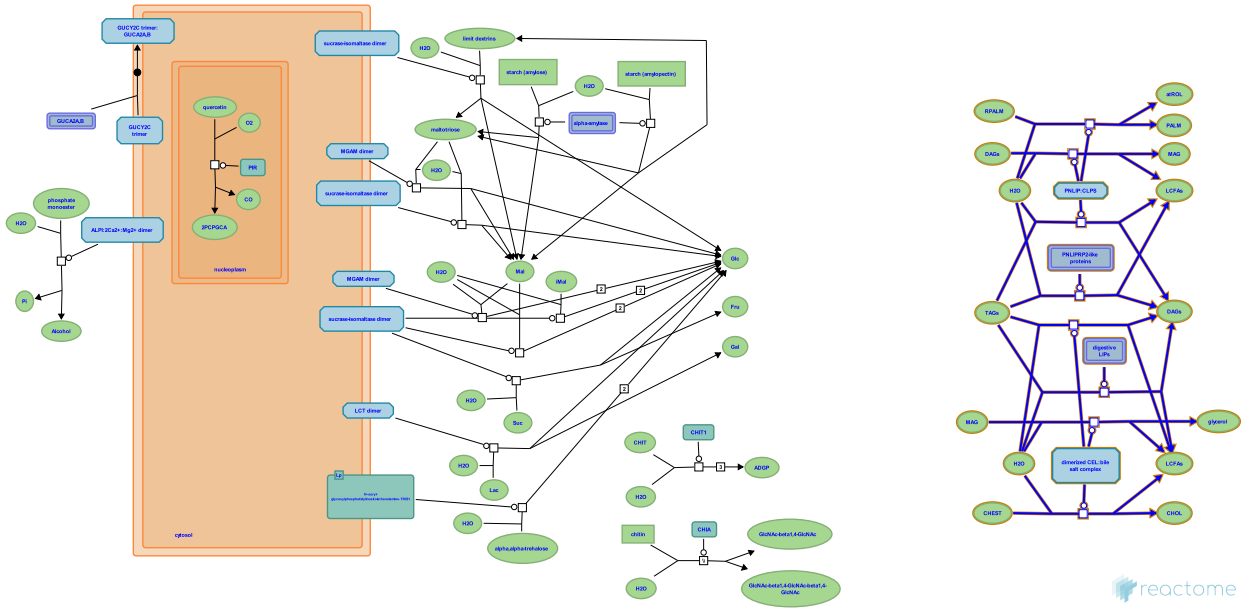
Digestion of dietary lipid



D'Eustachio, P., Jassal, B., Stephan, R.

European Bioinformatics Institute, New York University Langone Medical Center, Ontario Institute for Cancer Research, Oregon Health and Science University.

This is just an excerpt of a full-length report for this pathway. To access the complete report, please download it at the Reactome Textbook.

16/09/2024

Introduction

Reactome is open-source, open access, manually curated and peer-reviewed pathway database. Pathway annotations are authored by expert biologists, in collaboration with Reactome editorial staff and cross-referenced to many bioinformatics databases. A system of evidence tracking ensures that all assertions are backed up by the primary literature. Reactome is used by clinicians, geneticists, genomics researchers, and molecular biologists to interpret the results of high-throughput experimental studies, by bioinformaticians seeking to develop novel algorithms for mining knowledge from genomic studies, and by systems biologists building predictive models of normal and disease variant pathways.
The development of Reactome is supported by grants from the US National Institutes of Health (P41 HG003751), University of Toronto (CFREF Medicine by Design), European Union (EU STRP, EMI-CD), and the European Molecular Biology Laboratory (EBI Industry program).

Literature references

Fabregat, A., Sidiropoulos, K., Viteri, G., Forner, O., Marin-Garcia, P., Arnau, V. et al. (2017). Reactome pathway analysis: a high-performance in-memory approach. *BMC bioinformatics, 18*, 142. ↗

Sidiropoulos, K., Viteri, G., Sevilla, C., Jupe, S., Webber, M., Orlic-Milacic, M. et al. (2017). Reactome enhanced pathway visualization. *Bioinformatics, 33*, 3461-3467. ↗

Fabregat, A., Jupe, S., Matthews, L., Sidiropoulos, K., Gillespie, M., Garapati, P. et al. (2018). The Reactome Pathway Knowledgebase. *Nucleic Acids Res, 46*, D649-D655. ↗

Fabregat, A., Korninger, F., Viteri, G., Sidiropoulos, K., Marin-Garcia, P., Ping, P. et al. (2018). Reactome graph database: Efficient access to complex pathway data. *PLoS computational biology, 14*, e1005968. ↗

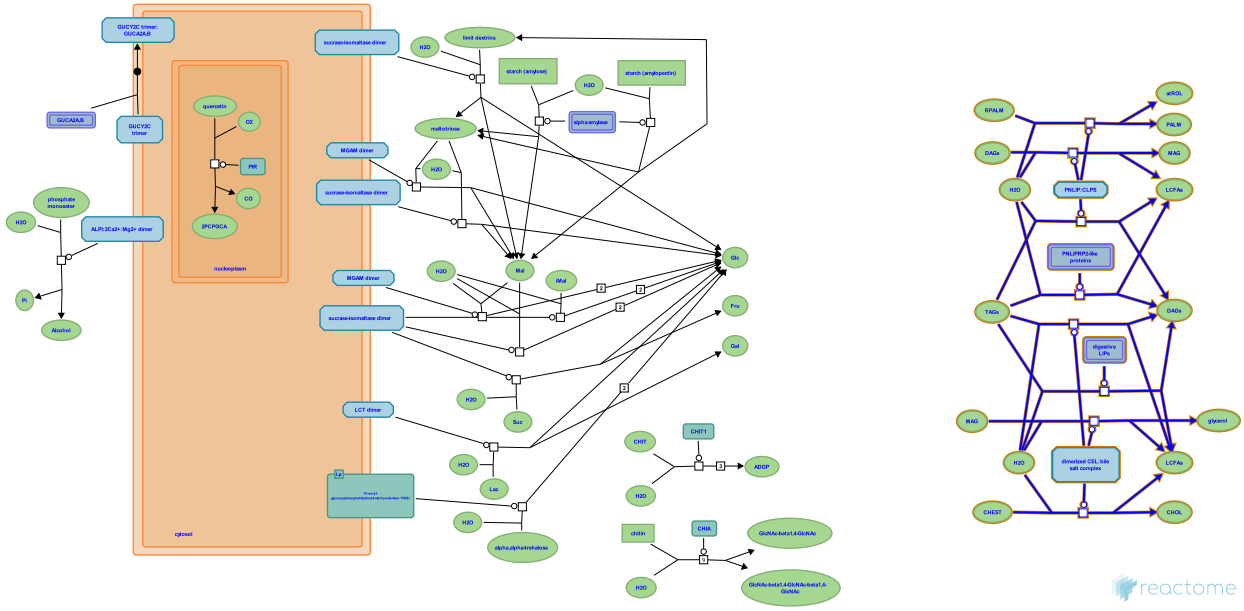
Reactome database release: 89

This document contains 1 pathway and 8 reactions (see Table of Contents)

Digestion of dietary lipid ↗

Stable identifier: R-HSA-192456

Compartments: extracellular region



Dietary lipids such as long-chain triacylglycerols and cholesterol esters are digested in the stomach and small intestine to yield long-chain fatty acids, monoacylglycerols, glycerol and cholesterol through the action of a variety of lipases, and are then absorbed into enterocytes.

Literature references

Lombardo, D. (2001). Bile salt-dependent lipase: its pathophysiological implications. *Biochim Biophys Acta, 1533*, 1-28 . ↗

Lowe, ME. (2002). The triglyceride lipases of the pancreas. *J Lipid Res, 43*, 2007-16. ↗

Editions

2007-02-03	Authored, Edited	D'Eustachio, P.

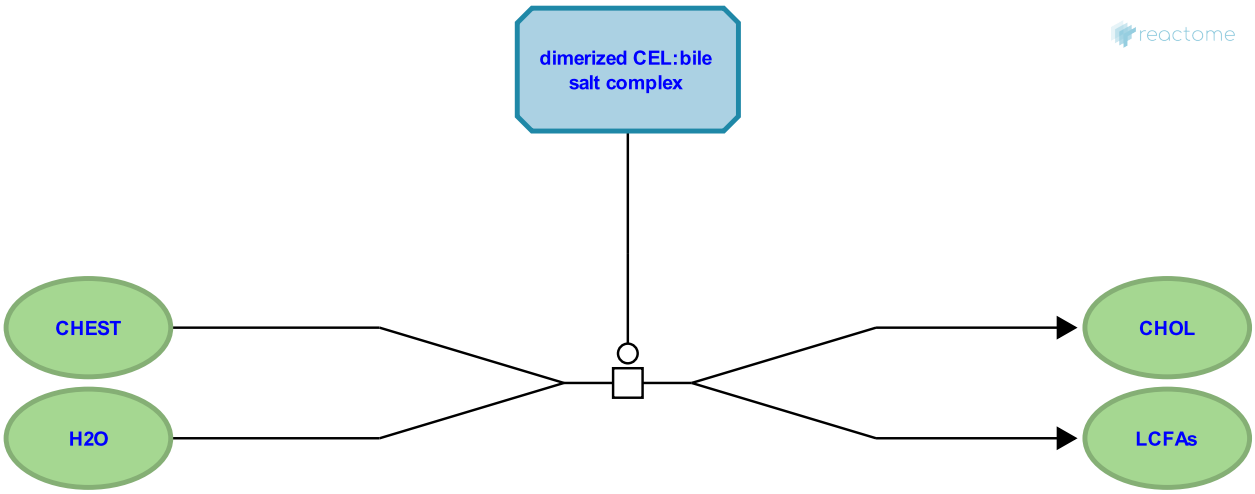
Digestion of cholesterol esters by extracellular CEL (bile salt-dependent lipase)

Location: Digestion of dietary lipid

Stable identifier: R-HSA-192417

Type: transition

Compartments: extracellular region



CEL (bile salt-dependent lipase) catalyzes the hydrolysis of extracellular cholesterol esters to yield cholesterol and a long-chain fatty acid. This reaction, in the lumen of the small intestine, is part of the process of digestion of dietary fats.

While alternative splicing gives rise to two CEL isoforms, only the longer one encodes all of the residues that form the active site of the enzyme (Reue et al. 1991). In vitro, monomeric CEL protein is active even in the absence of bile salts. Its activity is greatly increased when it is complexed with two molecules of cholate, chenodeoxycholate, or their glycine or taurine conjugates (Lombardo and Guy 1980), and the predominant form of the enzyme active on lipid micelles in the gut is a dimer of two such complexes (Aubert-Jousset et al. 2004).

CEL is synthesized in pancreatic acinar cells and released into the small intestine. It is also synthesized in the mammary gland and is a constituent of breast milk. The milk CEL is thought to play a role in digestion of milk fat in newborn infants, whose own pancreatic synthesis of the enzyme is low (Lombardo 2001; Bernback et al. 1990).

Literature references

Guy, O., Lombardo, D. (1980). Studies on the substrate specificity of a carboxyl ester hydrolase from human pancreatic juice. II. Action on cholesterol esters and lipid-soluble vitamin esters. *Biochim Biophys Acta, 611*, 147-55.

Editions

2007-02-03	Authored	D'Eustachio, P.

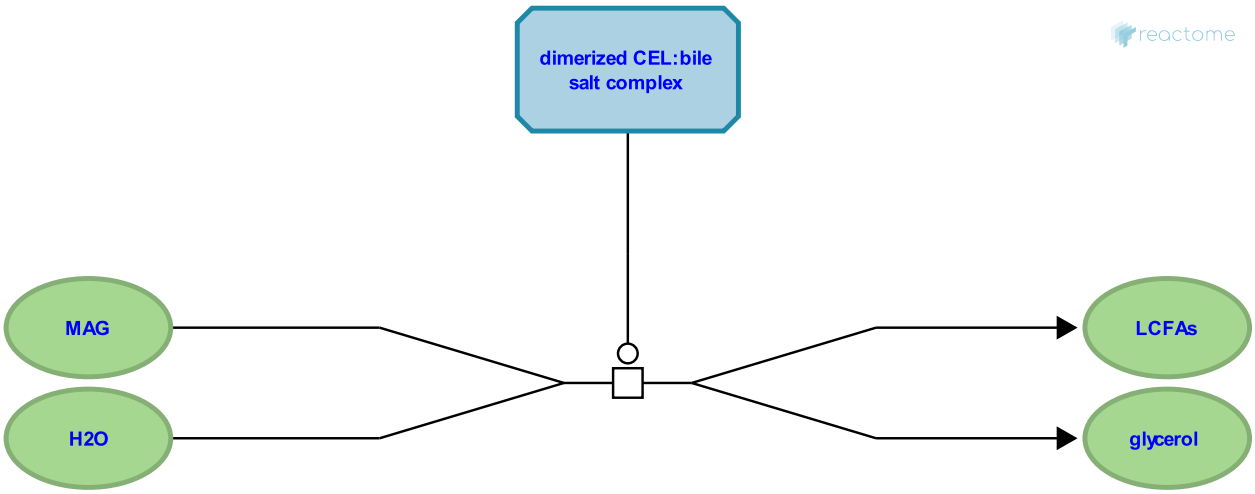
Digestion of monoacylglycerols by extracellular CEL (bile salt-dependent lipase) ↗

Location: Digestion of dietary lipid

Stable identifier: R-HSA-192425

Type: transition

Compartments: extracellular region



CEL (bile salt-dependent lipase) catalyzes the hydrolysis of extracellular monoacylglycerols to yield glycerol and a long-chain fatty acid. This reaction, in the lumen of the small intestine, is essential for the complete digestion of milk-derived triacylglycerols in the nursing infant (Bernback et al. 1990). Its importance in adult fat digestion is unclear.

While alternative splicing gives rise to two CEL isoforms, only the longer one encodes all of the residues that form the active site of the enzyme (Reue et al. 1991). In vitro, monomeric CEL protein is active even in the absence of bile salts. its activity is greatly increased when it is complexed with two molecules of cholate, chenodeoxycholate, or their glycine or taurine conjugates (Lombardo and Guy 1980), and the predominant form of the enzyme active on lipid micelles in the gut is a dimer of two such complexes (Aubert-Jousset et al. 2004).

CEL is synthesized in pancreatic acinar cells and released into the small intestine. It is also synthesized in the mammary gland and is a constituent of breast milk (Lombardo 2001; Bernback et al. 1990).

Preceded by: Digestion of diacylglycerols by extracellular PTL:colipase

Literature references

Hernell, O., Bernback, S., Blackberg, L. (1990). The complete digestion of human milk triacylglycerol in vitro requires gastric lipase, pancreatic colipase-dependent lipase, and bile salt-stimulated lipase. *J Clin Invest, 85*, 1221-6 . ↗

Editions

2007-02-03	Authored	D'Eustachio, P.

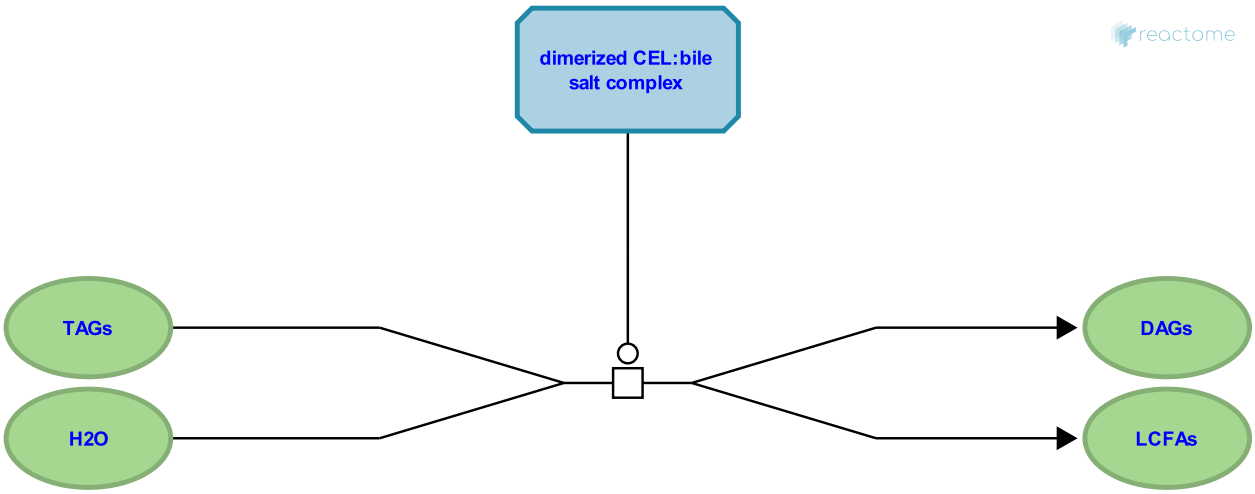
Digestion of triacylglycerols by extracellular CEL (bile salt-dependent lipase) ↗

Location: Digestion of dietary lipid

Stable identifier: R-HSA-192430

Type: transition

Compartments: extracellular region



CEL (bile salt-dependent lipase) catalyzes the hydrolysis of extracellular monoacylglycerols to yield glycerol and a long-chain fatty acid. This reaction, in the lumen of the small intestine, is essential for the complete digestion of milk-derived triacylglycerols in the nursing infant (Bernback et al. 1990). Its importance in adult fat digestion is unclear.

While alternative splicing gives rise to two CEL isoforms, only the longer one encodes all of the residues that form the active site of the enzyme (Reue et al. 1991). In vitro, monomeric CEL protein is active even in the absence of bile salts. its activity is greatly increased when it is complexed with two molecules of cholate, chenodeoxycholate, or their glycine or taurine conjugates (Lombardo and Guy 1980), and the predominant form of the enzyme active on lipid micelles in the gut is a dimer of two such complexes (Aubert-Jousset et al. 2004).

CEL is synthesized in pancreatic acinar cells and released into the small intestine. It is also synthesized in the mammary gland and is a constituent of breast milk (Lombardo 2001; Bernback et al. 1990).

Followed by: Digestion of diacylglycerols by extracellular PTL:colipase

Literature references

Guy, O., Fauvel, J., Lombardo, D. (1980). Studies on the substrate specificity of a carboxyl ester hydrolase from human pancreatic juice. I. Action on carboxyl esters, glycerides and phospholipids. *Biochim Biophys Acta, 611*, 136-46. ↗

Editions

2007-02-03	Authored	D'Eustachio, P.

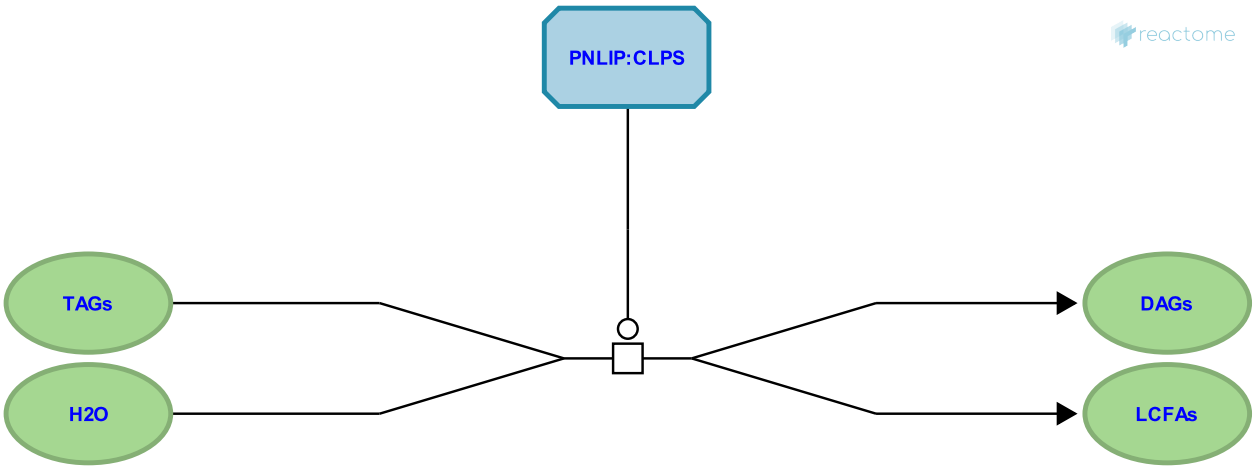
Digestion of triacylglycerols by extracellular PTL:colipase ↗

Location: Digestion of dietary lipid

Stable identifier: R-HSA-192422

Type: transition

Compartments: extracellular region



Pancreatic lipase catalyzes the hydrolysis of extracellular triacylglycerols to yield diacylglycerols and long-chain fatty acids. The enzyme is active only when complexed with colipase protein and plays a major role in the digestion of dietary triacylglycerols in the small intestine (Carriere et al. 2000; Giller et al. 1992).

Followed by: Digestion of diacylglycerols by extracellular PTL:colipase

Literature references

Buchwald, P., Giller, T., Hunziker, W., Blum-Kaelin, D. (1992). Two novel human pancreatic lipase related proteins, hPLRP1 and hPLRP2. Differences in colipase dependence and in lipase activity. *J Biol Chem, 267*, 16509-16. ↗

Ferrato, F., De Caro, J., Verger, R., Laugier, R., Renou, C., Lopez, V. et al. (2000). The specific activities of human digestive lipases measured from the in vivo and in vitro lipolysis of test meals. *Gastroenterology, 119*, 949-60. ↗

Editions

2007-02-03	Authored	D'Eustachio, P.

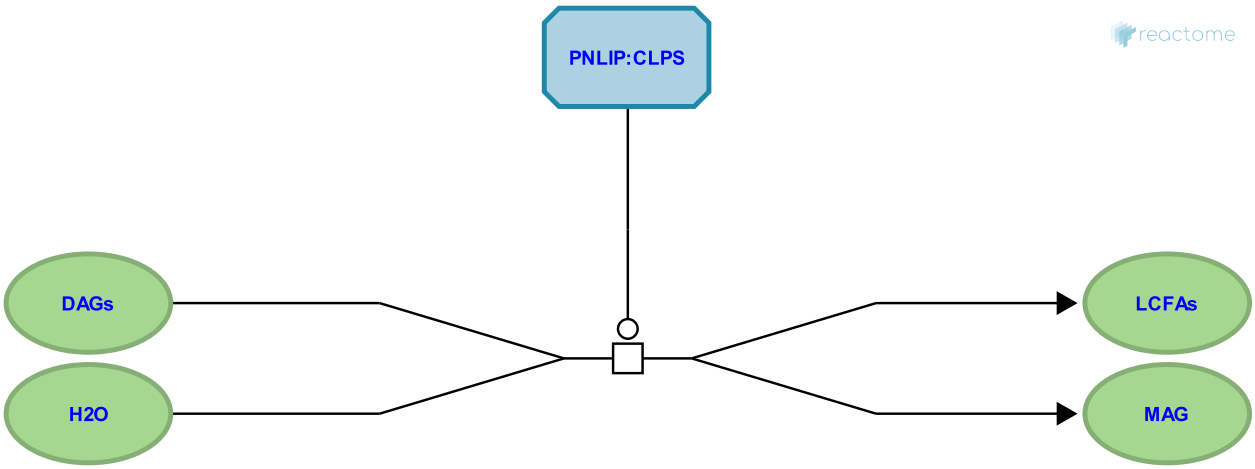
Digestion of diacylglycerols by extracellular PTL:colipase ↗

Location: Digestion of dietary lipid

Stable identifier: R-HSA-192434

Type: transition

Compartments: extracellular region



Pancreatic lipase catalyzes the hydrolysis of extracellular dicylglycerols to yield monoacylglycerols and long-chain fatty acids. The enzyme is active only when complexed with colipase protein and plays a major role in the digestion of dietary diacylglycerols in the small intestine (Carriere et al. 2000; Giller et al. 1992).

Preceded by: Digestion of triacylglycerols by extracellular CEL (bile salt-dependent lipase), Digestion of triacylglycerols by extracellular PTL:colipase

Followed by: Digestion of monoacylglycerols by extracellular CEL (bile salt-dependent lipase)

Literature references

Buchwald, P., Giller, T., Hunziker, W., Blum-Kaelin, D. (1992). Two novel human pancreatic lipase related proteins, hPLRP1 and hPLRP2. Differences in colipase dependence and in lipase activity. *J Biol Chem, 267*, 16509-16. ↗

Ferrato, F., De Caro, J., Verger, R., Laugier, R., Renou, C., Lopez, V. et al. (2000). The specific activities of human digestive lipases measured from the in vivo and in vitro lipolysis of test meals. *Gastroenterology, 119*, 949-60. ↗

Editions

2007-02-03	Authored	D'Eustachio, P.

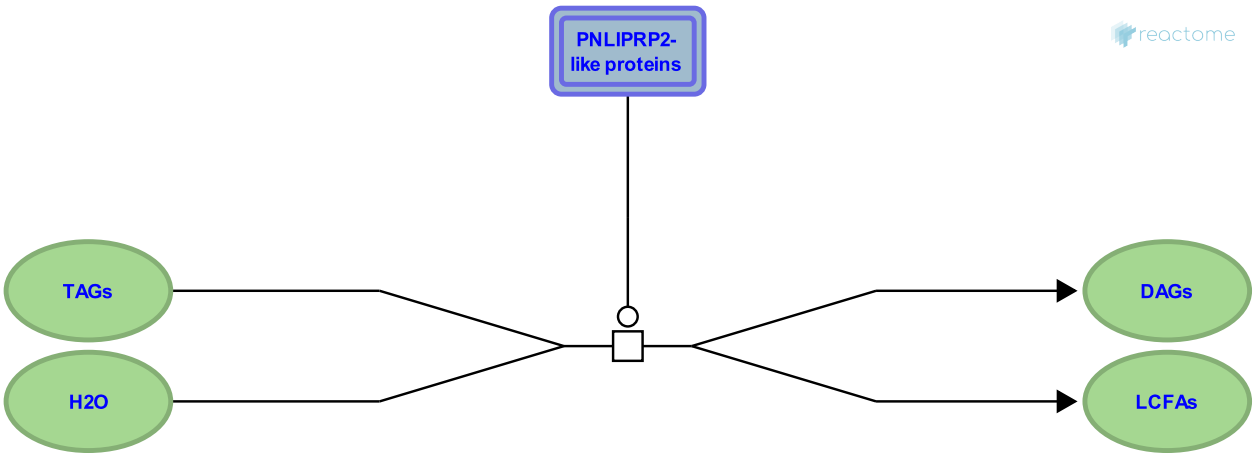
Digestion of triacylglycerols by extracellular pancreatic lipase-related protein 2 ↗

Location: Digestion of dietary lipid

Stable identifier: R-HSA-192475

Type: transition

Compartments: extracellular region



Pancreatic lipase-related protein 2 catalyzes the hydrolysis of extracellular triacylglycerols to yield diacylglycerols and free long-chain fatty acids. This enzyme, unlike the closely related pancreatic lipase protein, does not require colipase protein for activity. The protein is synthesized in the pancreas, but its role in the digestion of dietary fat has not been established (Giller et al. 1992).

Literature references

Buchwald, P., Giller, T., Hunziker, W., Blum-Kaelin, D. (1992). Two novel human pancreatic lipase related proteins, hPLRP1 and hPLRP2. Differences in colipase dependence and in lipase activity. *J Biol Chem, 267*, 16509-16. ↗

Editions

2007-02-03	Authored	D'Eustachio, P.

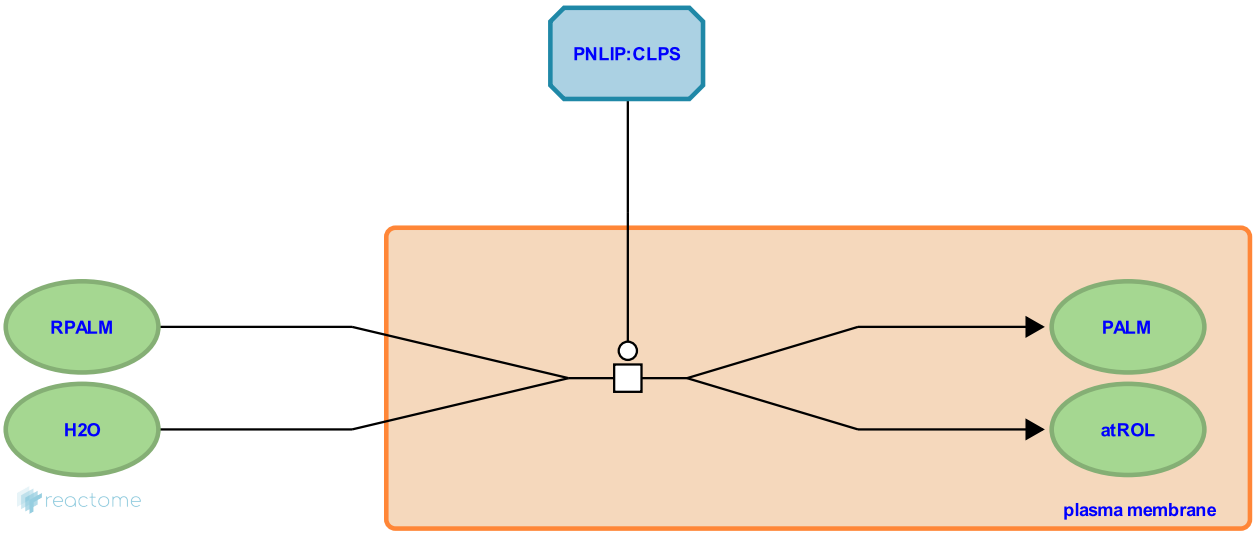
PNLIP:CLPS hydrolyses RPALM to atROL and PALM ↗

Location: Digestion of dietary lipid

Stable identifier: R-HSA-975593

Type: transition

Compartments: plasma membrane, extracellular region



Part of nutritional vitamin A is in the form of retinyl esters (REs). The main fatty acids which can form esters with retinol are palmitate, oleate, stearate and linoleate. REs are digested together with other lipids, and by the same enzymes. Pancreatic lipase catalyses the hydrolysis of RE to all-trans-retinol (atROL) and fatty acid which are then both taken up by enterocytic cell membranes (Bennekum et al. 2000).

Literature references

Fisher, EA., Harrison, EH., van Bennekum, AM., Blaner, WS. (2000). Hydrolysis of retinyl esters by pancreatic triglyceride lipase. *Biochemistry, 39*, 4900-6. ↗

Editions

2010-09-19	Authored	Stephan, R.
2010-10-01	Edited	Jassal, B.
2010-11-09	Reviewed	D'Eustachio, P.

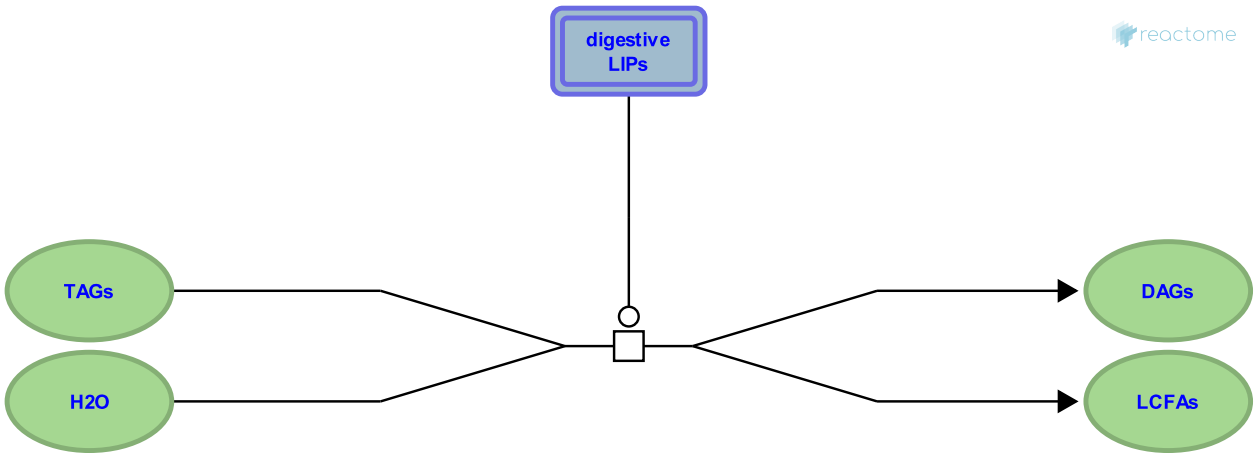
LIPs hydrolyze TG to DAG and LCFA ↗

Location: Digestion of dietary lipid

Stable identifier: R-HSA-8979996

Type: transition

Compartments: extracellular region



Lipases are enzymes that hydrolyse dietary lipids such as fats, oils and triglycerides. The majority of human lipases are secreted by the pancreas and function mainly in the digestive system. Humans not only digest fat with pancreatic lipases but also with gastric lipase (LIPF) (Roussel et al. 1999). The pancreatic lipase-related protein 3 (PNLIPRP3) is another candidate lipase included here.

Literature references

Egloff, MP., Rivière, M., Cambillau, C., Roussel, A., Dupuis, L., Verger, R. et al. (1999). Crystal structure of human gastric lipase and model of lysosomal acid lipase, two lipolytic enzymes of medical interest. *J. Biol. Chem., 274*, 16995-7002. ↗

Editions

2015-07-30	Authored, Edited	Jassal, B.
2015-09-14	Reviewed	D'Eustachio, P.

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