

Lowe ME, et al "Pancreatic triglyceride lipase and colipase: insights into dietary fat digestion" Gastroenterology 1994 Nov;107(5):1524-36

Pancreatic triglyceride lipase is essential for efficient digestion of dietary fats.

Fave G, et al "Physicochemical properties of lipids: new strategies to manage fatty acid bioavailability" Cell Moll Biol (Noisy-le-grand) 2004 Nov;50(7):815-31

Triglyceride structure affects digestion, absorption and fatty acid metabolism  
Optimal fatty acid transport to specific tissues is dependent on vehicle molecule (triglyceride, ethyl ester, phospholipids)

Avijit Hazra, et al "Pharmacology and therapeutic potential of the n-3 polyunsaturated fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in fish oils" Indian Journal of Pharmacology 1999; 31: 247-264

The rate of absorption varies with the form in which they are administered.

Carlier H, et al "Digestion and absorption of polyunsaturated fatty acids" Reprod Nutr Dev. 1991;31(5):475-500

Because of the specificity of the pancreatic lipid hydrolases, triglyceride fatty acid distribution is an essential parameter in the digestibility of fats. The efficiency of intestinal intake depends on the hydrolysis and especially on their micellarization. N-3 polyunsaturated fatty acid ethyl ester digestion is recognized as being impaired

Christensen MS, et al "Intestinal absorption and lymphatic transport of eicosapentaenoic (EPA), docosahexaenoic (DHA), and decanoic acids: dependence on intramolecular structure." Am J Clin Nutr 1995;61:56-61

Dyerberg P, et al "Bioavailability of n-3 Fatty Acid Formulations In n-3 Fatty Acids: Prevention and Treatment in Vascular Disease." 1995

Beckerman B, et al, "Comparative bioavailability of eicosapentaenoic acid and docosahexaenoic acid from triglycerides, free fatty acids and ethyl esters in volunteers" Arzneimittelforschung. 1990 Jun;40(6):700-4

Mean relative bioavailability of EPA/DHA compared to triglycerides was 186/136% from free fatty acids and 40/48% from ethyl esters. Maximal plasma levels were about 50% higher with free fatty acids and about 50% lower with ethyl esters compared to triglycerides.

Lawson LD, et al, "Absorption of eicosapentaenoic acid and docosahexaenoic acid from fish oil triacylglycerols or fish oil ethyl esters co-ingested with a high-fat meal." Biochem Biophys Res Commun. 1988 Oct 31;156(2):960-3

With a high fat meal (44g), absorption of EPA, but not DHA, from fish oil triacylglycerols was significantly improved from 69% to 90% by co-ingestion with a high-fat meal. Absorption of both EPA and DHA from fish oil ethyl esters increased three-fold, to about 60%, indicating that absorption of fatty acid ethyl esters is highly dependent on the amount of co-ingested fat.

Lawson LD, et al "Human absorption of fish oil fatty acids as triacylglycerols, free acids, or ethyl esters." Biochem Biophys Res Commun. 1988 Apr;152(1):328-35

As free acids, the fish oil fatty acids were well absorbed (greater than or equal to 95%). As triacylglycerols, eicosapentaenoic acid (1.00g) and docosahexaenoic acid (.67g) were absorbed 68% and 57% as well as the free acids. The ethyl esters were absorbed only 20% and 21% as well as the free acids.

el Boustani S, et al "*Enteral absorption in man of eicosapentaenoic acid in different chemical forms*" *Lipids* 1987 Oct;22(10):711-4

EPA incorporation into plasma triglyceride was markedly smaller and later when EPA was administered as an ethyl ester rather than as EPA free fatty acid, EPA arginine salt, or 1,3-dioctanoyl-2-eicosanpentaenoic glycerol (2-EPA).

Yang LY, et al "*Lipolysis of menhaden oil triacylglycerols and the corresponding fatty acid alkyl esters by pancreatic lipase in vitro: a reexamination*" *J Lipid Res* 1990 Jan;31(1):137-47

In vitro, ethyl esters were hydrolyzed 10-50 times more slowly than corresponding glyceryl esters

Yang LY, et al "*Luminal hydrolysis of menhaden and rapeseed oils and their fatty acid methyl and ethyl esters in the rat*" *Biochem Cell Biol* 1989 Apr-May;67(4-5):192-204

Methyl and ethyl esters are hydrolyzed about 4 times more slowly than the corresponding triacylglycerols

Ikeda I, et al "*Digestion and lymphatic transport of eicosapentaenoic and docosahexaenoic acids given in the form of triacylglycerol, free acid and ethyl ester in rats*" *Biochem Biophys Acta* 1995 Dec 7;1259(3):297-304

Lymphatic recovery of EPA and DHA in rats given TriEPA and TriDHA was significantly higher at the first 3 hours after administration compared to those given as free acid or ethyl ester. 24 hour recovery was comparable between triacylglycerol (TAG) and free acid, while it was significantly lower in ethyl ester. In vitro, the hydrolysis rate by pancreatic lipase of ethyl ester was extremely low even in 6 hours incubation with lipase.

Reicks M, et al "*Recovery of fish-oil derived fatty acids in lymph of thoracic duct of cannulated Wistar rats*" *Lipids* 1990 Jan;25(1):6-10

After 24 hours, the absorption of eicosapentaenoic acid was greater for the free fatty acid and menhaden oil than for the ethyl ester form, but docosahexaenoic acid was comparable for all forms.