

Marine lecithin : interest in vectorisation of biofunctional molecules

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Summary

- I • Reminder and definitions
- II • Interest of lecithin
- III • Specificity of marine lecithin
- IV • Lecithin and biofunctional molecules
- V • Perspectives

I- Reminder and definitions



**Theodore Nicolas
Gobley**

Born in Paris on May
11th, 1811 and died on
September **1st, 1876**

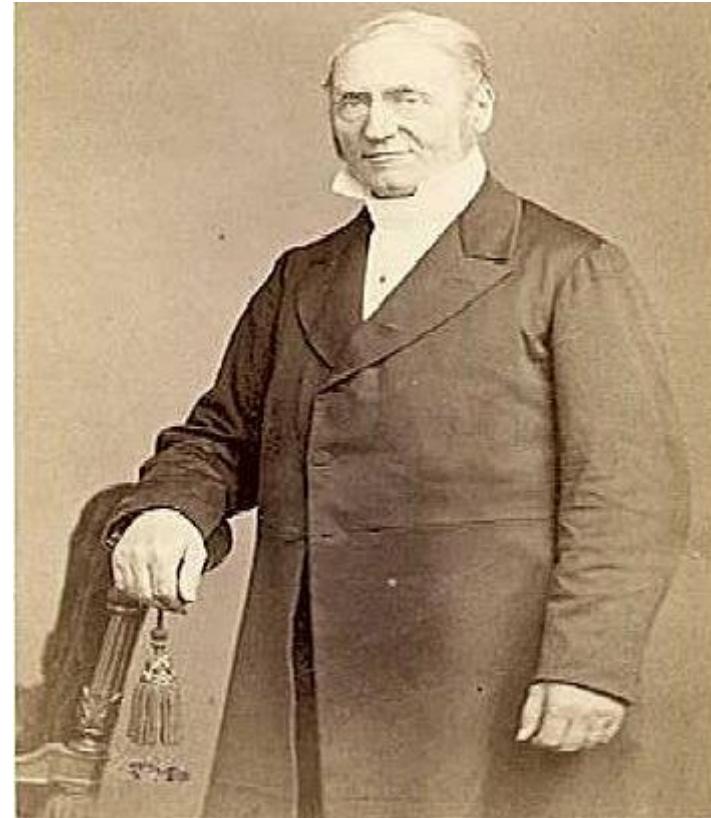
I- Reminder and definitions

In 1847:

Theodore Nicolas Gobley
(French chemist and pharmacist)
discovers the lecithin

In 1874:

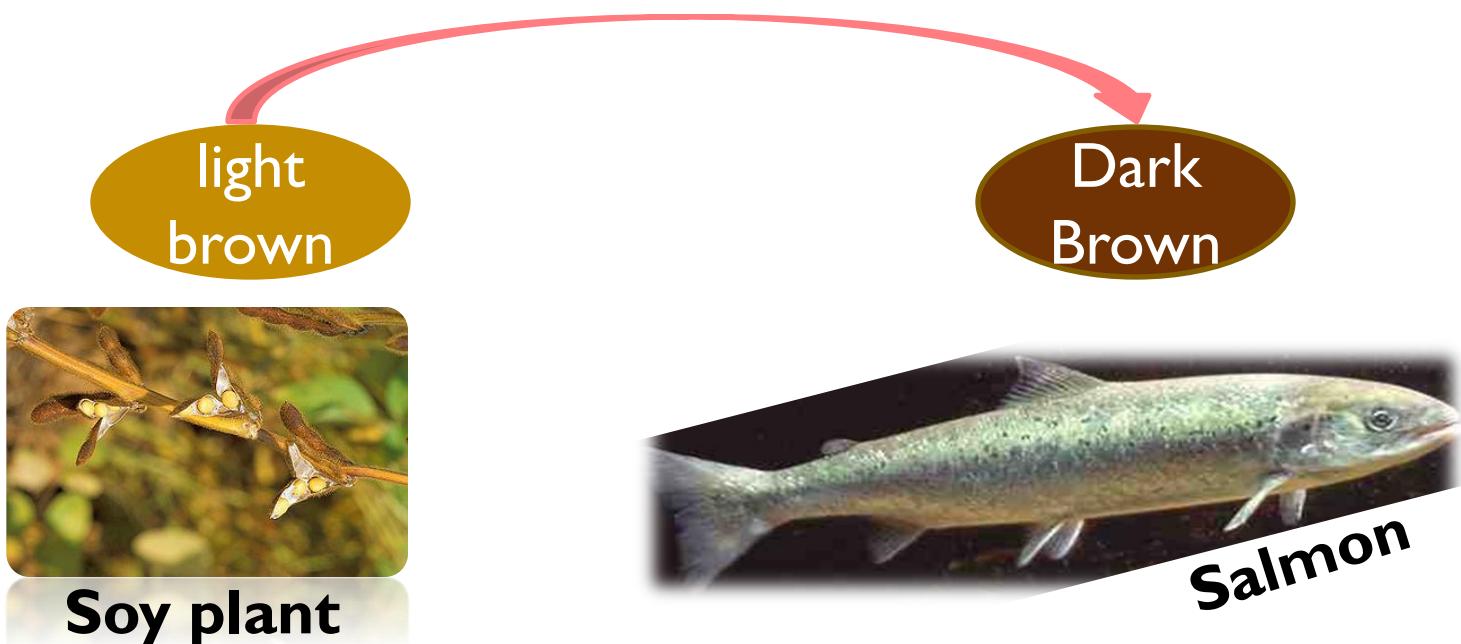
he had demonstrated the presence of lecithin in venous blood, bile, and human brain



I- Reminder and definitions

Lecithin or Lekithos in Greek means egg yolk

It has different colors depending on its fatty acid composition.

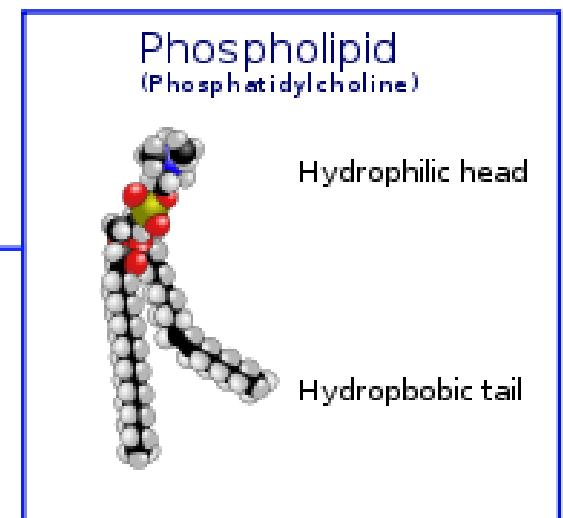
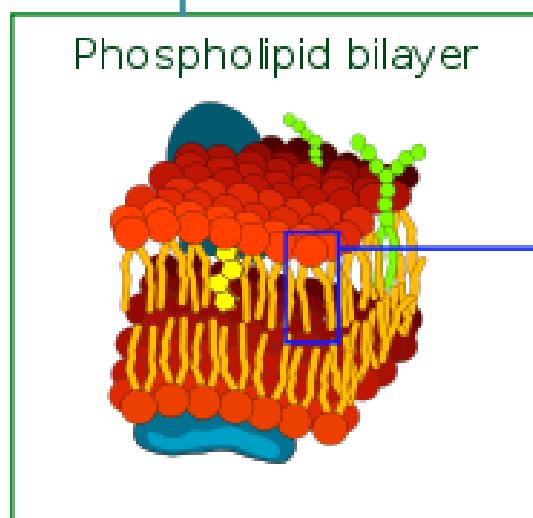
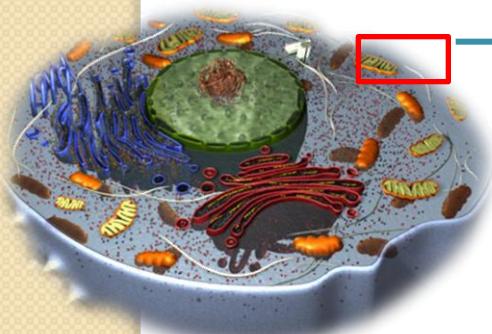


I- Reminder and definitions

Lecithin is :

A phospholipid compound

An important phospholipid needed by all living cells



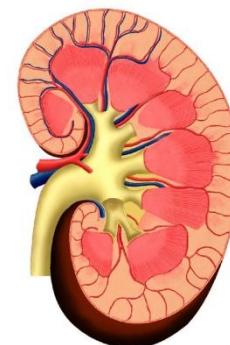
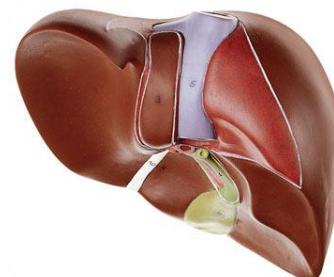
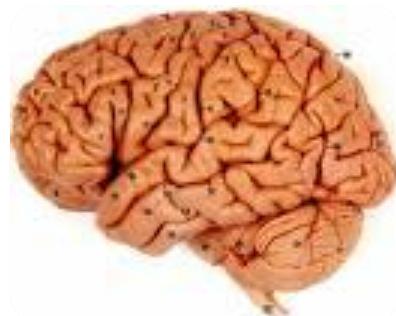
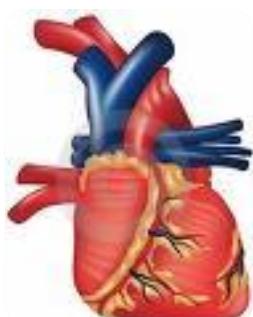
I- Reminder and definitions

Lecithin is :

Produced within our own body

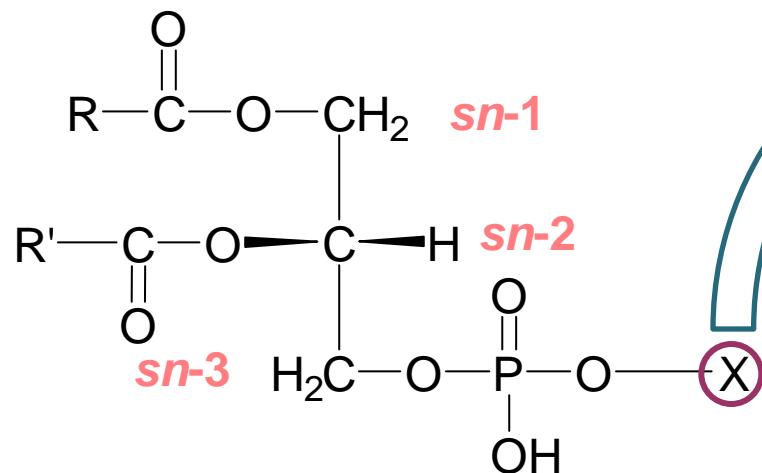
Can be found in the major organs: the heart, the brain, the liver, and the kidneys

Contributes to maintain our overall health.

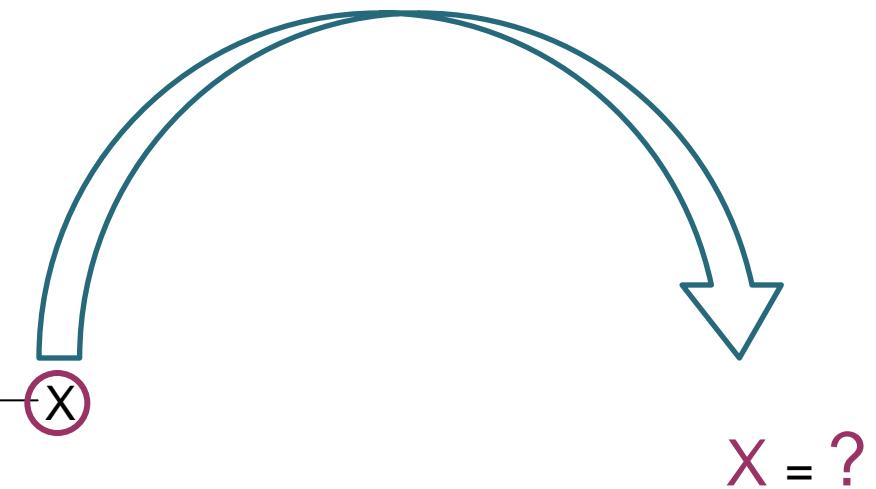


I- Reminder and definitions

Composition of lecithin:



Chemical skeleton
of lecithin



PC: phosphatidylcholine

PE: phosphatidylethanolamine

PI: phosphatidylinositol

PS: phosphatidylserine

Sph: Sphingomyelin

I- Reminder and definitions

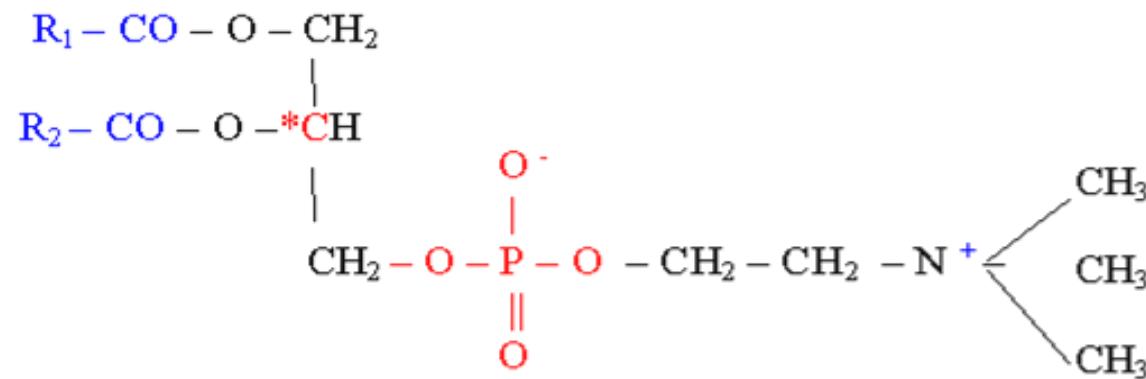
Phosphatidylcholine

Is also named lecithin

Occurs in all cellular organisms

One of the major components of the phospholipid portion of the cell membrane

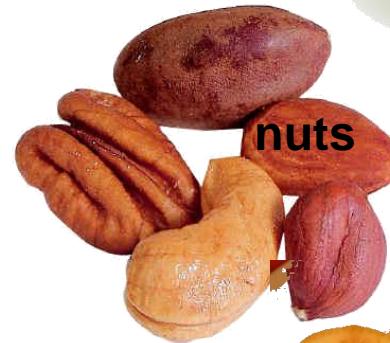
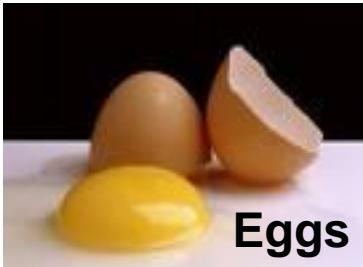
Dominant specie in lecithin mixture



Chemical structure of PC

I- Reminder and definitions

Sources of Lecithin :



II- Interest of lecithins

II - 1 Health benefits

Production of energy in cells (ATP)

Polarization of cell membranes

The transmission of nervous energy

Transport of cholesterol and triglycerides

Solubilization of fats to facilitate their passage through the
vascular walls

un esprit sain dans un corps sain



II- Interest of lecithins

II - 1 Health benefits

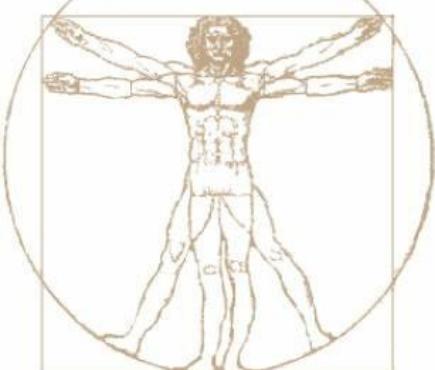
Prevents the deposit of fats in the arteries

Emulsifying fats in the blood, bile and in digestive tract

Promotes by emulsification, the absorption of fat soluble
vitamins like :

vitamin A, E, D, K and the omega 3 fatty acids

un esprit sain dans un corps sain



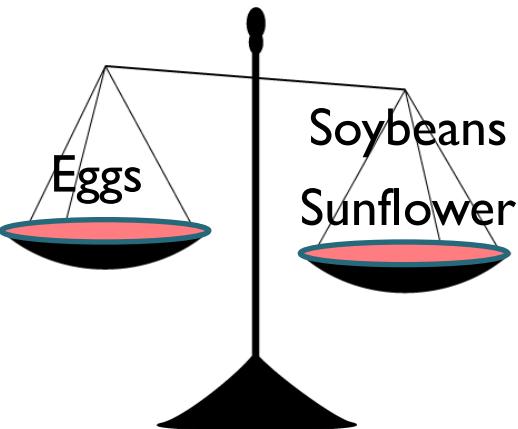
II- Interest of lecithins

II - 2 Food application

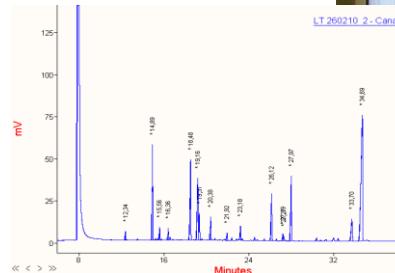
Sources of commercial lecithin



creamy products



chocolates
or candy bars



LIBio data



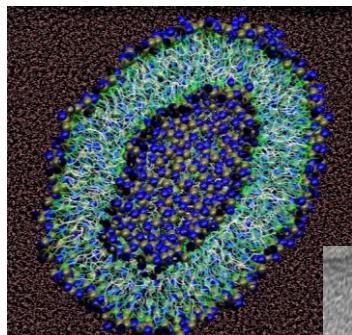
Fatty acids	Soy lecithin	Sun flower lecithin
C16	15.87 ± 0.12	11.06 ± 0.11
C18	3.45 ± 0.01	4.17 ± 0.02
C18 1 n-9t	23.373 ± 0.04	21.61 ± 0.01
C18 2n6	51.86 ± 0.10	63.15 ± 0.08
c18 3n3	5.44 ± 0.02	-



margarine

II- Interest of lecithins

II.3 - Cosmetic application



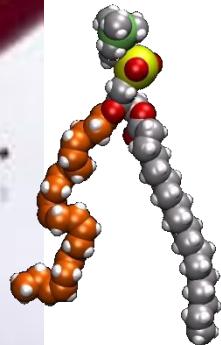
*Liposome
Modelised by Pascale Sautot in LIBio*



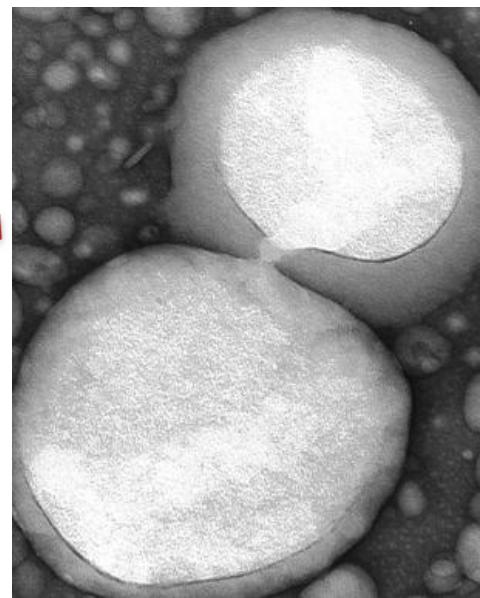
*Liposome
Observed by MET (MLV)
Nabila*



Lecithin



*Lecithin Modelised by
Pascale Sautot in LIBio*



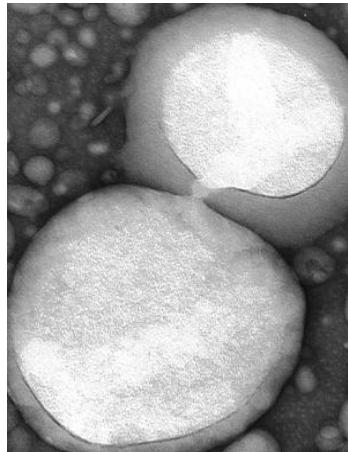
*Emulsion
Observed by MET
Nabila*

II- Interest of lecithins

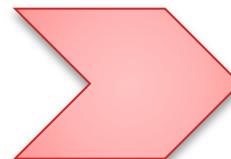
II.3 - Cosmetic application



Liposome



Emulsion



Essences, lotions
and creams

Liposome-containing cosmetics formulations

Encapsulation of hydrophobic active ingredients

Liposomes mimic biomembranes, so they have high affinity for the skin

II- Interest of lecithins

II.4 - Nutraceutical application



Nutraceutical term is the combination of nutrition and pharmaceutical

Originally defined by Dr. Stephen L. DeFelice
(Founder of the Foundation of Innovation Medicine (FIM))



II- Interest of lecithins

II.4 - Nutraceutical application



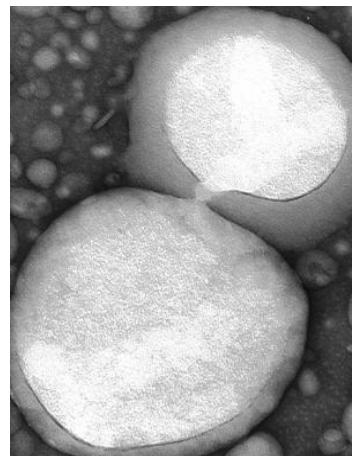
Examples:

Polyphenols like antioxydants
Carotenoids
Probiotics and prebiotics

} Fat soluble compounds



Liposome



Emulsion



Lecithin

II- Interest of lecithins

II.4 - Pharmaceutical application

Pharmaceutical formulations use emulsion/liposome system to deliver medicine.

Examples:

- Vaccines
- Liposoluble drugs (emulsion)
- Hydrophilic drugs (liposomes)



- Oral administration
- Injected formulations
- Creams and lotions

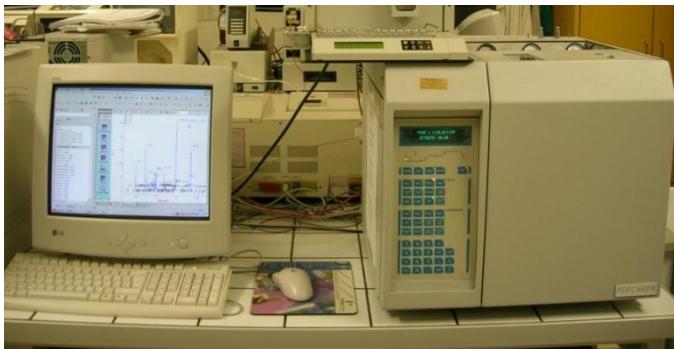


Soy lecithin is typically used

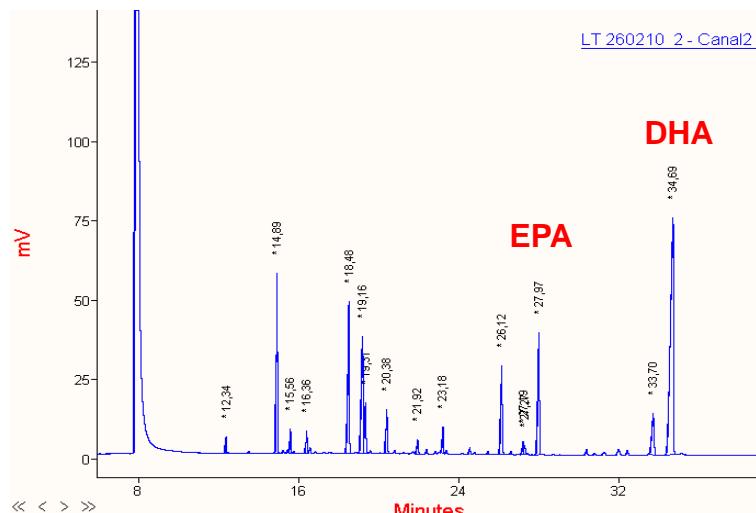


III- Specificity of marine lecithin

Fatty acids composition by GC



Lipid extracts were transesterified to FAME (BF₃ MeOH)



Fatty acids	Salmon lecithin	Soy lecithin
C14:0	1.60 ± 0.11	--
C16:0	12.70 ± 0.06	15.87 ± 0.12
C18:0	4.90 ± 0.05	3.45 ± 0.01
SFA	19.2	19.32
C16:1	3.21 ± 0.08	--
C18:1(n-9)	14.23 ± 0.35	23.37 ± 0.04
C18:1(n-7)	0.71 ± 0.03	--
C20:1(n-7)	1.69 ± 0.05	--
C20:1(n-9)	0.41 ± 0.02	--
MUFA	20.25	23.37
C18:2(n-6)	1.52 ± 0.08	51.86 ± 0.10
C18:3(n-3)	--	5.44 ± 0.02
C18:4(n-3)	0.61 ± 0.05	--
C20:4(n-6)	3.22 ± 0.10	--
C20:4(n-3)	1.14 ± 0.13	--
C20:5(n-3)	10.25 ± 0.12	--
C22:5(n-3)	2.94 ± 0.25	--
C22:6(n-3)	33.11 ± 0.35	--
PUFA	52.79	57.30
n-3/n-6	10.13	0.09
DHA/EPA	3.23	--

III- Specificity of marine lecithin



Salmon (*Salmo Salar*)



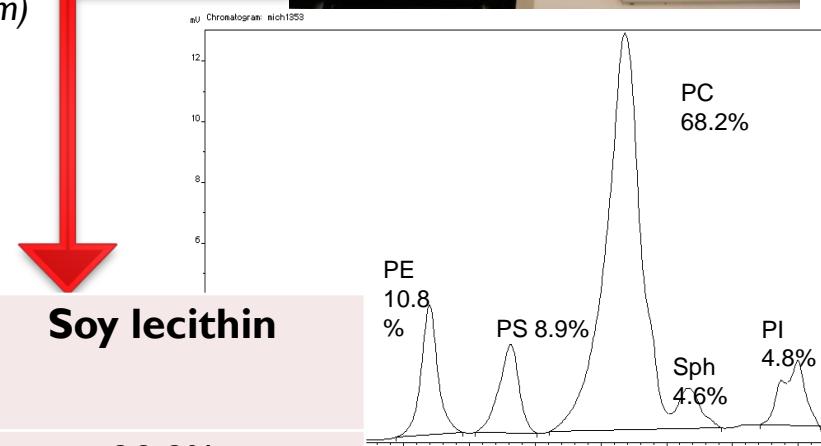
Vectomega
(Laboratoires Le Stum)



Iatroscan

Lipid classes were identified by Iatroscan

Phospholipids	Salmon lecithin	Soy lecithin
Phosphatidylcholines	68%	28.8%
phosphatidylethanolamines	11%	30.1%
phosphatidylinositols	5%	26%
phosphatidylserines	9%	-
Sphingomyelin	5%	-
Phosphatidic acid	-	13.7%



24/03/2010

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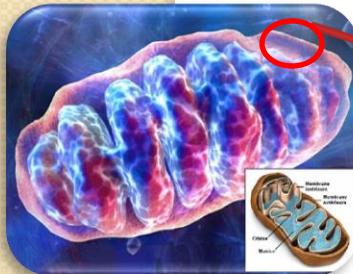
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IV- Lecithin and biofunctional molecules

IV.1 - Coenzyme Q10



**CoQ10 or
ubiquinone**



mitochondria

Vitamin-like substance

Found in small amounts in a wide variety of foods

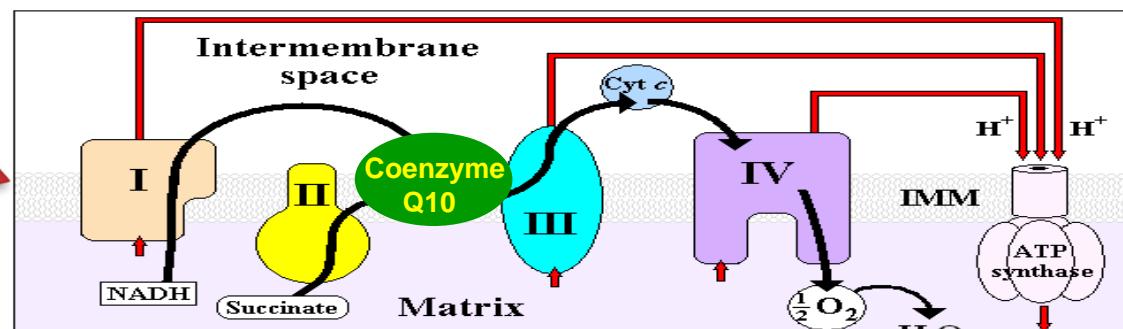
Generating energy in cells

Synthesized on the liver

Powerful antioxidant

Liposoluble compound

Provides the electron and proton transfer in the membrane of mitochondria

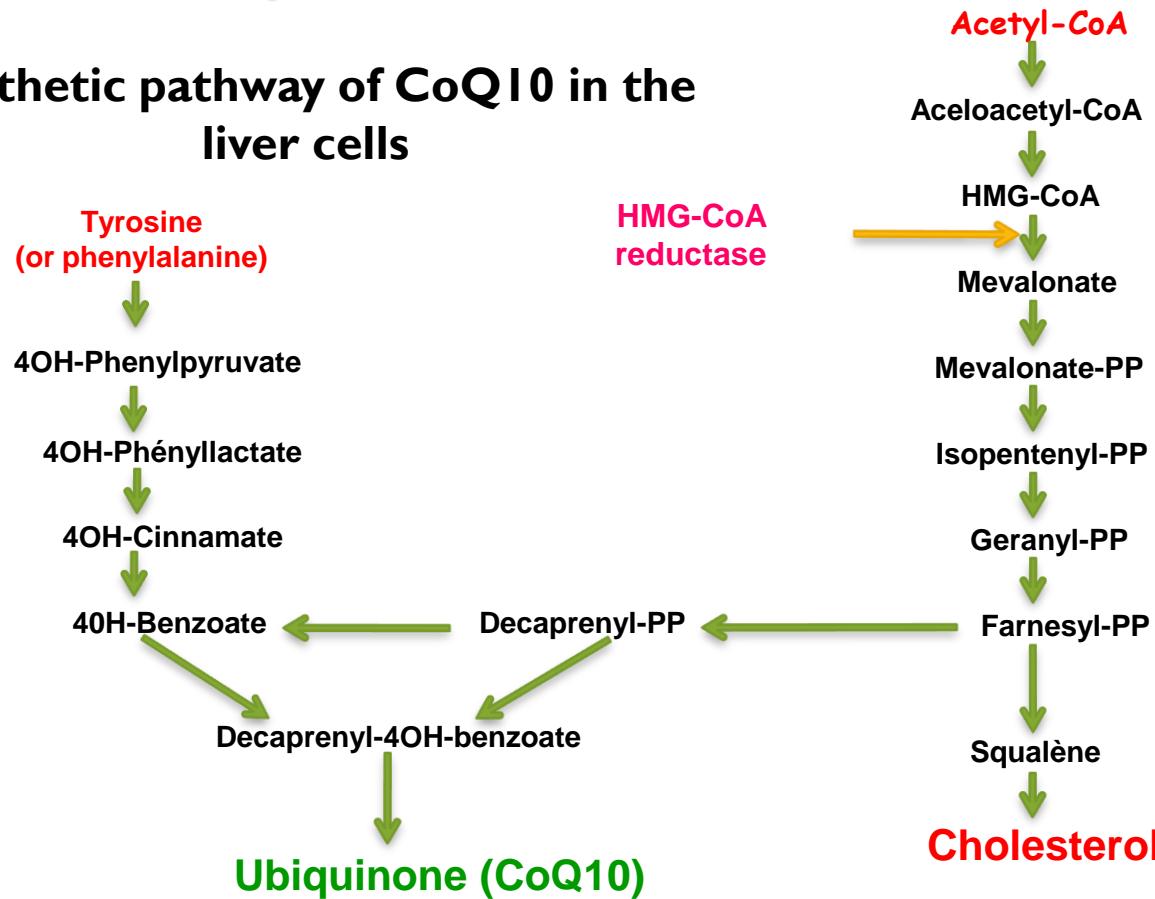


Electron transport chain in mitochondria

IV- Lecithin and biofunctional molecules

IV.1 - Coenzyme Q10

Synthetic pathway of CoQ10 in the liver cells



By reducing cholesterol synthesis (using **hydroxy-methyl-glutaryl-coenzyme A reductase** inhibitors) we block the production of coenzyme Q10.

IV- Lecithin and biofunctional molecules

IV.1 - Coenzyme Q10

**Increase the bioavailability
of CoQ10 using emulsions**



Preparation of emulsions:



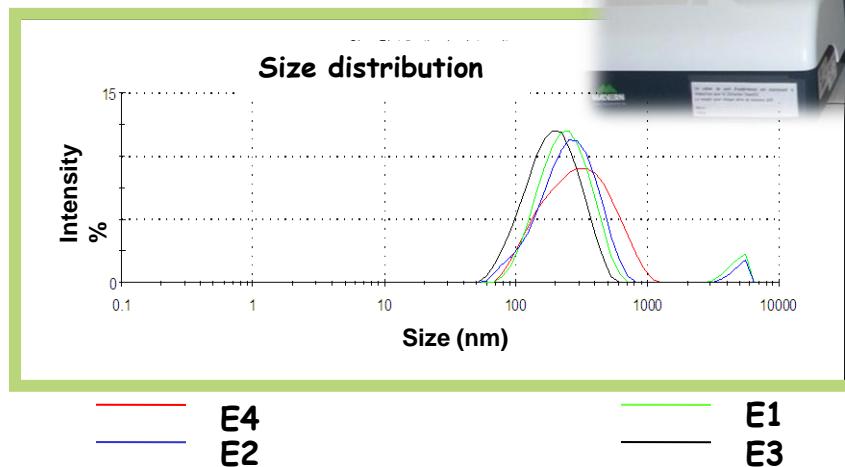
Extruder



Dynamic light scattering
Malvern Zetasizer
Nano ZS



Homogénéisateur
haute pression
(5 cycles/1500 bars)



sonication



French pressure

24/03/2010

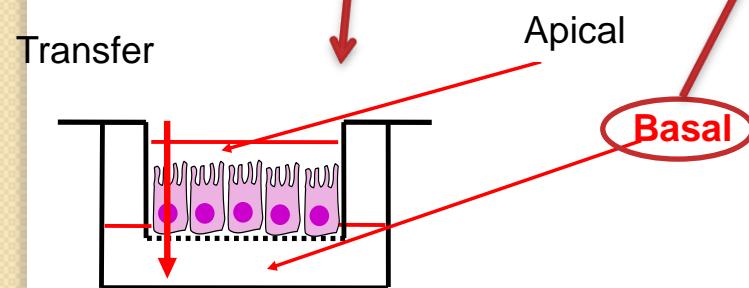
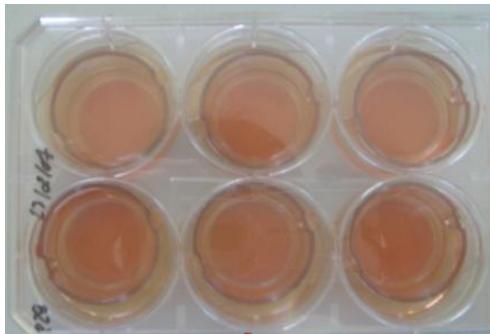
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IV- Lecithin and biofunctional molecules

IV.1 - Coenzyme Q10



CoQ10 in solvent

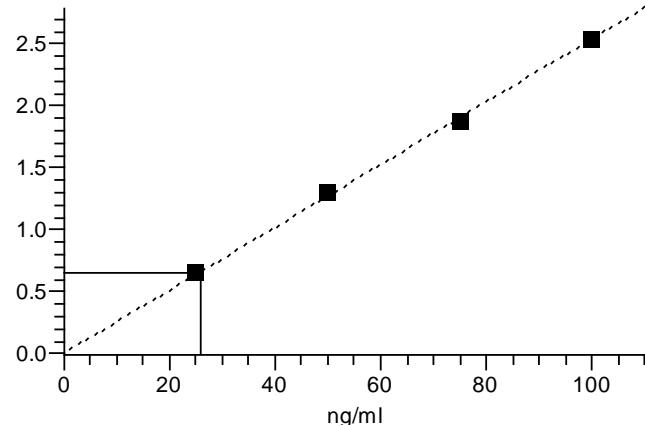


CoQ10 in emulsion



The basal solution was analysed by mass spectroscopy

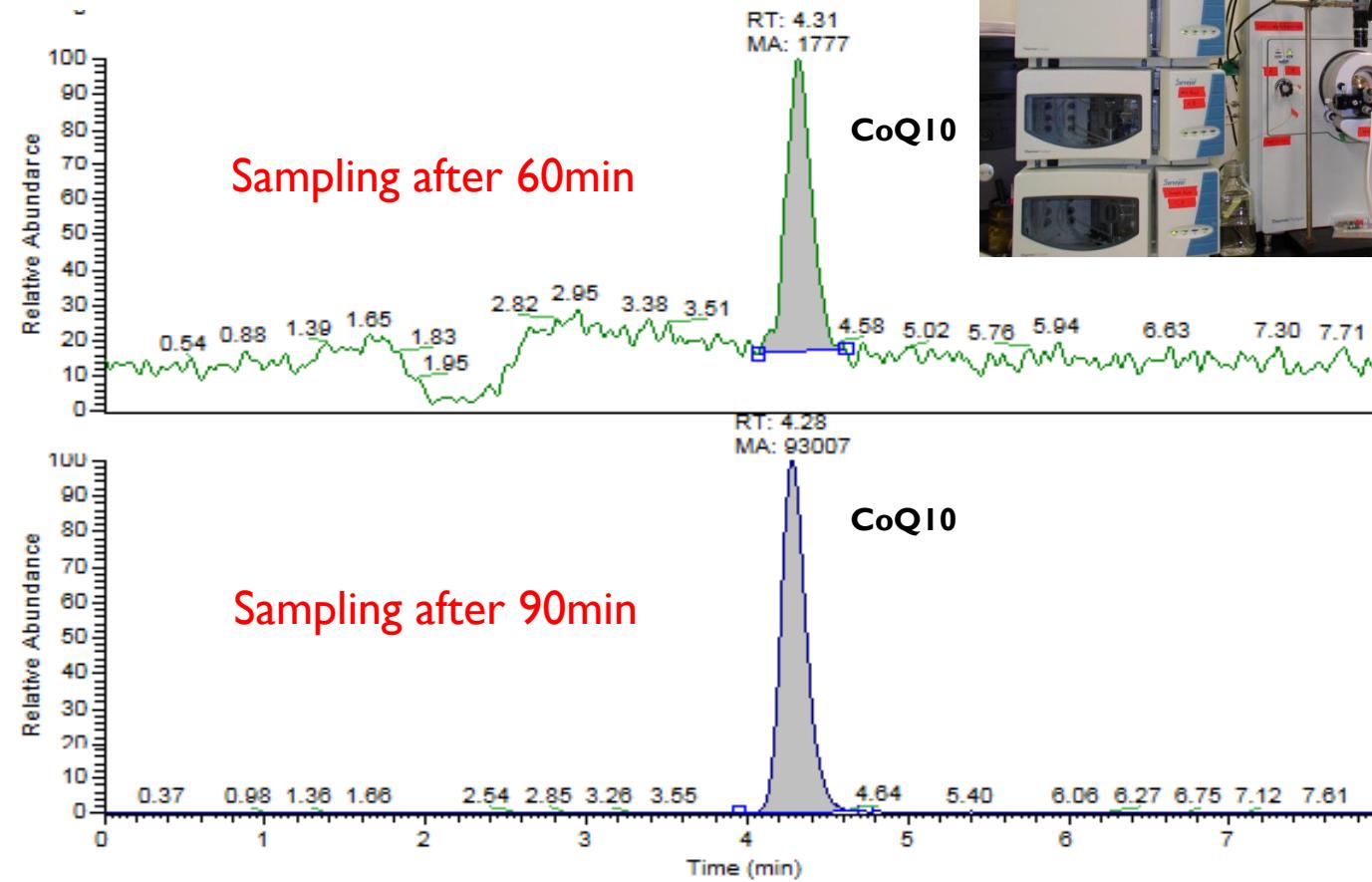
CoQ10
 $Y = 0.0253819 \cdot X$ $R^2 = 0.9989$ W: Equal



Calibration curve of CoQ10 using internal standard (CoQ9)

IV- Lecithin and biofunctional molecules

IV.1 - Coenzyme Q10



IV- Lecithin and biofunctional molecules

IV.2 - m-tetrahydroxyphenylchlorin (mTHPC)

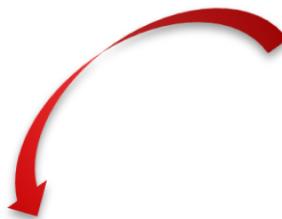
Photodynamic therapy



the uptake of photosensitizers followed by
the photoirradiation of cancer tissue



Induced cellular death



Nanoemulsions and liposomes are investigated as vehicles for
delivery of photodynamic therapy agent

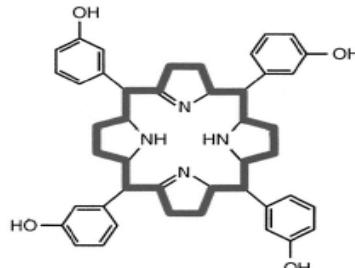


Combination of photosensitizers and DHA using marine lecithin to
stabilize liposomes and nanoemulsions

IV- Lecithin and biofunctional molecules

IV.2 - m-tetrahydroxyphenylchlorin mTHPC

mTHPC = photosensitizer (liposoluble)



mTHPC



Preparation of emulsion
by sonication



Put emulsion in contact with cells
(MCF7)
breast cancer cell line

IV- Lecithin and biofunctional molecules

IV.2 - m-tetrahydroxyphenylchlorin mTHPC

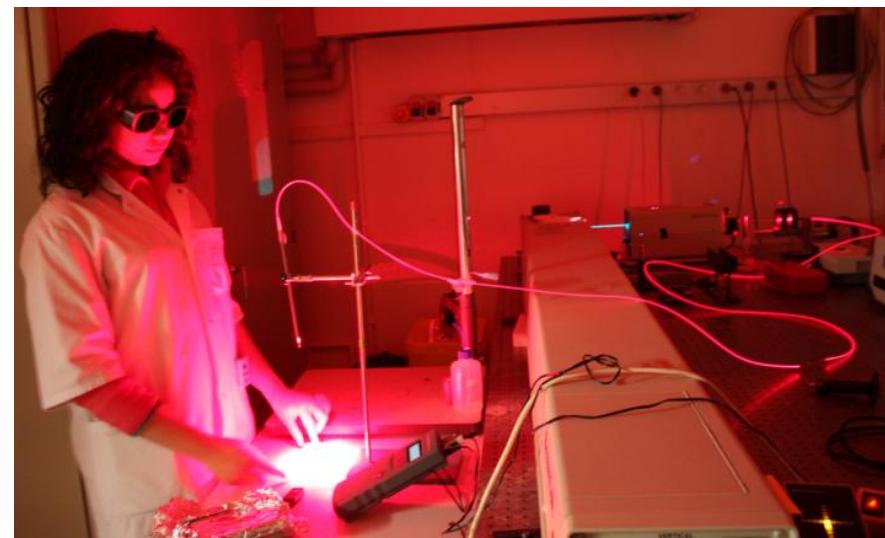
The cells culture were incubated in presence of nanoemulsions for 3h and

24h at 37°C

Cytotoxicity test

Phototoxicity test

Cell viability was determined 24 h later
using the MTT assay



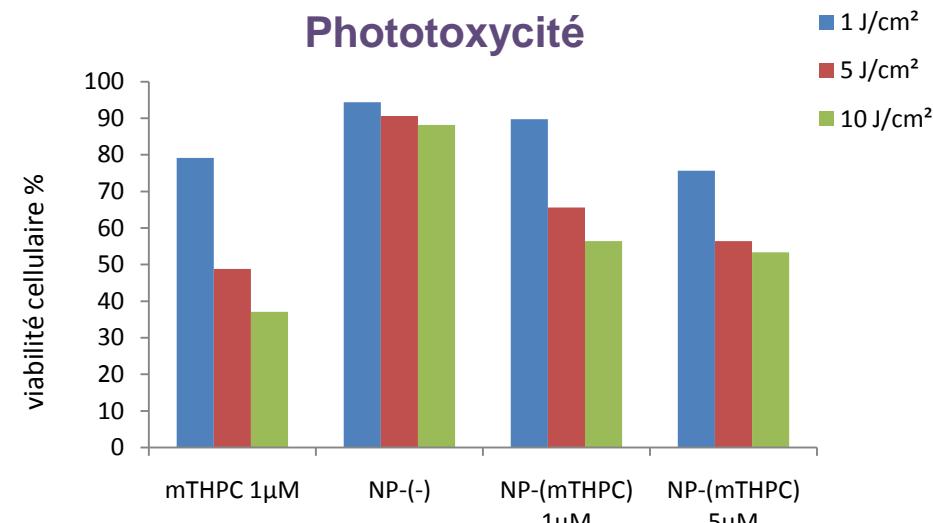
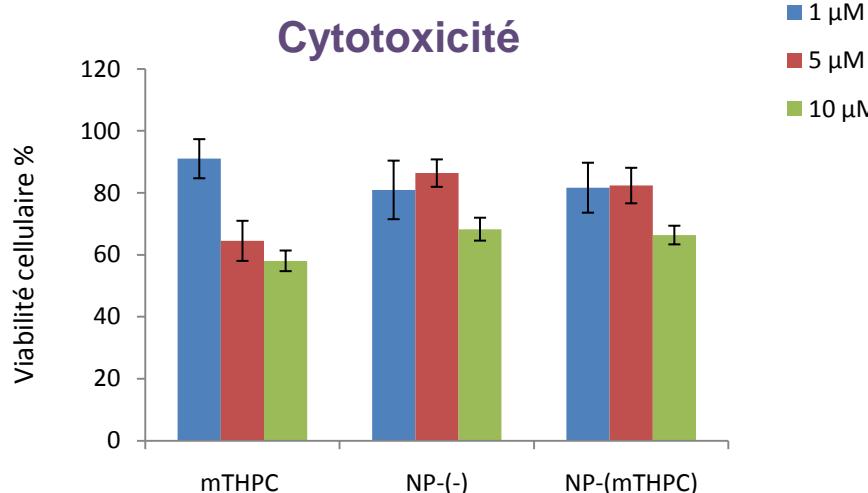
MTT 3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) = standard colorimetric assays which measures changes in color. The intensity of color increase with the increasing of cell viability

Irradiation of cells (635 – 760 nm)

Cell viability was determined 24 h later
using the MTT assay

IV- Lecithin and biofunctional molecules

IV.2 - m-tetrahydroxyphenylchlorin mTHPC



Nanoparticles don't affect the activity of photodynamic photosensitizer

At **5 μ M**: mTHPC alone was cytotoxic
mTHPC was not toxic in emulsion

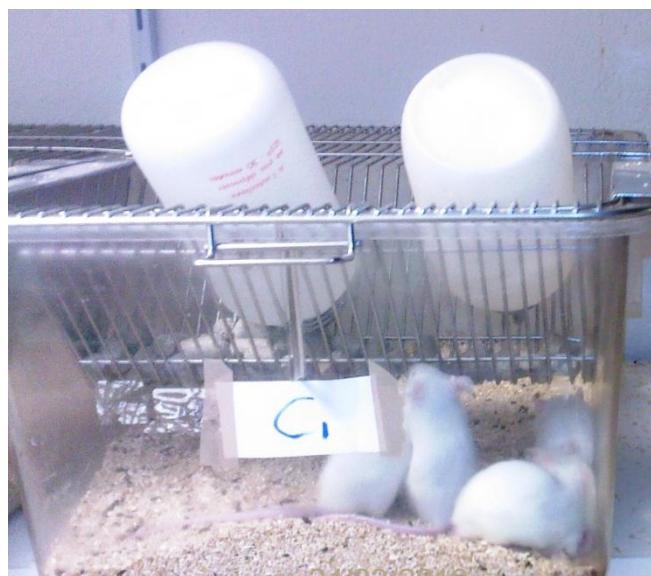
The emulsion \downarrow
cytotoxicity

At **5 μ M and 10 J/cm²** we obtain 50% of mortality in cellular population.

V- Perspectives



To test these interested formulations in mice
rats (*in vivo study*)



ACKNOWLEDGMENTS



Professors

Michel Linder
Jacques Fanni
Elmira Arab Tehrany

PhD Students

Pascale Sautot
Tin Hinan Kabri
Mehrani Behnoush

Collaborations:

Muriel Barberie CRAN-Centra Alesia Vautrin (Nancy)

Céline Frochot ENSIC- CNRS (Nancy)

Rachid Soulimani UPV – Equipe Neurotoxicologie alimentaire et bioactivité (Metz)

Many thanks for your attention

