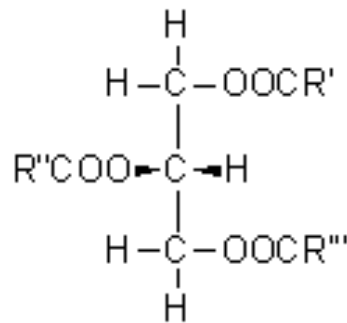
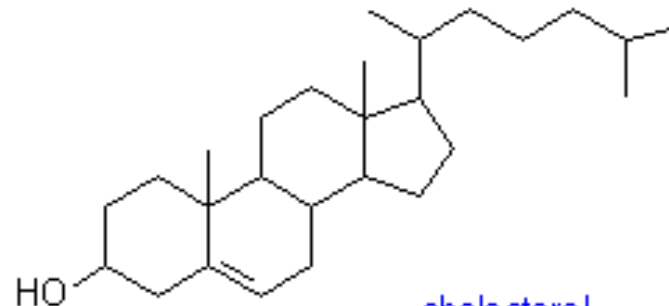


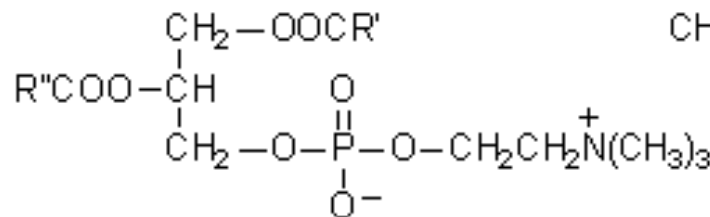
Σημαντικές κατηγορίες λιπιδίων



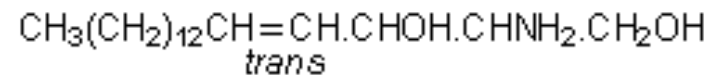
triacyl-*sn*-glycerol



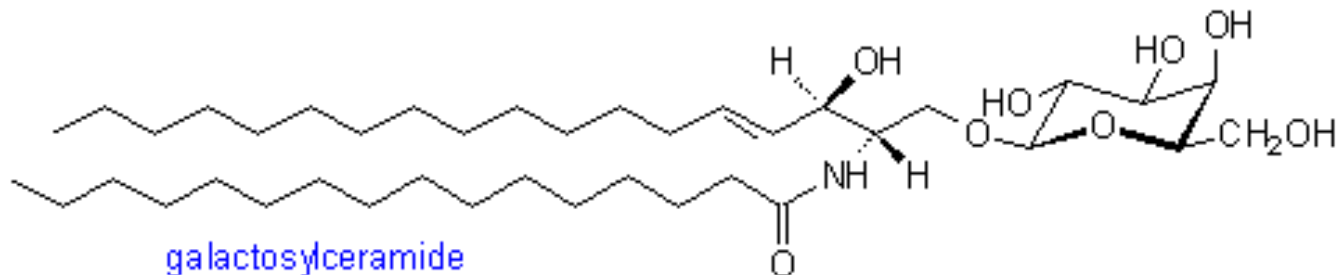
cholesterol



phosphatidylcholine



sphingosine

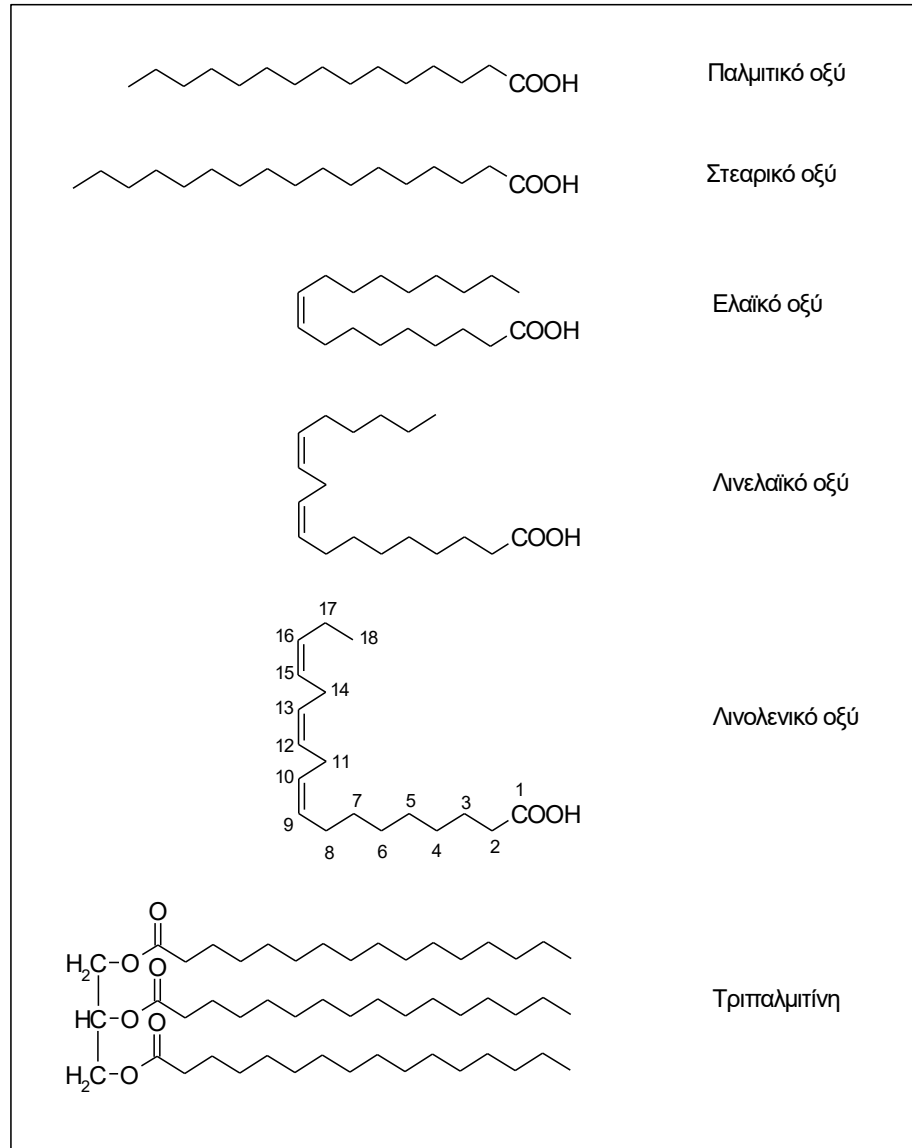


galactosylceramide

Σύσταση σε λιπαρά οξέα

- Θρεπτική αξία (κορεσμένα-ακόρεστα-πολυακόρεστα)
- Αυθεντικότητα – νοθεία λιπαρών ουσιών
- Φωσφολιπίδια : γαλακτωματοποιητές τροφίμων
- Πολυακόρεστα στα ψάρια
-

Λιπαρά οξέα σε βρώσιμα έλαια



Λιπαρά οξέα εδώδιμων ελαίων

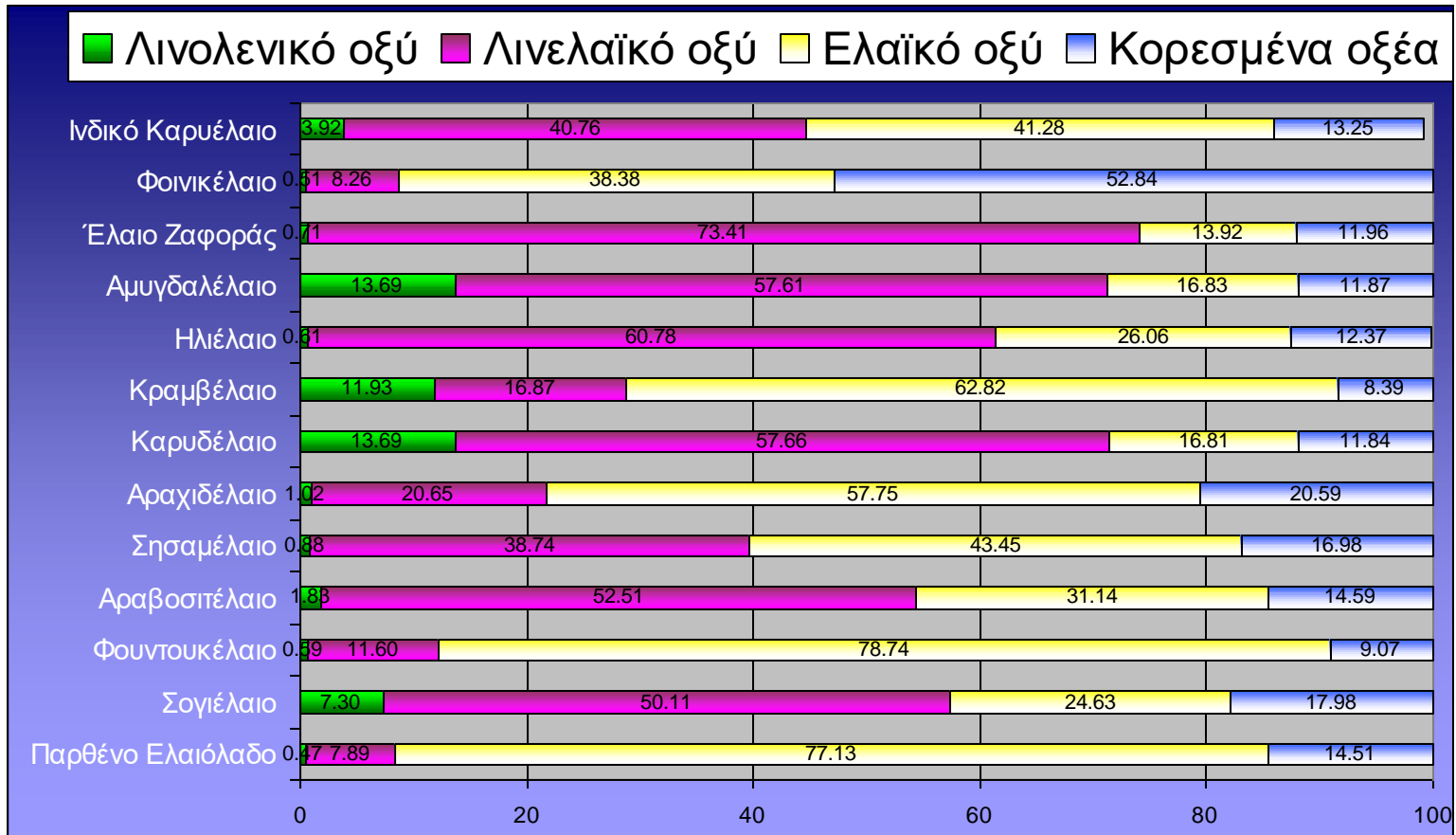
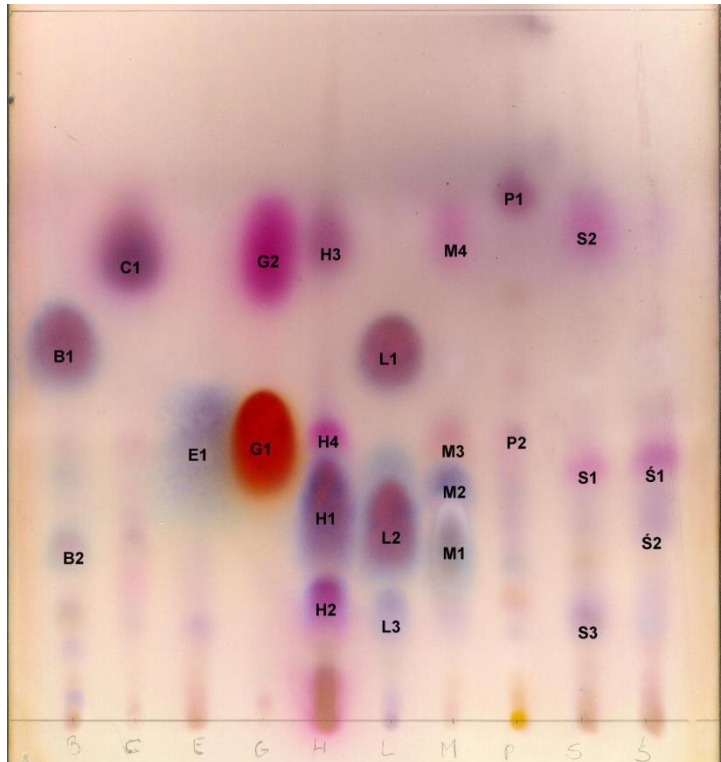
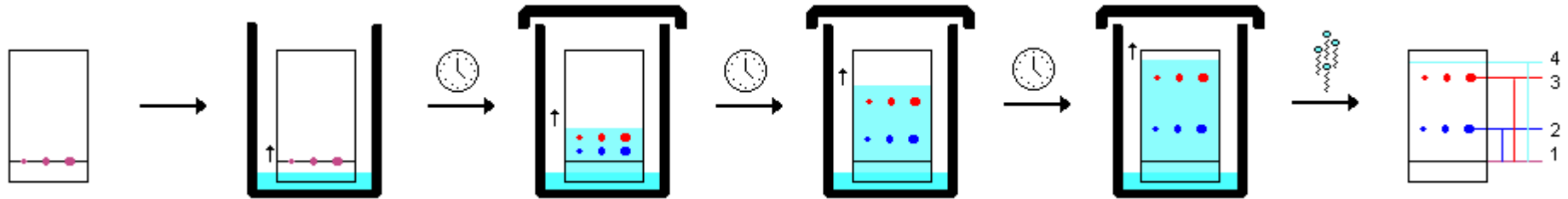


TABLE 4 Positional Distribution of Individual Fatty Acids in Triacylglycerols of Some Natural Fats

| Source | Position | Fatty acid (mol%) | | | | | | | | | | | | | | |
|------------------|----------|-------------------|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|
| | | 4:0 | 6:0 | 8:0 | 10:0 | 12:0 | 14:0 | 16:0 | 18:0 | 18:1 | 18:2 | 18:3 | 20:0 | 20:1 | 22:0 | 24:0 |
| Cow's milk | 1 | 5 | 3 | 1 | 3 | 3 | 11 | 36 | 15 | 21 | 1 | | | | | |
| | 2 | 3 | 5 | 2 | 6 | 6 | 20 | 33 | 6 | 14 | 3 | | | | | |
| | 3 | 43 | 11 | 2 | 4 | 3 | 7 | 10 | 4 | 15 | 0.5 | | | | | |
| Coconut | 1 | | 1 | 4 | 4 | 39 | 29 | 16 | 3 | 4 | | | | | | |
| | 2 | | 0.3 | 2 | 5 | 78 | 8 | 1 | 0.5 | 3 | 2 | | | | | |
| | 3 | | 3 | 32 | 13 | 38 | 8 | 1 | 0.5 | 3 | 2 | | | | | |
| Cocoa butter | 1 | | | | | | | 34 | 50 | 12 | 1 | | | | | |
| | 2 | | | | | | | 2 | 2 | 87 | 9 | | | | | |
| | 3 | | | | | | | 37 | 53 | 9 | | | | | | |
| Com | 1 | | | | | | | 18 | 3 | 28 | 50 | | | | | |
| | 2 | | | | | | | 2 | | 27 | 70 | | | | | |
| | 3 | | | | | | | 14 | 31 | 52 | 1 | | | | | |
| Soybean | 1 | | | | | | | 14 | 6 | 23 | 48 | 9 | | | | |
| | 2 | | | | | | | 1 | | 22 | 70 | 7 | | | | |
| | 3 | | | | | | | 13 | 6 | 28 | 45 | 8 | | | | |
| Olive | 1 | | | | | | | 13 | 3 | 72 | 10 | 0.6 | | | | |
| | 2 | | | | | | | 1 | | 83 | 14 | 0.8 | | | | |
| | 3 | | | | | | | 17 | 4 | 74 | 5 | 1 | | | | |
| Peanut | 1 | | | | | | | 14 | 5 | 59 | 19 | | 1 | 1 | | 1 |
| | 2 | | | | | | | 2 | | 59 | 39 | | | | | 0.5 |
| | 3 | | | | | | | 11 | 5 | 57 | 10 | | 4 | 3 | 6 | 3 |
| Beef (depot) | 1 | | | | | | 4 | 41 | 17 | 20 | 4 | 1 | | | | |
| | 2 | | | | | | 9 | 17 | 9 | 41 | 5 | 1 | | | | |
| | 3 | | | | | | 1 | 22 | 24 | 37 | 5 | 1 | | | | |
| Pig (outer back) | 1 | | | | | | 1 | 10 | 30 | 51 | 6 | | | | | |
| | 2 | | | | | | 4 | 72 | 2 | 13 | 3 | | | | | |
| | 3 | | | | | | | | 7 | 73 | 18 | | | | | |

Χρωματογραφία λεπτής στοιβάδας, TLC

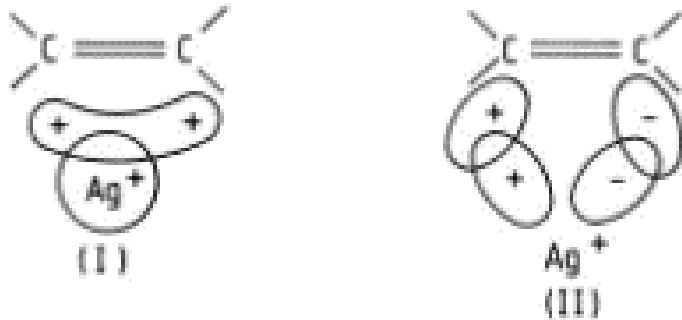


$$R_f = 3/4 = \sim 0.8$$

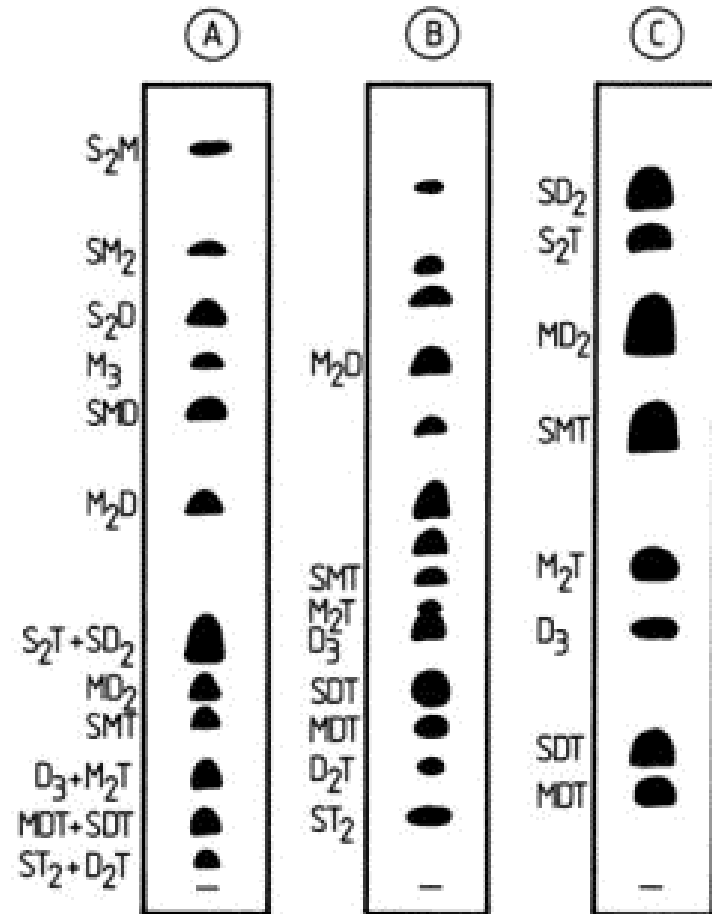
$$R_f = 2/4 = \sim 0.3$$

TLC αιθέριων ελαίων

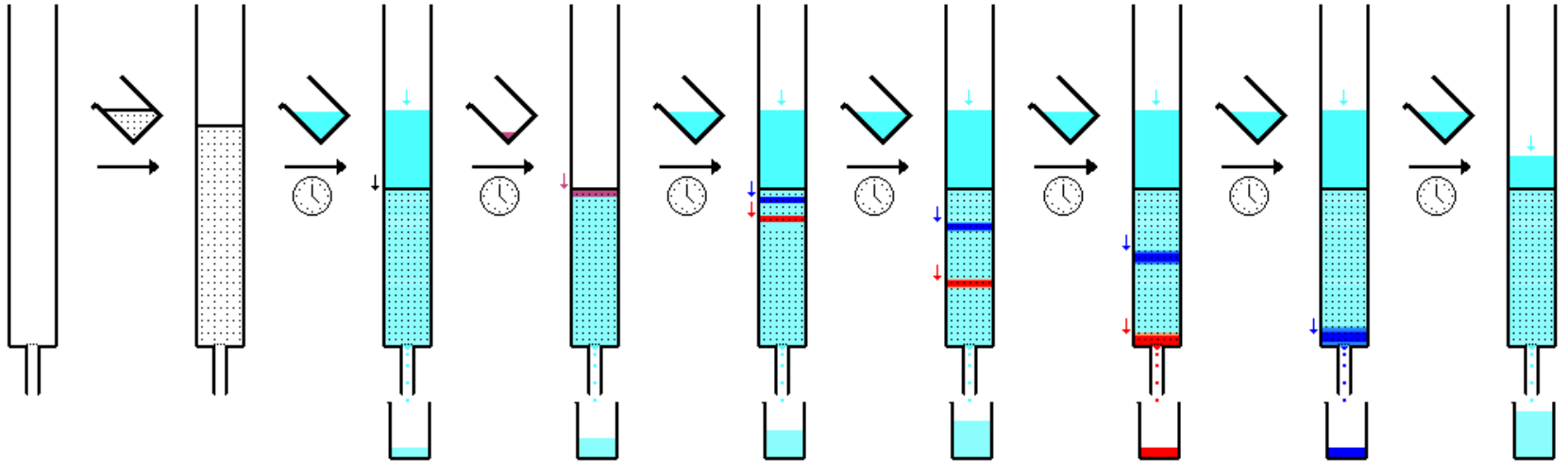
Silver ion TLC, έλαιο σπόρου πορτοκαλιού



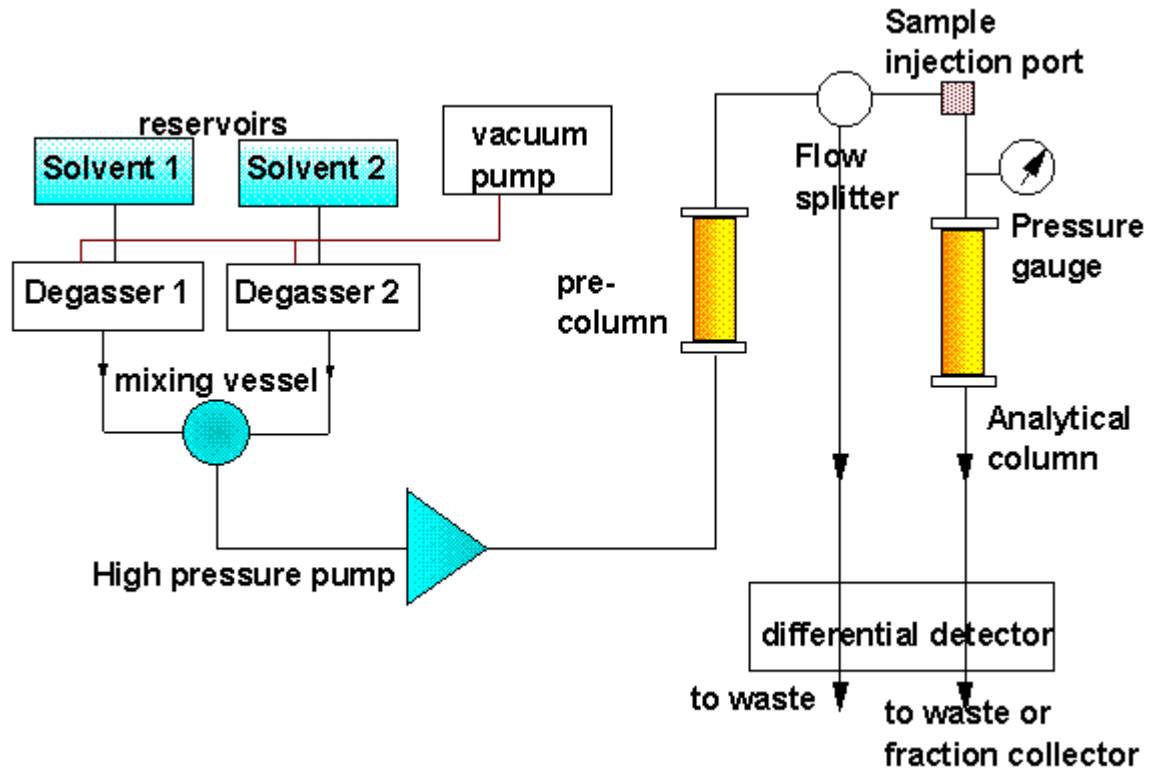
S κορεσμένο λιπαρό οξύ
 M λιπαρό οξύ με 1 δδ
 D λιπαρό οξύ με 2 δδ
 T λιπαρό οξύ με 3 δδ



Χρωματογραφία στήλης



HPLC



©1995 CHP



Χρωματογραφία HPLC

- Κανονικής φάσης: πολική στήλη (πολυσιλοξάνιο)
άπολος διαλύτης (εξάνιο, διχλωρομεθάνιο, χλωροφόρμιο)
- Αντίστροφης φάσης : άπολη στήλη (C18, C8)
πολικός διαλύτης (μεθανόλη, ακετονιτρίλιο, νερό)
- Άλλες κατηγορίες στήλης : σίλικα, αλουμίνα, χειρόμορφες στήλες,
ιοντανταλλακτικές ρητίνες, κλπ.

Ανίχνευτής : UV, δείκτης διάθλασης, φασματόμετρο μάζας

HPLC

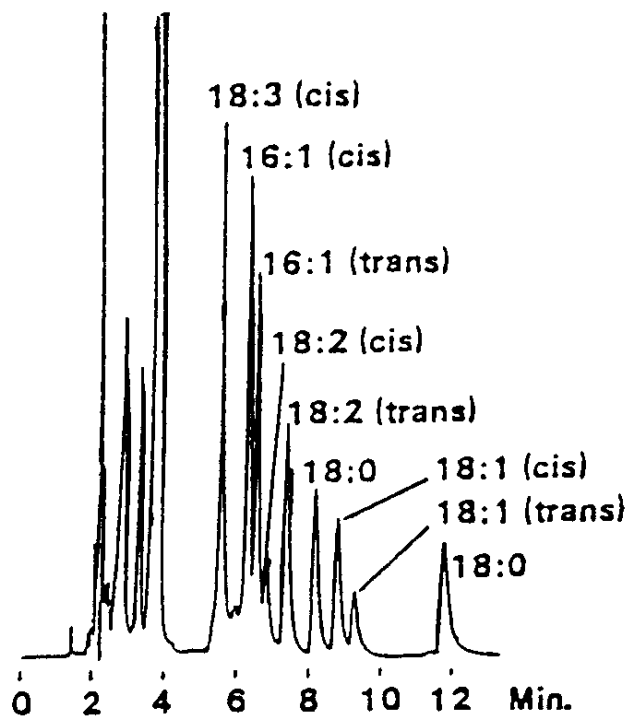
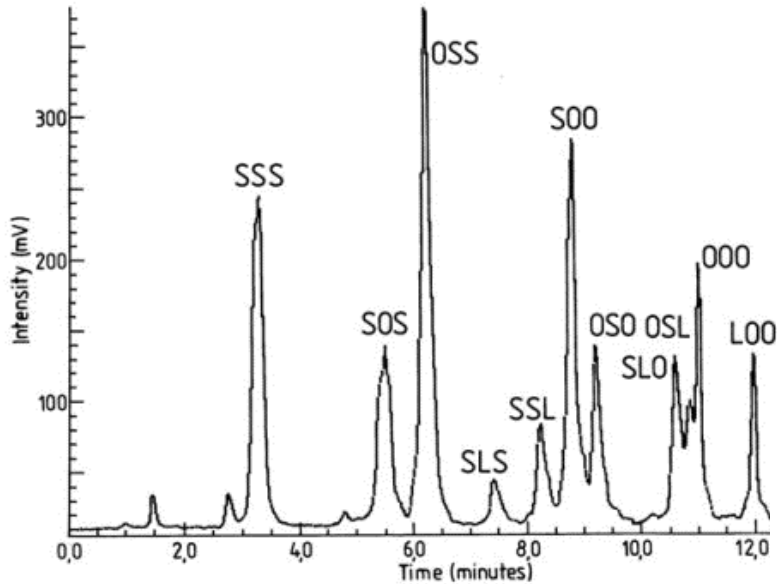
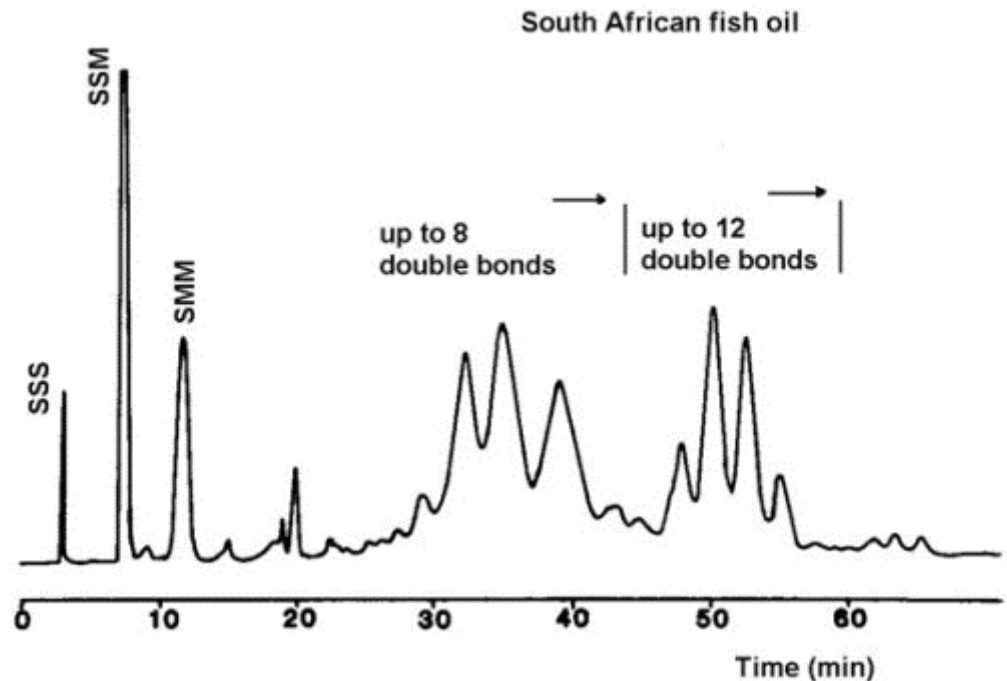


Fig. 1 HPLC of free fatty acids. Column: SUPELCOSIL LC 18. 25 cm \times 4.6-mm ID. (5 μ); mobile phase: tetrahydrofuran/acetonitrile/0.1% phosphoric acid, pH 2.2 (21.6:50.4:28.0); flow rate: 1.5 ml/min; temperature: 35°C; detection at 220 nm; sample concentration 1–2 mg/ml per component. 16:1 (cis) = *cis*-9-hexadecenoic acid (*cis*-palmitoleic acid); 16:1 (trans) = *trans*-9-hexadecenoic acid (*trans*-palmitoleic acid); 18:0 = octadecanoic acid (stearic acid); 18:1 (cis) = *cis*-9-octadecenoic acid (oleic acid); 18:1 (trans) = *trans*-9-octadecenoic acid (elaidic acid); 18:2 (cis) = *cis*-9-*cis*-12-octadecadienoic acid (linoleic acid); 18:2 (trans) = *trans*-9-*trans*-12-octadecadienoic acid (linolelaidic acid); 18:3 (cis) = *cis*-9-*cis*-2-*cis*-15-octadecatrienoic acid (linolenic acid).

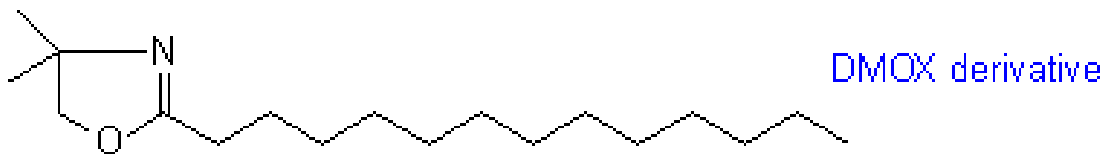
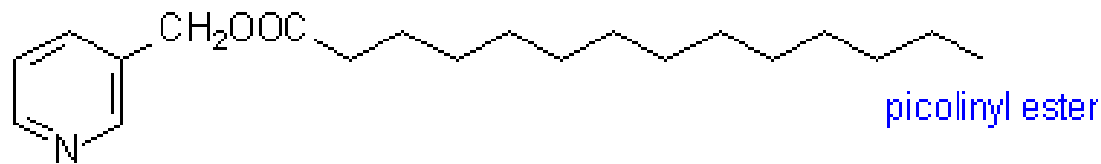
Silver ion HPLC, μείγμα τριγλυκεριδίων



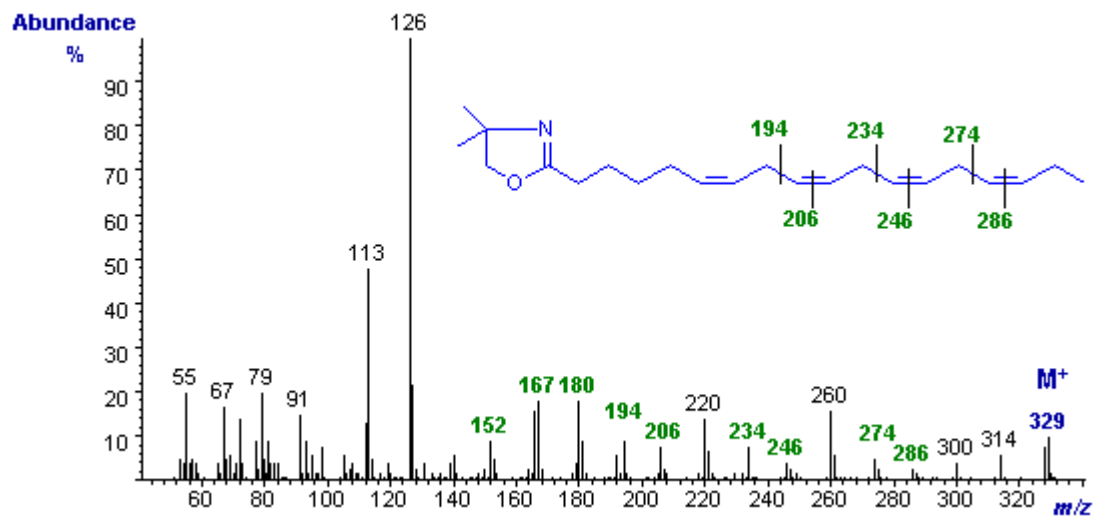
S κορεσμένο λιπαρό οξύ
O ολεϊκό οξύ (1 δδ)
L λινολεϊκό οξύ (2 δδ)



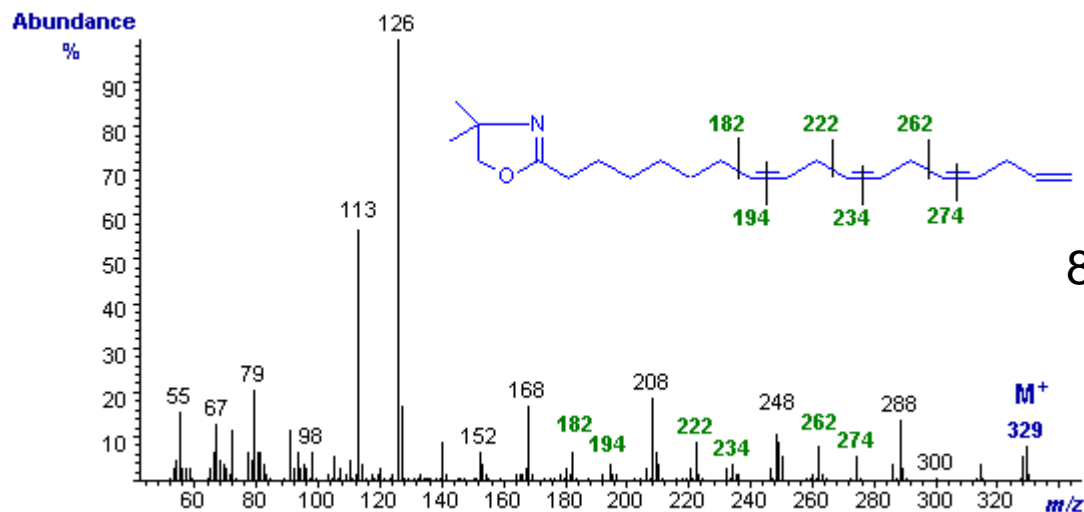
Παράγωγα λιπαρών οξέων για ανάλυση με φασματομετρία μάζας, MS



Προσδιορισμός δομής λιπαρών ιχθυελαίου με MS

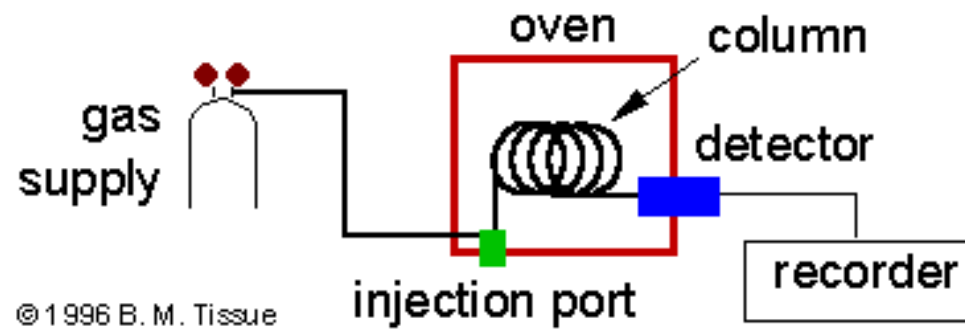


6,9,12,15-octadecatetraenoate

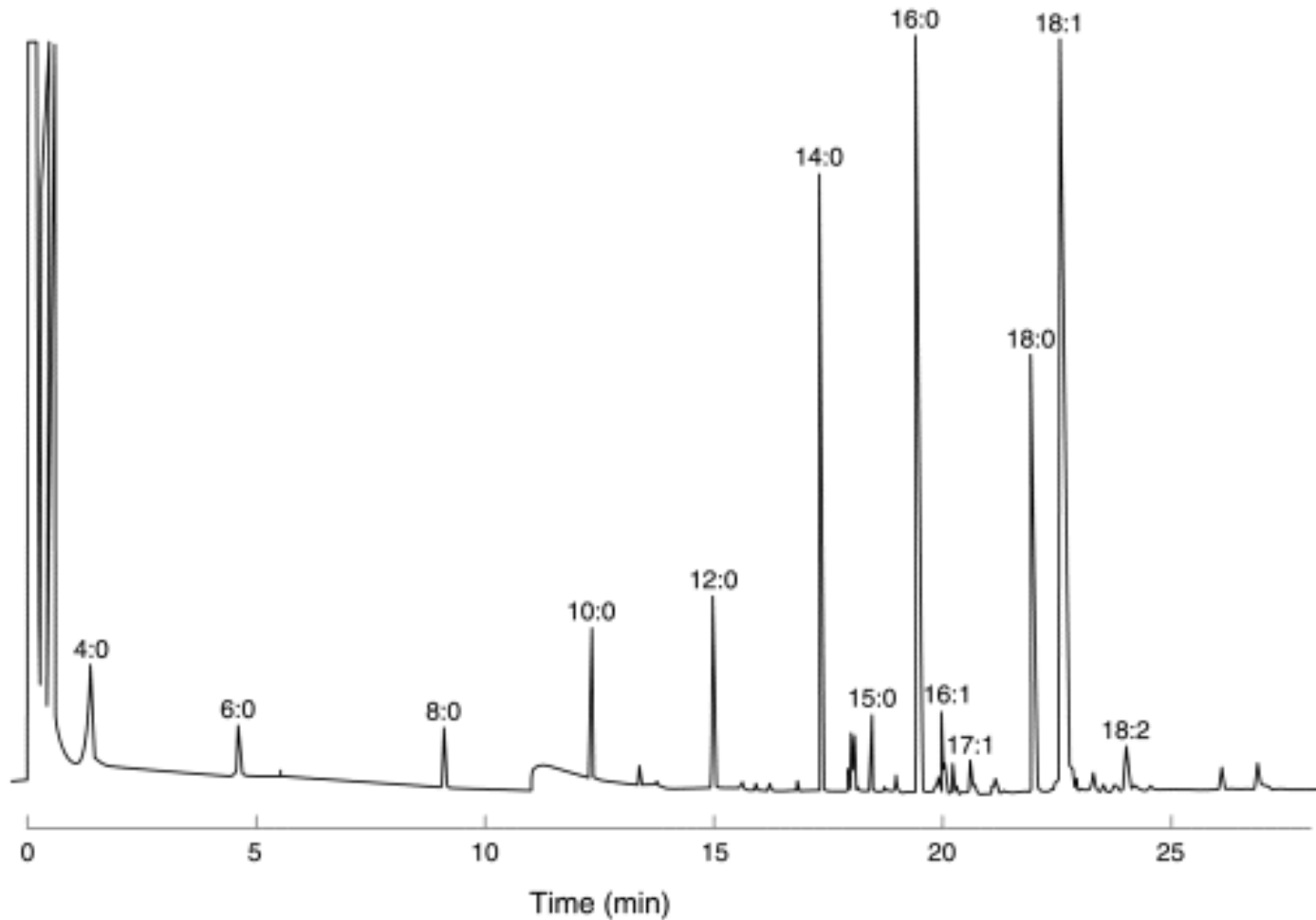


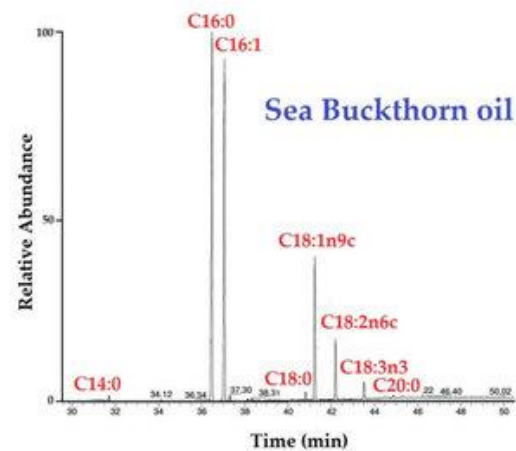
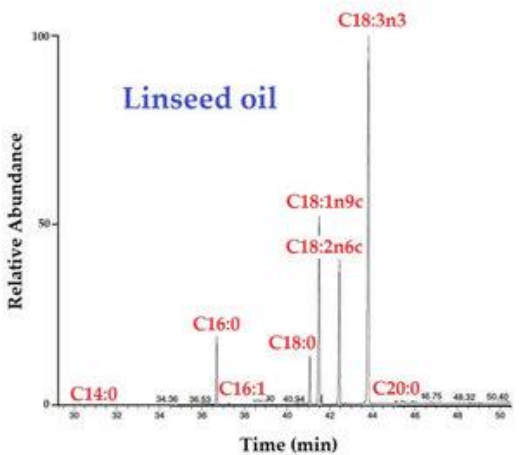
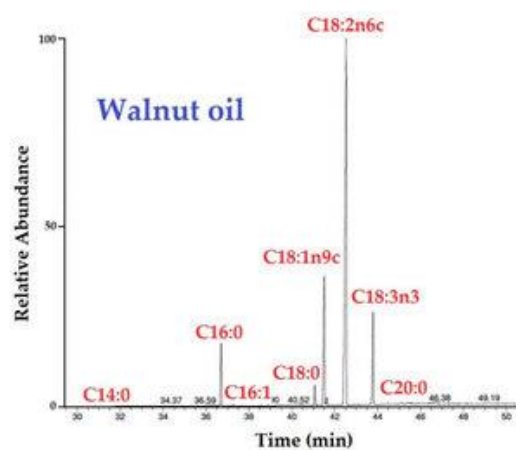
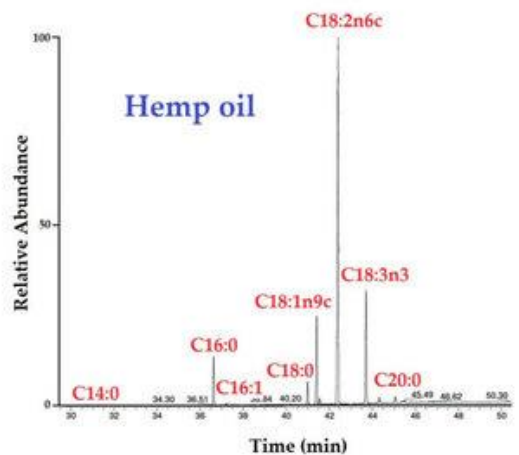
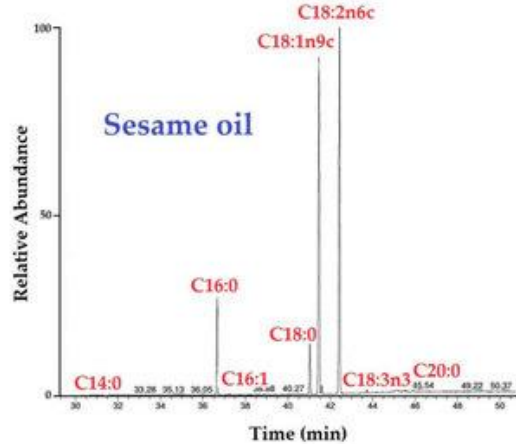
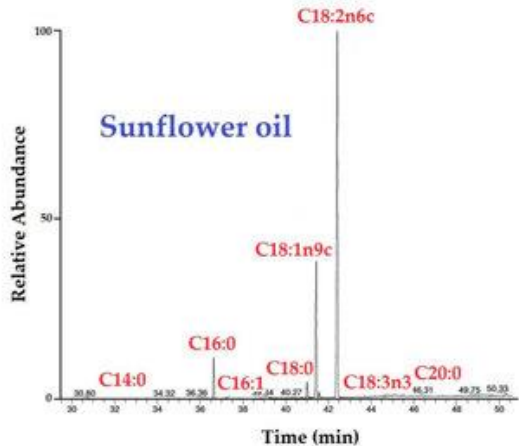
8,11,14,17-octadecatetraenoate

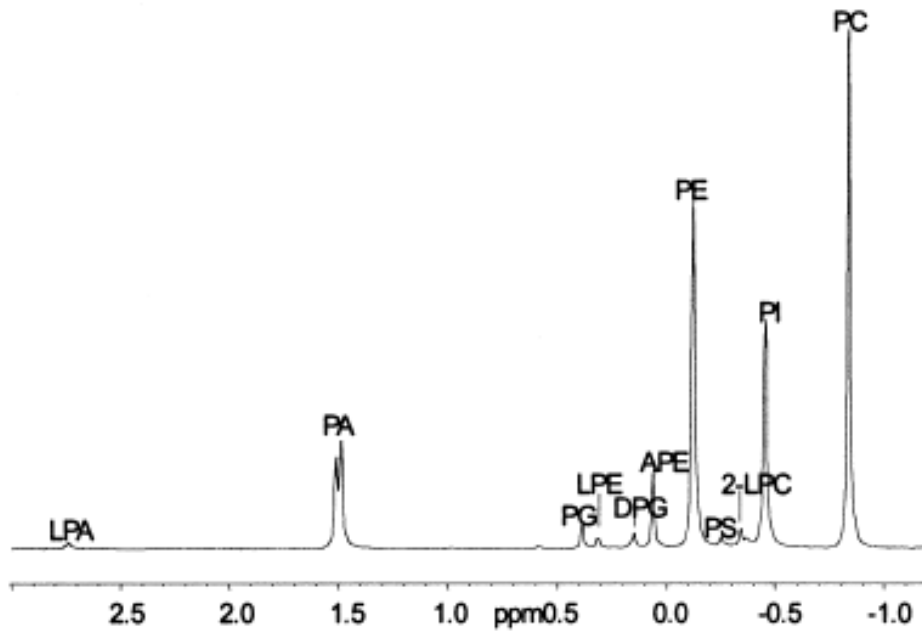
GC



Διαχωρισμός με GC λιπαρών οξέων του γάλακτος







Φασματοσκοπία ^{31}P NMR

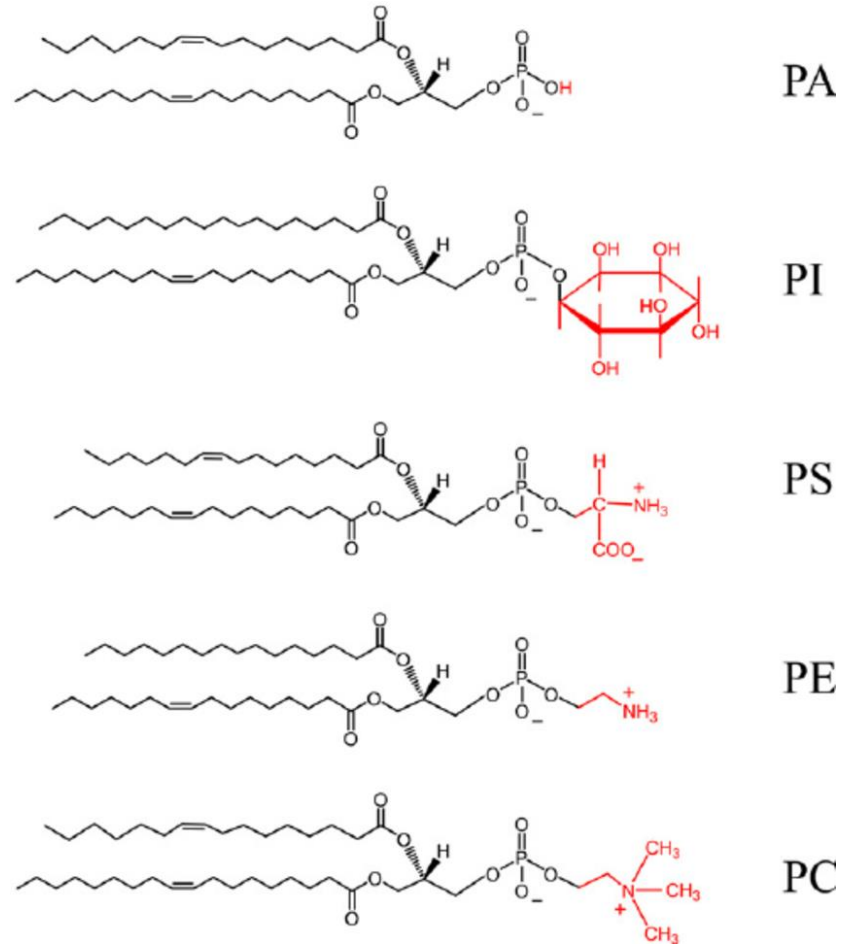
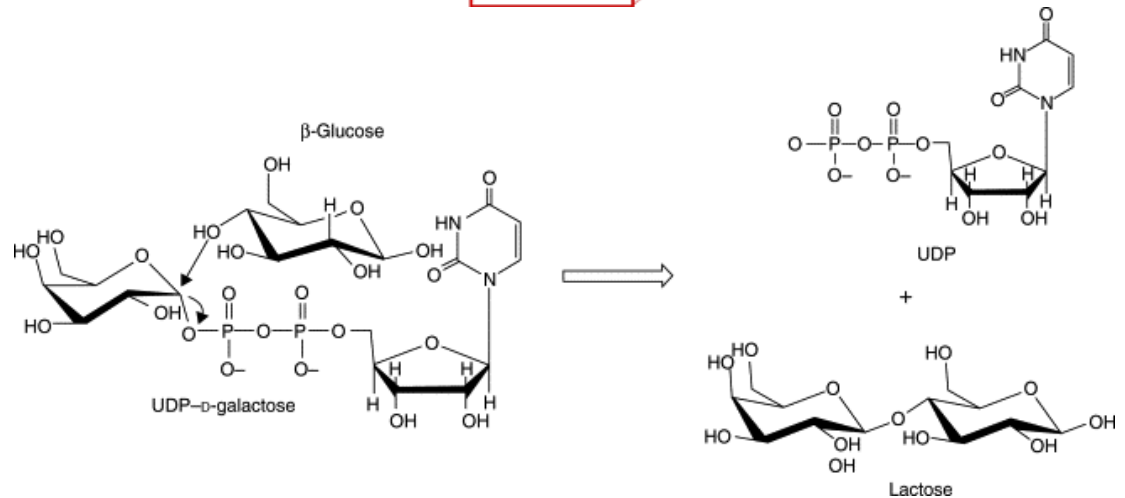
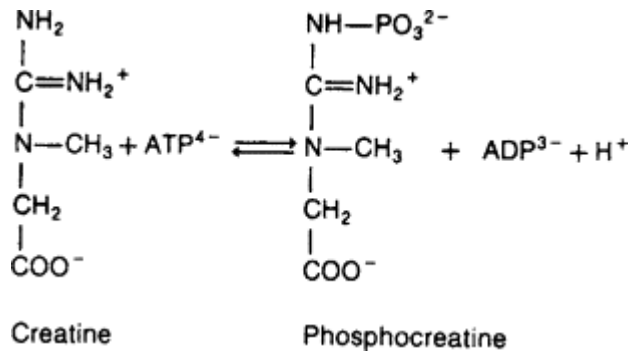
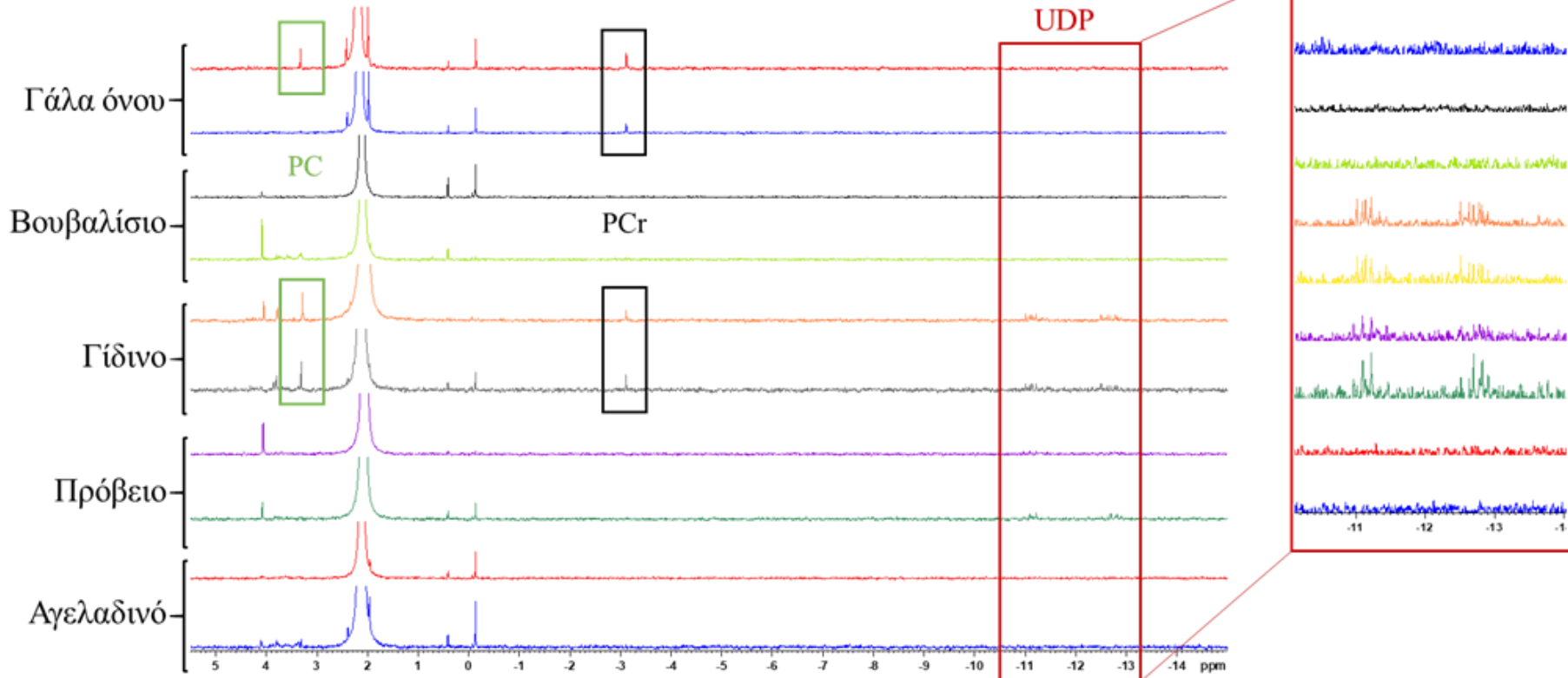
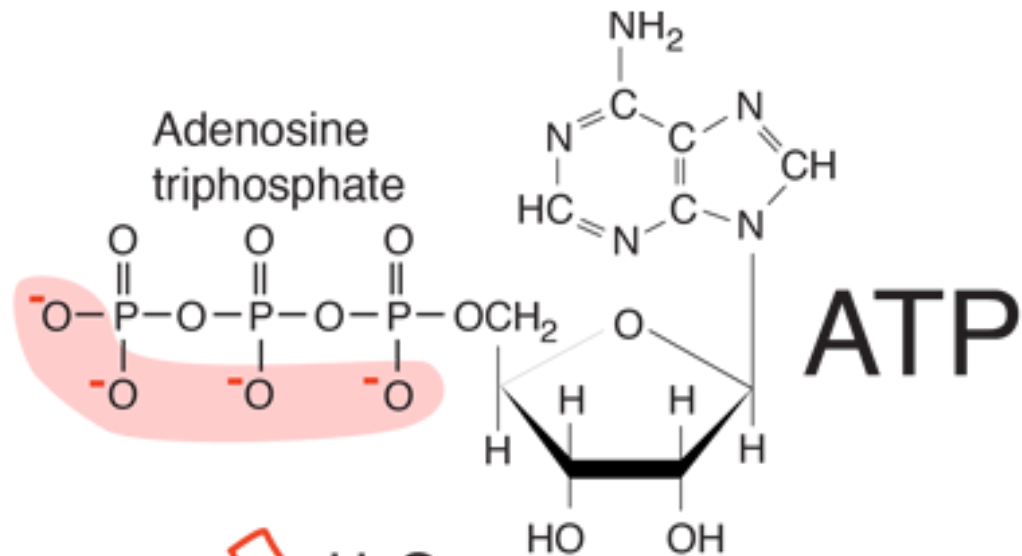


Fig. 7. ^{31}P -NMR of soybean lecithin.

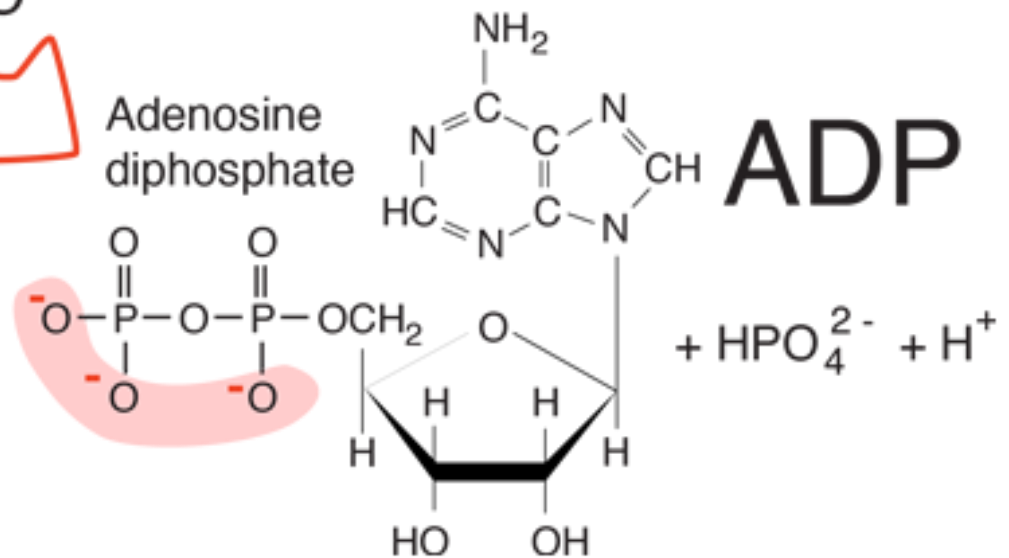
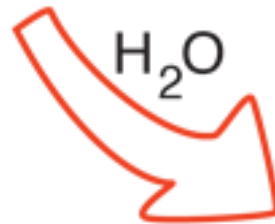
- PC Phosphatidylcholine
- PI Phosphatidylinositol
- 2-LPC 2-Lyso-phosphatidylcholine
- PS Phosphatidylserine
- PE Phosphatidylethanolamine
- APE N-Acylphosphatidylethanolamine
- DPG Diphosphatidylglycerol, cardiolipin
- LPE Lyso-Phosphatidylethanolamine
- PG Phosphatidylglycerol
- PA Phosphatidic acid
- LPA Lyso-phosphatidic acid

³¹P NMR of milks





The conversion of ATP to ADP as illustrated yields about 7.3 kcal/mol of ATP. This is the energy source for a wide variety of processes in both plants and animals.



Ανίχνευση αλλοίωσης κρέατος με ^{31}P NMR

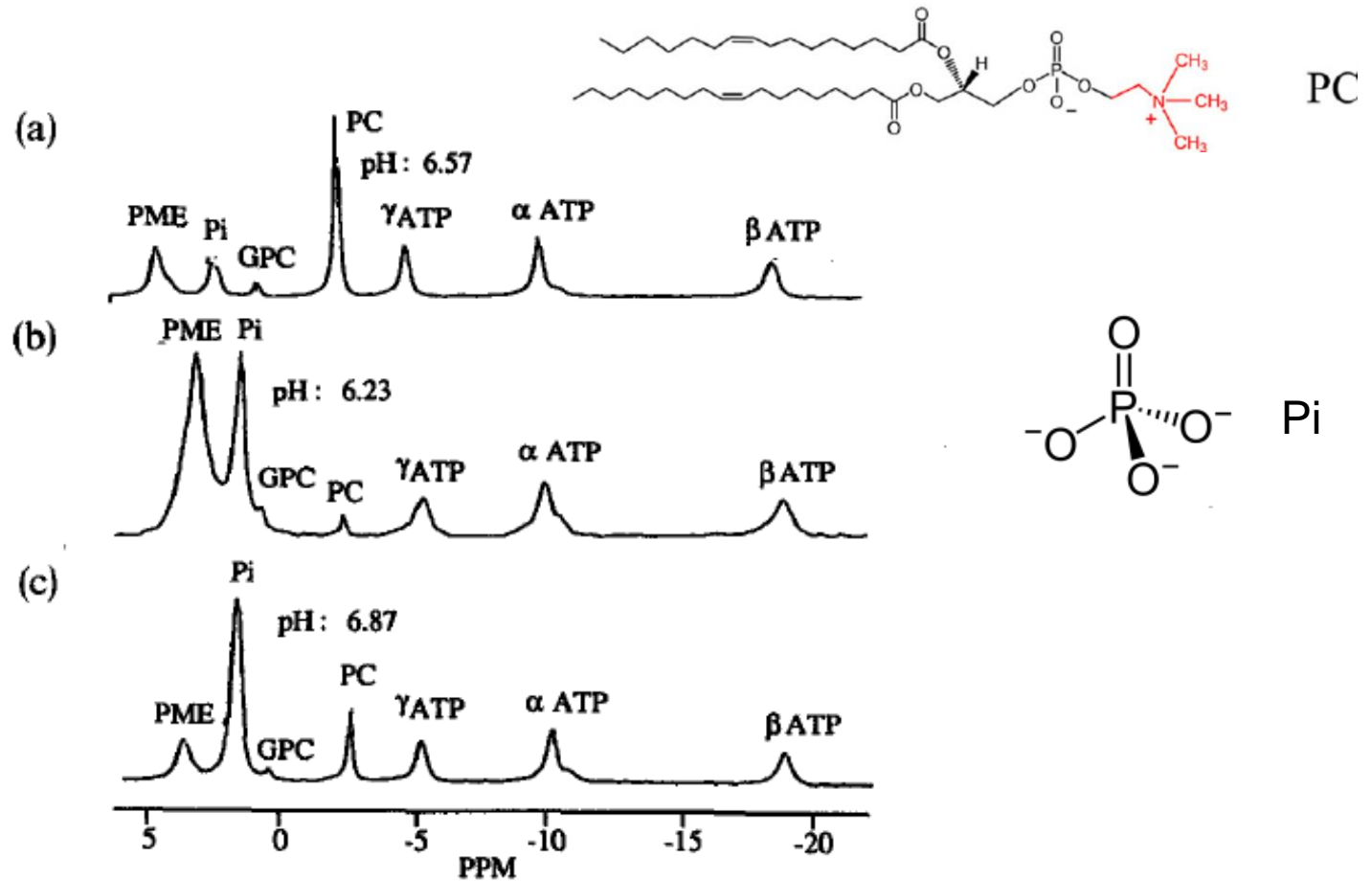
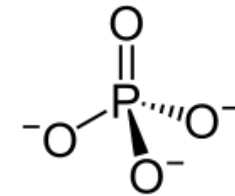
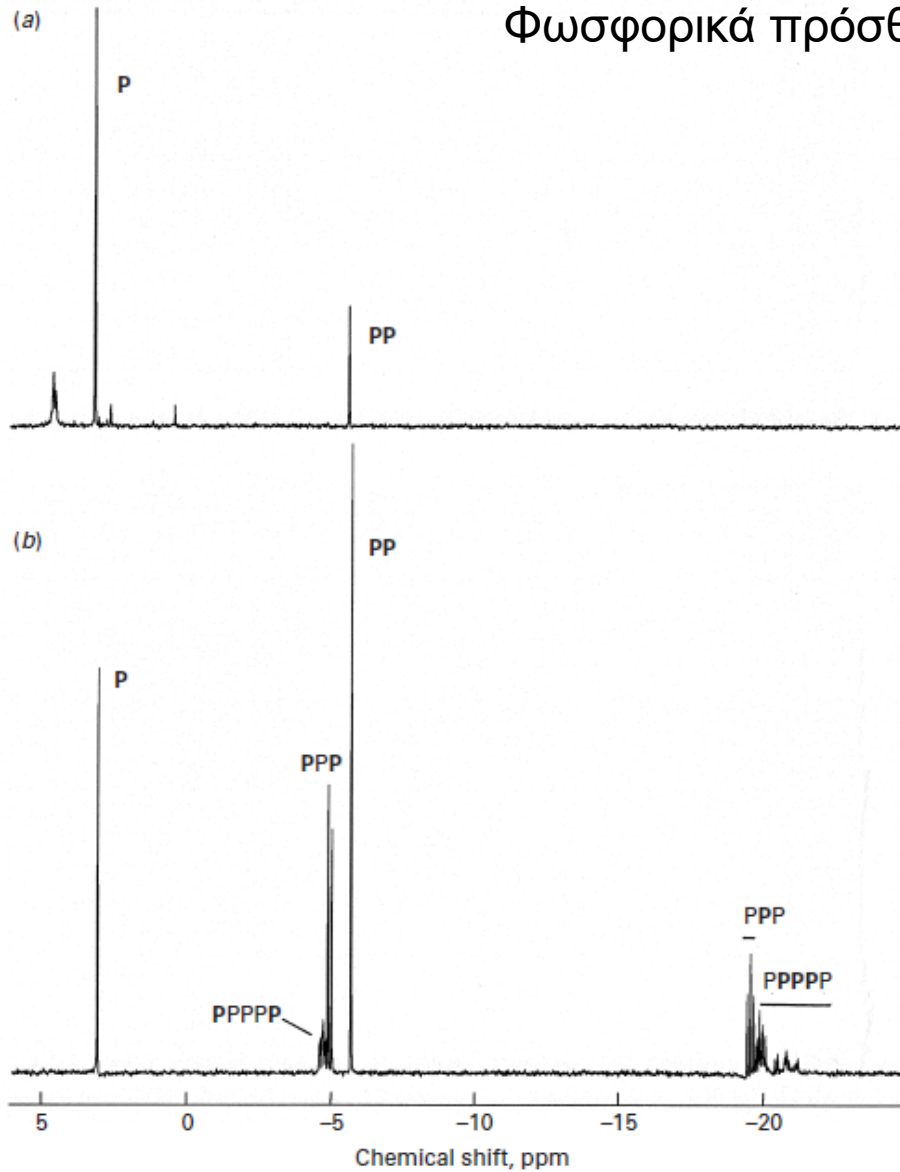
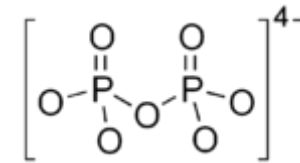


Fig. 2. Examples of spectra from: (a) normal muscle; (b) PSE-prone muscle; (c) DFD muscle at 30 min *post mortem*.

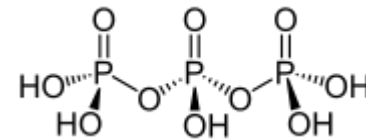
Φωσφορικά πρόσθετα στο γάλα



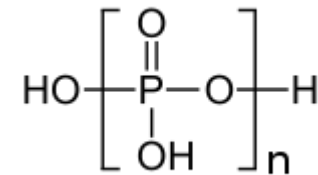
P



PP



PPP



Polyphosphates

Fig. 2. ^{31}P -NMR spectra of (a) a UHT milk sample and (b) a commercial polyphosphate. The presence of diphosphate can be seen in (a). In (b) numerous resonances from the mixture of phosphates can be seen: **P**, monophosphate; **PP**, diphosphate; **PPP**, triphosphate; **PPPP**, polyphosphates. The last was tentatively identified as a pentaphosphate. Bold lettering indicates the phosphorus atoms located at specific sites of the chain that give rise to the signal.

Προσδιορισμός *trans* Λιπαρών με FT-IR

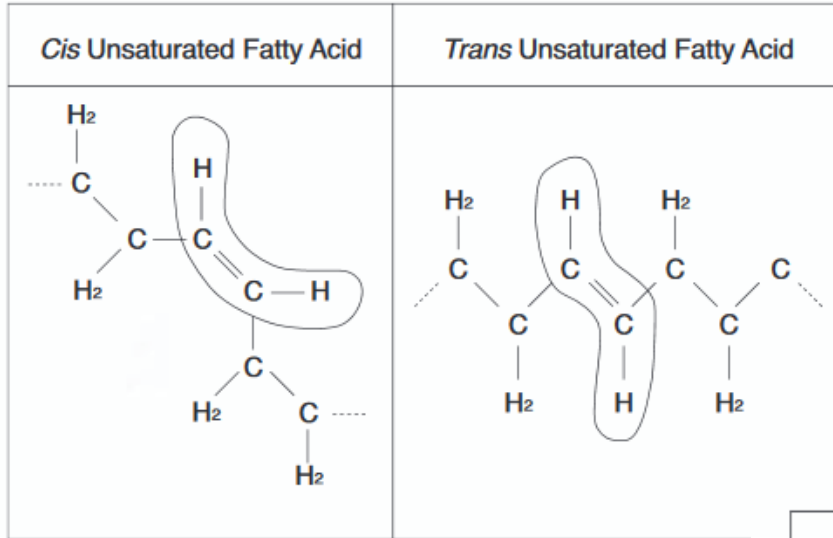


Fig. 2 Structures of *Cis* and *Trans* Fatty Acids

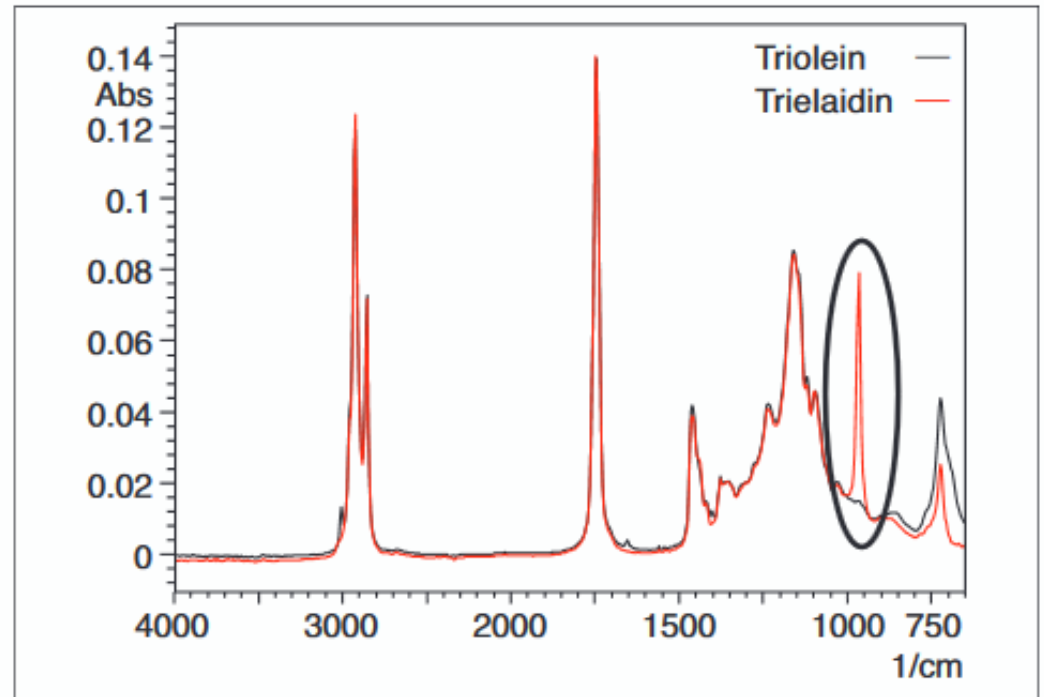
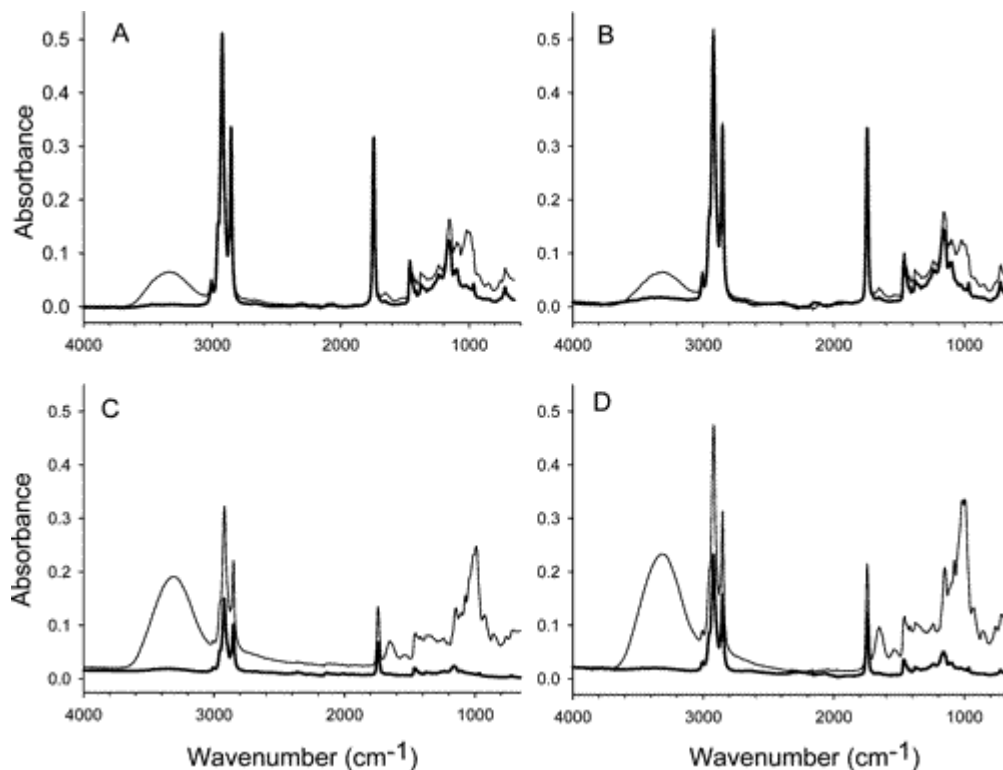


Fig. 3 Infrared Spectra of Triolein and Trielaidin

Προσδιορισμός *trans* Λιπαρών με FT-IR

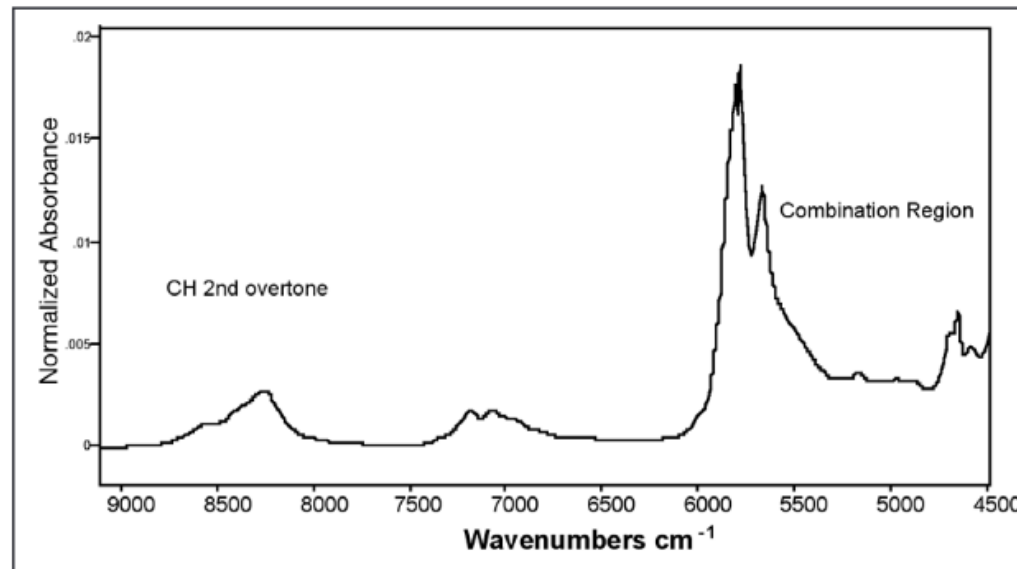
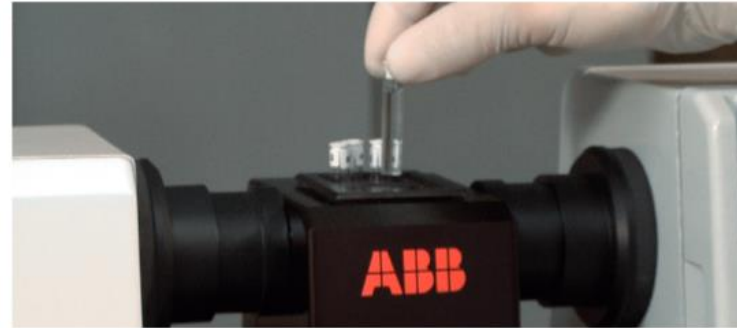
J. Agric. Food Chem., **55** (11), 4327 -4333

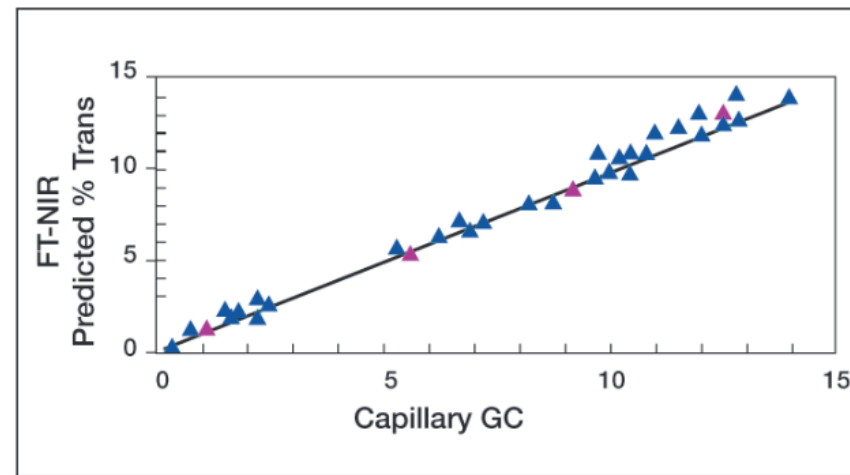
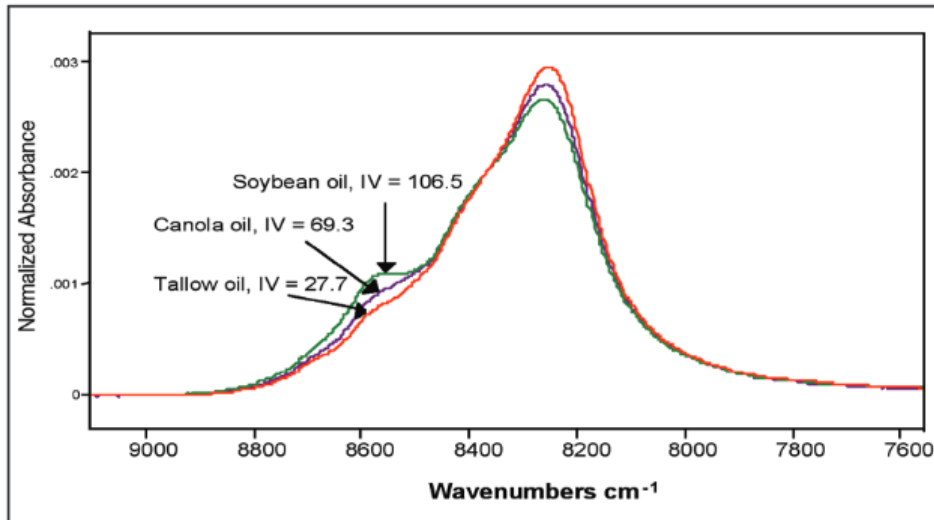
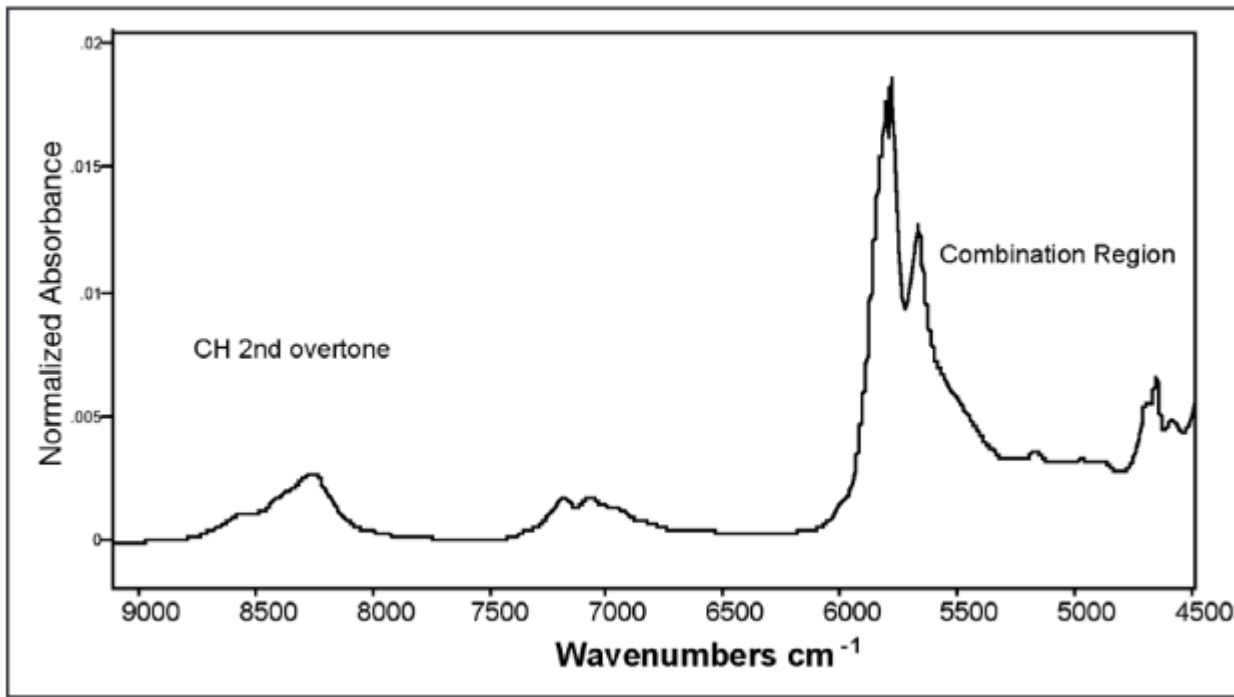


966 cm⁻¹

IR spectra (4000-650 cm⁻¹) of typical cereal samples in the ground sample form (fine line) and in the residual film (bold line) for four products: corn chips (**A**), cheese curls (**B**), a cookie product (**C**), and a cracker product (**D**).

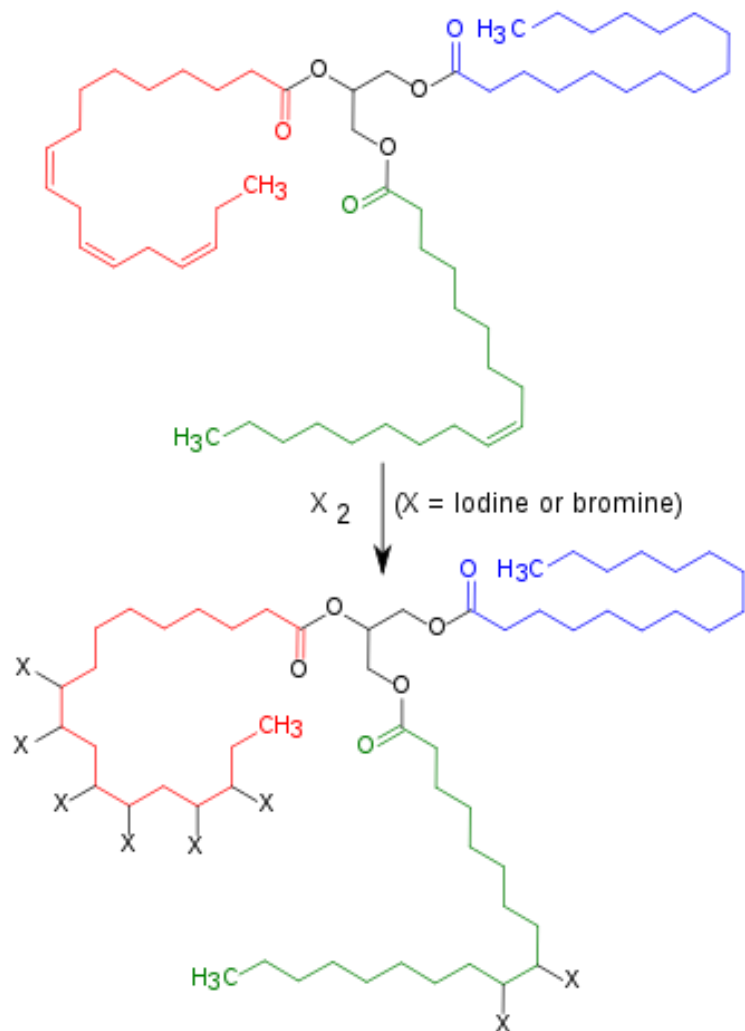
FT-NIR Analyzer for Oils, Fats



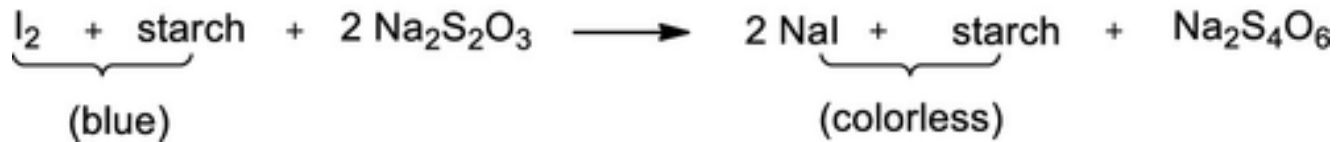
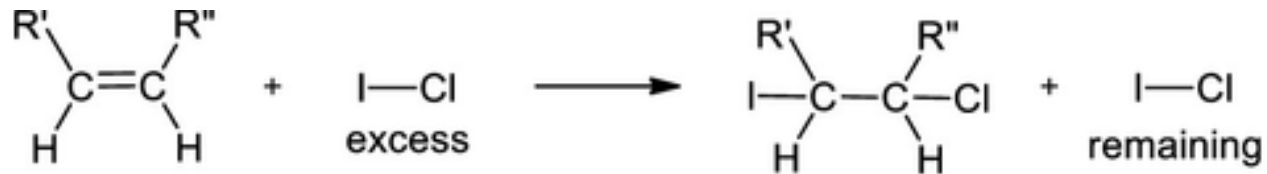


What is iodine value?

Iodine value is the amount of iodine that 100 grams of a particular substance can absorb. In general words, the amount of iodine that can react with a common mass's fat is known as the "**iodine value**" or "**iodine number**" (100 grams).



Προσδιορισμός Αριθμού Ιωδίου



| Oils/fats | Iodine numbers | Normal ranges ^a |
|-----------|----------------|----------------------------|
| Coconut | 11.3 ± 1.28 | 8–10 |
| Soybean | 132.8 ± 2.19 | 125–140 |
| Canola | 122.5 ± 0.911 | 110–126 |
| Safflower | 135 ± 2.01 | 130–140 |
| Olive | 86.1 ± 2.90 | 75–95 |
| Corn | 124 ± 3.82 | 115–130 |
| Pea | 100 ± 2.60 | 85–100 |
| Cod liver | 160 ± 0.85 | 120–180 |
| Butter | 40.0 ± 3.88 | 25–40 |
| Lard | 73.3 ± 4.25 | 45–70 |

Προσδιορισμός Αριθμού Υπεροξειδίων

Reaction of peroxide with HI



Titration of I₂



Extra Virgin Olive Oil

| Existing Extra Virgin Olive Oil Standards | | | | | | |
|---|--|--------------------------------|---|-----------------------------|---|--|
| Chemical Parameters | IOOC - International Olive Oil Council | USDA - US Dept. of Agriculture | COOC - California Olive Oil Council *5,000 gallons or less | EVA - Extra Virgin Alliance | AOOA - Australian Olive Oil Association | Havasü Olive & Garlic Company |
| <u>Free Fatty Acid</u> | ≤ 0.8 | ≤ 0.8 | ≤ 0.5 | ≤ 0.5 | ≤ 0.8 | ≤ 0.3 |
| <u>Peroxide Value</u> | ≤ 20 | ≤ 20 | ≤ 15 | ≤ 15 | ≤ 20 | ≤ 9 |
| <u>Phenolic Content</u> | N/A | N/A | N/A | N/A | N/A | ≥ 130 |
| <u>K232</u> | ≤ 2.50 | ≤ 2.50 | ≤ 2.4 | ≤ 2.2 | ≤ 2.50 | ≤ 2.0 |
| <u>K270</u> | ≤ 0.22 | ≤ 0.22 | ≤ 0.22 | ≤ 0.18 | ≤ 0.22 | ≤ 0.20 |
| <u>ΔK</u> | ≤ 0.01 | ≤ 0.01 | ≤ 0.01* | ≤ 0.01 | ≤ 0.01 | ≤ 0.01 |
| <u>Oleic Acid (C18:1)</u> | 55.0 - 83.0 | 55.0 - 83.0 | N/A | N/A | 53.0 - 85.0 | ≥ 65 |
| <u>DAG</u> | N/A | N/A | ≥ 35* | ≥ 40 | ≥ 35 | ≥ 90 (within 30 days of crush date) |
| <u>PPP</u> | N/A | N/A | ≤ 17* | ≤ 15 | ≤ 17 | ≤ 5 |

* applies to production of less than 5,000 gallons

8.9 PRACTICE PROBLEMS

1. To determine the fat content of a semimoist food by the Soxhlet method, the food was first vacuum oven dried. The moisture content of the product was 25%. The fat in the dried food was determined by the Soxhlet method. The fat content of the dried food was 13.5%. Calculate the fat content of the original semimoist product.
2. The fat content of 10 g of commercial ice cream was determined by the Mojonnier method. The weights of extracted fat after the second extraction and the third extraction were 1.21 g and 1.24 g, respectively. How much of fat, as a percentage of the total, was extracted during the third extraction?

Answers

1. If the sample weight of a semimoist food is 10 g and the moisture content is 25%, the dried weight of the original food is 7.5 g ($10 \text{ g} \times 75\% = 7.5 \text{ g}$). If the fat content of the dried food is 13.5%, the 7.5 g of dried sample has 1.0125 g fat ($7.5 \text{ g dried food} \times 13.5\% \text{ fat} = 1.0125 \text{ g fat}$). The 10 g of semimoist food contains the

same amount of fat, i.e., 1.0125 g. Therefore, the fat content of the semimoist food is 10.125% (1.0125 g fat/10 g semimoist food).

2. $[(1.24 \text{ g} - 1.21 \text{ g}) / 10 \text{ g}] \times 100 = 0.3\%$