

تفريغ كيمياء حيوية



Lipid metabolism

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إعداد الصيدلاني/ة:



لجان الدفعات

ملاحظة: التفريغ للفهم،
غير شامل شرح د. ايمان والمعلومات الاضافية

Lipid metabolism

منه فسمنا ال 4 macromolecules الي احنا عننا بالام ؟
- carbohydrate
- proteins
- lipids
- nucleic acids

3 types of lipids
- اللحيدي ياتي ما يقدر ايتكونه polymer لانه عسكي
كل structure يتشكل عنه التاني .



Raneem Abo Qaoud ✨

Lipid metabolism

- Lipids are water-insoluble organic molecules that can be extracted from tissues by nonpolar solvents إخراج
- Present as membrane associated, lipoproteins or droplets of triglycerides in adipose tissues متم تخزينها
- They are the major source of energy أهم وأكبر مصدر للطاقة في أجسامنا
- Responsible for dissolving fat-soluble vitamins which have regulatory or coenzyme functions in the body A و D و E and K

لأنه فوسفور carbone

phospholipid bilayer of membrane

يرتبط ال LDL بالم
وال HDL قتل

A و D و E and K

عشانه يذوبوا فيهم ... فقال لنا نذهب حدنا فيتامينه منه همدول نحكيه تناوله مع وجبة غنية بالدهونه
عشانه يذوب
أسرع بالدهونه
absorption
يشكل أسرع

Prostaglandins and steroid hormones play role in body's homeostasis

مادة نقل كهرونه
بتنظم هليان كثيره
الظمم مثل ال inflammation
contraction and relaxation of smooth muscles
Lipid مكوته من

immune response
Lipid مكوته من

Lipid digestion

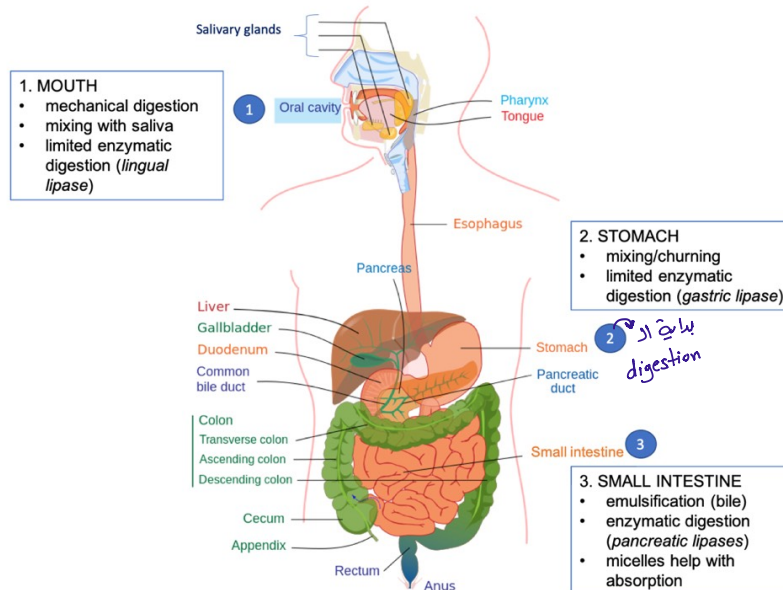
- An adult ingest 60-90 g of fat /day, 90% as triglycerides and the rest as cholesterol, phospholipids and free fatty acids.
- Digestion starts in stomach by lingual lipase and gastric lipase
- Triglycerides of short and medium chain length fatty acids (<12C) are the target of these enzymes.

أقل منه يعني الـ lingual lipase ولا gastric lipase فقط الـ triglycerides الأقصر من 12c
- The enzymes are important in neonates to digest fat in milk and for people with cystic fibrosis (no pancreatic lipase)

التنين يلي حكيما عنهم
حديتي الولادة
لله الـ enzyme يلي بيكمل digestion الـ triglycerides
فلا يكونه عند الشخص الـ cystic fibrosis يكونه المقلص الـ ducts يلي بتأخذ صداد الأوزيم منه
البنكرياس الـ intestine صانالي ما يحوي الـ digestion الـ triglycerides
الـ pancreatic duct
intestine الـ digestion الـ triglycerides
- Emulsification of dietary lipid occurs in duodenum in presence of bile salts and perstalsis which will increase the surface area of digestion

تقليل الحجم وزيادة الـ surface area
للحم غشائي زيبريلام امتصاصه أفضل
- Bile salts are produced in liver and stored in gallbladder

المواد
الأملاح الصفراوية



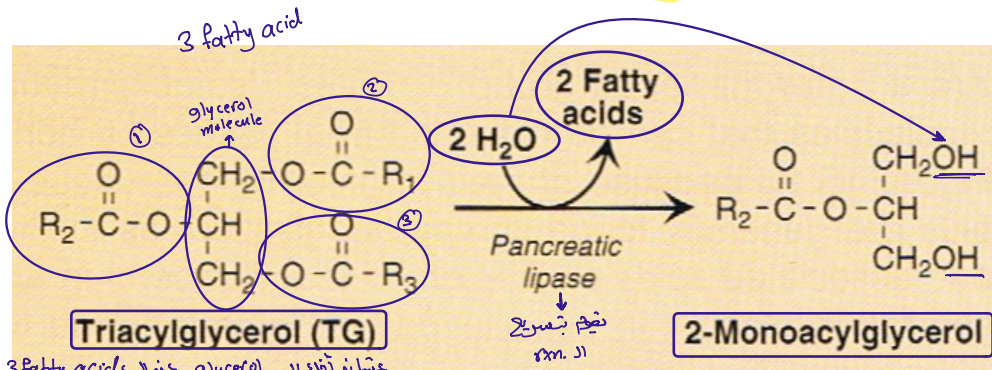
in stomach: - lingual
- gastric

in intestine: pancreatic
lipase

Degradation by pancreatic enzymes

انحلل بواسطة
الإنزيمات البنكرياسية

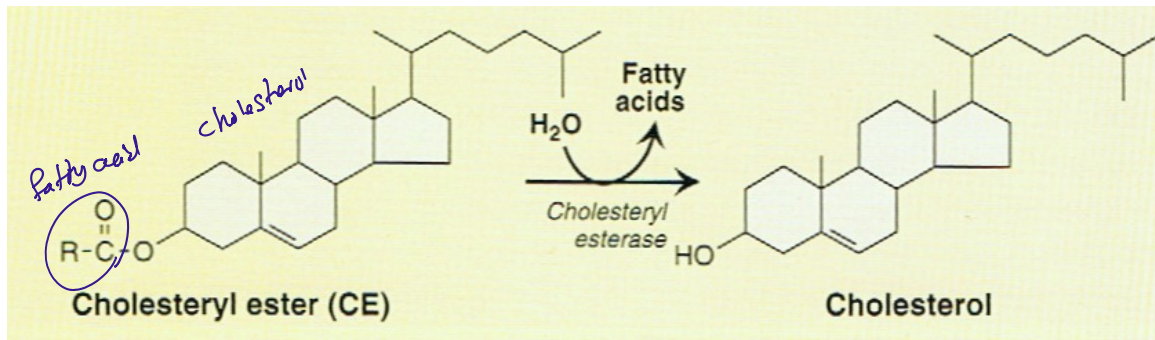
- **Triacylglycerol degradation:**
- Degraded by pancreatic lipase to **2-monoacylglycerol** and free fatty acids
- **Colipase** (activated by trypsin) binds to the lipase in ratio 1:1 and anchors it to the lipid-aqueous interface
- **Orlistat** (antiobesity drug) inhibits gastric and pancreatic lipase and so decrease the absorption of fat



oil

Degradation by pancreatic enzymes

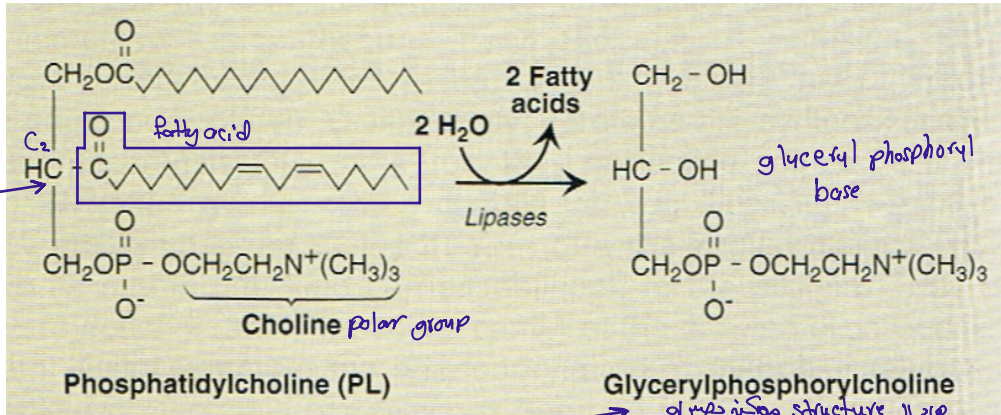
- **Cholesteryl ester degradation:** *esterification of cholesterol*
- 10-15% of cholesterol is present in **esterified form** *esterification of*
- It is hydrolyzed by **pancreatic cholesteryl esterase** *cholesterol و fatty acid بين ال ester bond يقطع* to cholesterol and free fatty acids
- The activity of the enzyme is increased in the presence of **bile salt**



Degradation by pancreatic enzymes

- Phospholipid degradation (like phosphatidylcholine):
- Degraded by **phospholipase A2** in presence of bile salts by removal of one fatty acid from C2 of PL to form lysophospholipid
- Lysophospholipid is hydrolyzed by **lysophospholipase** leaving free fatty acid and glyceryl phosphoryl base that can excreted in feces, further degraded or absorbed

phospholipase A2 يجعل C2
 لا fatty acid كوجود على C2
 lysophospholipid
 فحيدر اسه
 ↓
 hydrolysis
 بواسطه انزيم تاني اسمه
 lysophospholipase
 وينتج عنده



ال Structure ال
 excreted in feces
 degrader ال
 absorbed ال

Control of lipid digestion

- It is hormonally controlled *تتمكنة بطريقة hormones*
- *الهرمونات الأذن* Cholecystikinin (CCK) which is secreted from the mucosa of jejunum and lower duodenum and acts on:
 - Gallbladder to release bile
 - Pancreas to release pancreatic enzymes
 - Decrease gastric motility and so decrease gastric emptying
- *الهرمونات الثاني* Secretin which is secreted by other intestinal cells in response to the lower pH of the chyme cause pancreas and liver to release bicarbonate which will neutralize the pH making it optimum for the pancreatic enzymes to work *تقريباً*

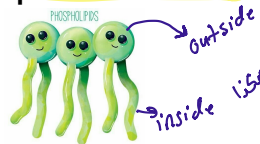
↓
الخطية
ال digested
food
gastric juice
منه (stomach) ينزل
ال intestinal
↑ acidity (pH ↓)

Absorption of lipids by intestinal mucosal cells

- The degradation products of lipids together with bile salts form mixed micelle (hydrophobic inside and hydrophilic outside)

لumen
intestin

lipids
hydrophobic
hydrophilic



- The hydrophilic surface facilitate the transport of the hydrophobic lipids through the unstirred water layer to the brush boarder membrane where they are absorbed.

تحت جوارح
نقصه
الayer

intestin membrane

Polan
intestin
lumen

- Formation of mixed micelles is not required for the absorption of short and medium chain length fatty acids

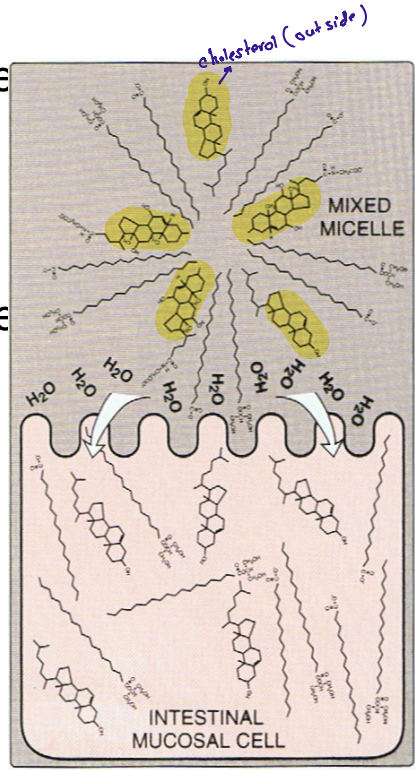
Short lipids
فيس

أقصر

degraded products of lipids?

- glycerol phosphoryl choline + fatty acid
- cholesterol + fatty acid
- 2 monoacylglycerol + fatty acid

micelle



micelle
outside
unstirred water (polar) layer
hydrophilic lipids (polar)

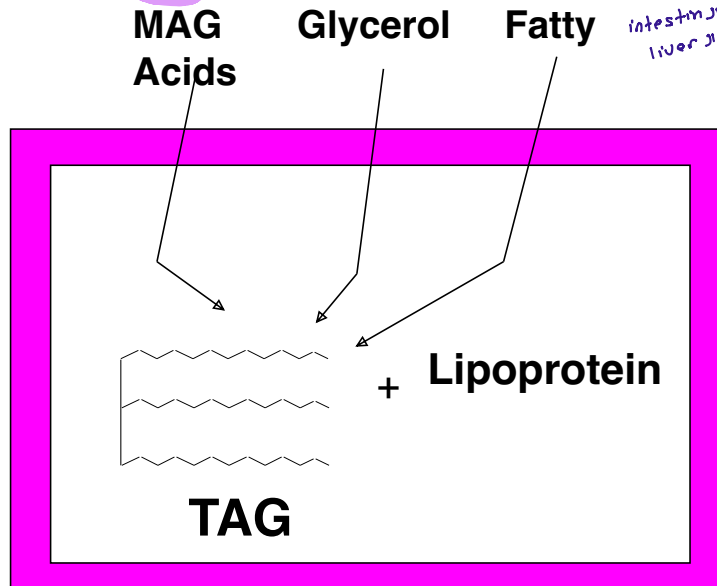
micelle
unstirred water layer
micelle

Absorption of lipids by intestinal mucosal cells

- In enterocytes **triacylglycerol** and **cholesteryl esters** are resynthesized → جوا خلايا ال intestine
 * ج يرجوا ال lipids زي ما كانوا degradation قبل ما يفسدهم
 همدل بي مكننا حنهم بال كيدي قبل (<12C) ما في داعي انفسلهم CoA enzyme
- (Short and medium chain length fatty acids) are not converted to their CoA derivatives but released into **portal circulation** and carried by **serum albumin** to the **liver** to be metabolized.
 partial circulation ال enterocytes ال جوا فوا حن ال ال
 برو تينز موجود بالدم
 بين ال intestine ال liver

انهم لا يربح الهوي

Intestinal lumen

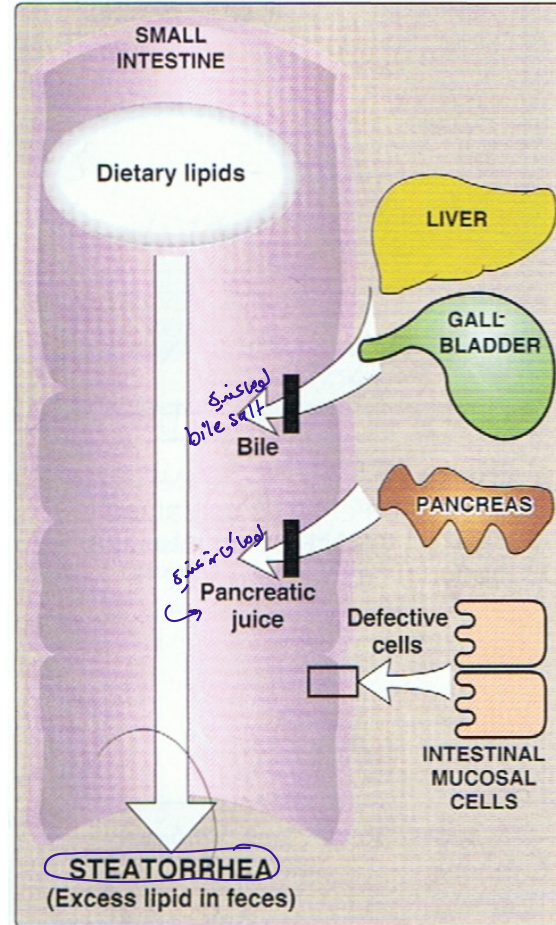


بِسببِ زَيْدِ الدَّلِ لِيَا ما صارها absorption فما راجع الدم وبالنتي طاعت منه طويلا feces دسبب **Lipid malabsorption (Steatorrhea)**

Cystic fibrosis

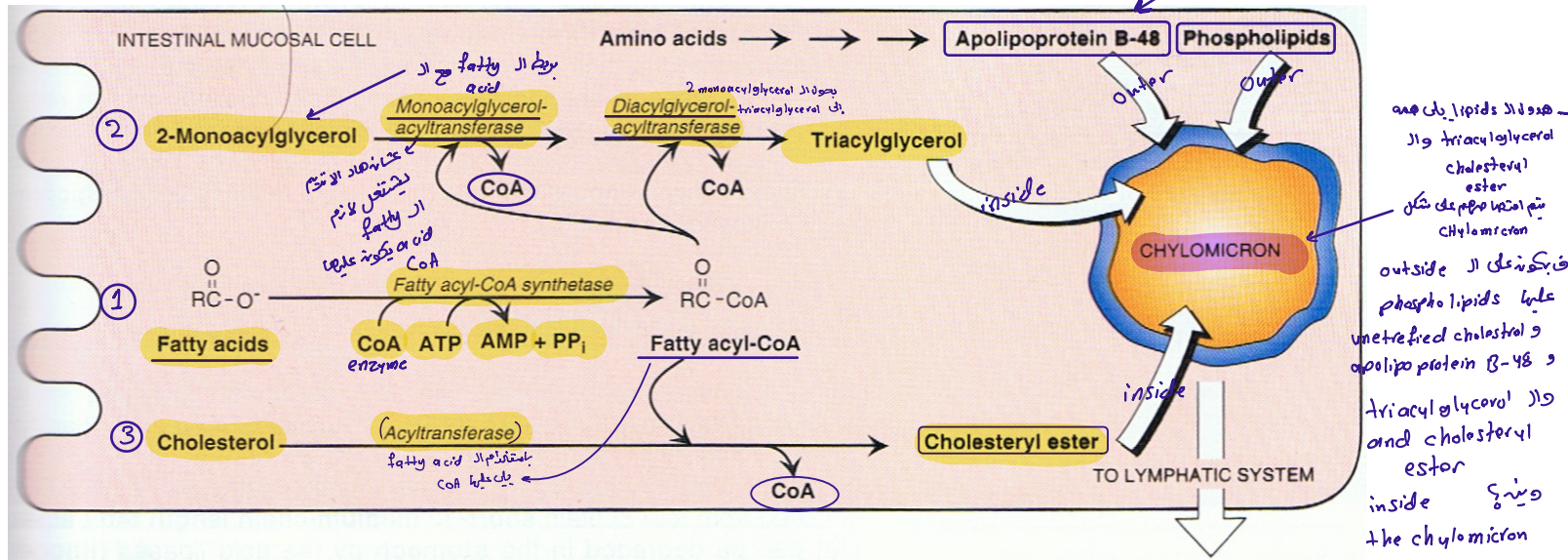
Shortened bowel

Both causes **decrease in absorption of lipids** (including **fat soluble vitamins and essential fatty acids**) leading to **increase in lipids in feces** (Steatorrhea)



Secretion of lipids from enterocytes

- **Phospholipids**, unesterified cholesterol, and (apolipoprotein B-48) are at the **outer layer** and **triacylglycerol** and **cholesterol ester** form **chylomicrons**. And this is released to the **chyle** (milky appearance)
- This is released to blood



Use in tissue

اكثر صحة من ذلك
Chylomicron في content



- Triacylglycerol is broken down primarily in the capillaries of skeletal muscle, adipose tissues, heart, lung, kidney, and liver.
- Triacylglycerol in chylomicrons is degraded to free fatty acids and glycerol by lipoprotein lipase. This enzyme is synthesized primarily by adipocytes and muscle cells.
- Familial lipoprotein lipase deficiency (type I hyperlipoproteinemia) is a rare, autosomal recessive disorder that results from a deficiency of lipoprotein lipase or its coenzyme, apo C-II. The result is massive chylomicronemia.

Fate of free fatty acids

يأتي لثلاثي منة تكسير ال triacylglycerol

- The free fatty acids derived from the hydrolysis of triacylglycerol may directly enter adjacent muscle cells or adipocytes

ممكنة نقل بالدم معصولة على ال albumin طرما تختصتها ال cells

- The free fatty acids may be transported in the blood in association with serum albumin until they are taken up by cells.

لثمة

- Most cells can oxidize fatty acids to produce energy

↓ مشت ال all

* most cells حتى ال cells لأنه ال oxidation بغير بار mitochondria / ولكن عند خلايا ما فيها mitochondria زي في RBCs فيالتالي ما بيقدروا

يحلوا oxidation لهدول ال fatty acids ... ونفس التي ال platelet وال brain cells

- Adipocytes can also reesterify free fatty acids to produce triacylglycerol molecules, which are stored until the fatty acids are needed by the body. بيتم تخزينها لوقت حاجة (زي الصيام)

Fate of glycerol

- **Glycerol** that is released from **triacylglycerol** used almost **exclusively** by the **liver** to produce **glycerol 3-phosphate**, which can enter either **glycolysis** or **gluconeogenesis** by oxidation to **dihydroxyacetone phosphate**

(على مستوى السكر)

(على تصنيع السكر)

ال glycerol وينتج بروتين؟ بروتين على الـ liver exclusively (حصرياً على الكبد فقط)

صبي لست؟ لأنه بالـ liver في عندي enzyme اسمه glycerol kinase يعمل لا glycerol ← phosphorylation وينتج الـ glycerol-3-phosphate

