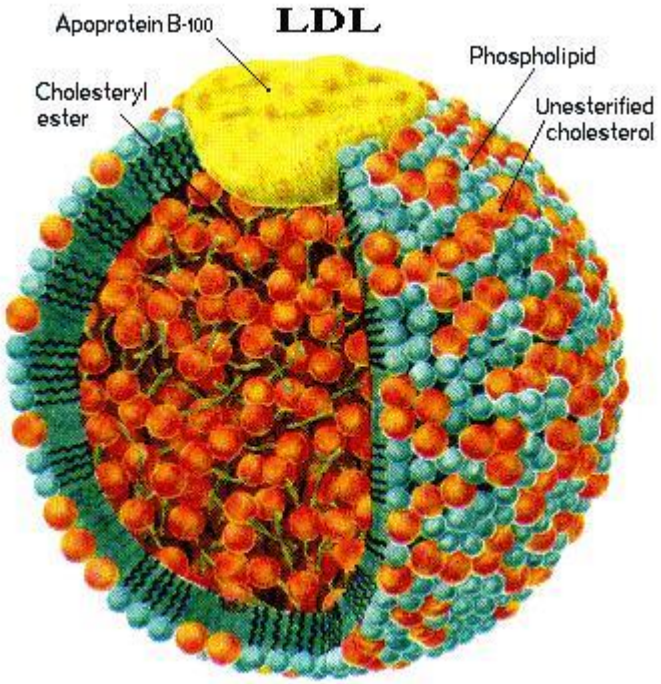
http://www.souzaoenterprises.com/LDLCholesterolMolecule.gif

http://www.coe.drexel.edu/ret/images/biotech/LDL.png



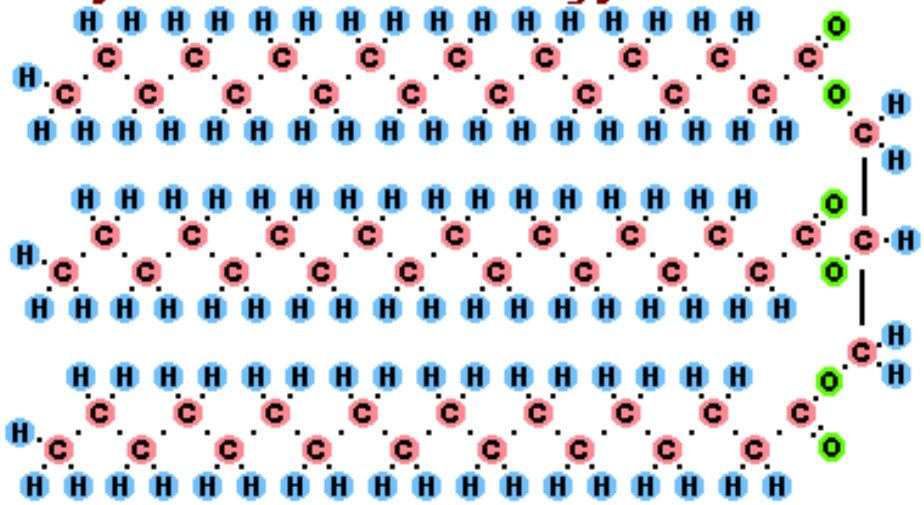
Modèle d'une LDL, d'après M. Brown et J. Goldstein

http://fderad.club.fr/atherome.htm

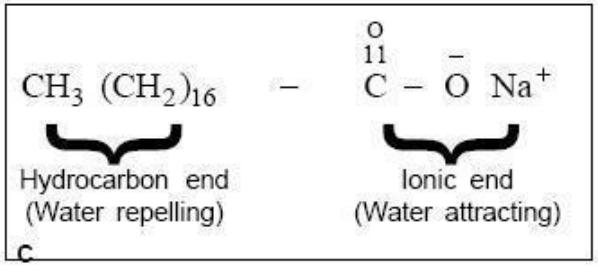


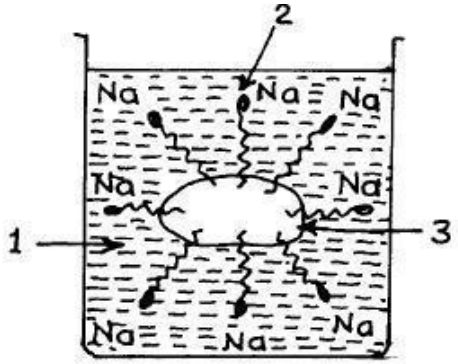
Triglyceride

A molecule of fat or oil. It consists of 3 free-swinging fatty acid molecules hooked to a glycerol backbone.



H Hydrogen
C Carbon
Na Sodium
O Oxygen





1. water 2. soap molecule 3. Dirt

http://en.wikipedia.org/wiki/Make_your_own_soap