ISSUE 25
CAYMAN CURRENTS

Cayman CHEMICAL

DIETARY FATTY ACIDS

IN THIS ISSUE:

Measurement of lipid mediators of resolution of inflammation after ω-3 fatty acid supplementation in humans

by Anne Barden, Ph.D. and Trevor Mori, Ph.D.
School of Medicine and Pharmacology, University of Western Australia

Epidemiological, clinical, and animal studies provide substantial support that the long chain ω-3 fatty acids from fish and fish oils, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are cardioprotective, particularly in the setting of secondary prevention.[1] Population studies have shown that ω-3 fatty acids have anti-arrhythmic effects that protect against sudden cardiac death. ω-3 Fatty acids benefit multiple cardiometabolic risk factors including blood pressure, vascular reactivity, arterial compliance, cardiac function, and lipid metabolism, as well as having antithrombotic, anti-oxidative, and anti-inflammatory actions.[1]

EPA and DHA improve outcomes in a number of disease states associated with inflammation including rheumatoid arthritis, acute myocardial infarction, and heart failure.[1,2] The mechanisms by which ω-3 fatty acids exert their protection are still emerging but likely include alterations in cell membrane composition and effects on gene expression and receptors regulating signaling. The anti-inflammatory actions of ω-3 fatty acids are, in part, related to reduced leukocyte-derived cytokine formation and modulation of eicosanoid

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synthesis. For example, ω-3 fatty acid-derived 3-series prostanoids and 5-series leukotrienes are substantially less potent than the analogous 2-series metabolites formed from arachidonic acid.

The emergence of a family of lipid mediators derived from EPA and DHA, which actively resolve inflammation, offers another avenue by which ω-3 fatty acids may protect against conditions associated with inflammation. Resolution of inflammation is completed by specialized pro-resolving lipid mediators (SPMs) that are synthesized by transcellular processes involving enzymes of epithelial cells and leukocytes.[3] SPMs derived from EPA and DHA are known as E-series and D-series resolvins, respectively. The synthesis of the E-series resolvins (RvE1, RvE2, and RvE3) from EPA involves acetylated COX-2 or cytochrome P450 monooxygenases and occurs *via* formation of an unstable hydroperoxy compound (18-HpEPE) leading to the intermediate 18-hydroxyeicosapentaenoic acid (18-HEPE) that is converted by 5-lipoxygenase (5-LO) to RvE1 or RvE2.[4] In humans, RvE3 can also be generated from EPA by 15-LO (**Figure 1**).[5] The stereochemistry of the E-series resolvins depends on whether initial synthesis involves acetylated COX-2 that predominantly produces 18R-HpEPE rather than 18S-HpEPE, leading to the 18R-E-series resolvins that are also known as aspirin-triggered E-series resolvins.

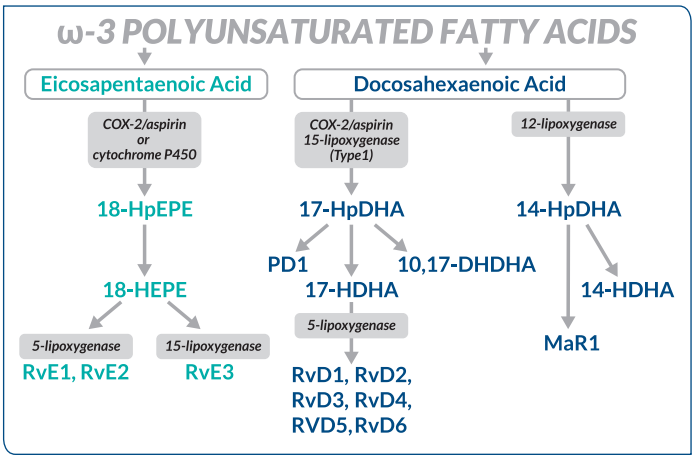

Figure 1. The biosynthesis of E-series resolvins from EPA and D-series resolvins, PD1, and maresins from DHA.

The D-series resolvins (RvD1, RvD2, RvD3, RvD4, RvD5, and RvD6) are synthesized from DHA by acetylated COX-2 or 15-LO. D-Series resolvin synthesis results *via* formation of 17-hydroperoxydocosahexaenoic acid (17-HpDHA) and 17-hydroxydocosahexaenoic acid (17-HDHA). The stereochemistry of these products is also enzyme dependent with the products of 15-LO leading to mainly 17S-HpDHA while acetylated COX-2 yields 17R-HpDHA.[6] The action of 5-LO on 17-HDHA leads to the D-series resolvins RvD1-RvD6 that can differ in their stereochemistry at the 17 carbon position.[7] In the absence of 5-LO, protectin D1 (PD1) and 10S,17S-DiHDHA are formed from 17-HpDHA. In humans, DHA can be metabolized by macrophage 12-LO to 14-HpDHA that leads to formation of 14-HDHA and the maresins (**Figure 1**).[8,9]

The majority of studies examining the effects of SPMs in the resolution of inflammation have utilized cell cultures or animal models of disease. The actions of SPMs in disease models have been extensively reviewed and include controlling inflammatory pain (RvE1, RvD1, 17R-RvD1, RvD2, and MaR1), accelerating wound healing in diabetes (RvD1), inhibiting secondary thrombosis and necrosis in burn injury (RvD2), preventing colitis (RvE1, RvD1, and RvD2), protection against reperfusion injury in the heart (RvE1), and inhibiting kidney fibrosis (RvE1 and RvD1).[3] The precursor to the D-series resolvins, 17-HDHA, is also biologically active, modulating macrophage function and alleviating experimental colitis and mediating B-cell differentiation to antibody secreting cells.[10,11]

In humans, plasma is the most readily available blood component for examination of SPM levels. Levels of SPMs in plasma can be measured using targeted liquid chromatography tandem mass spectrometry (LC-MS/MS) that requires authentic SPM standards and an appropriate internal standard for identification and quantification. Our group was the first to describe in detail an LC-MS/MS method for measuring levels of 18-HEPE, 17-HDHA, RvD1, 17R-RvD1 RvD2, 10S,17S-DiHDHA, and PD1 in human plasma.[12] In this report, we examined the effect of different blood collection methods on levels of SPMs. The levels of 18-HEPE, 17-HDHA, RvD1, 17R-RvD1, and RvD2 were all measurable in plasma from healthy humans after three weeks of ω-3 fatty acid supplements and ranged between 20 and 200 pg/ml.[12]

In a follow-up study, healthy volunteers were given ω-3 fatty acid supplements for seven days and then randomized to receive aspirin or placebo in addition to ω-3 fatty acids during the last two days.[13] A number of SPMs were measured at baseline, after five days of ω-3 fatty acids, and after seven days (i.e., after two days of aspirin in addition to ω-3 fatty acids). The SPMs measured included 18-HEPE, RvE1, RvE2, RvE3, and 18R-RvE3 derived from EPA and 17-HDHA, RvD1, 17R-RvD1, RvD2, PD1, 14-HDHA, and MaR1 that are derived from DHA. Chiral chromatography was used to separate and quantify the concentration of different epimers of 18-HEPE and 17-HDHA before and after aspirin. The study showed that, at baseline, the plasma concentration of 14-HDHA was 3-fold higher than the other SPMs. ω-3 Fatty acid supplementation for five days increased plasma levels of 18-HEPE, 17-HDHA, 14-HDHA, and RvE1. Aspirin taken in addition to ω-3 fatty acids did not differentially affect any SPM.[13] However, the ratio of R- to S-isomers of 17-HDHA, but not 18-HEPE, was significantly reduced by aspirin.

The changes in SPMs with ω-3 fatty acids are not confined to healthy humans. We reported plasma SPMs in 74 patients with chronic renal disease randomized to ω-3 fatty acids or coenzyme Q10 (CoQ) for eight weeks.[14] ω-3 Fatty acids significantly increased plasma levels of 18-HEPE, 17-HDHA, and RvD1 (**Figure 2**). CoQ had no effect on any plasma SPM. In regression analysis, the increase in 18-HEPE and 17-HDHA following ω-3 fatty acids was predicted by the change in platelet EPA and DHA, respectively.

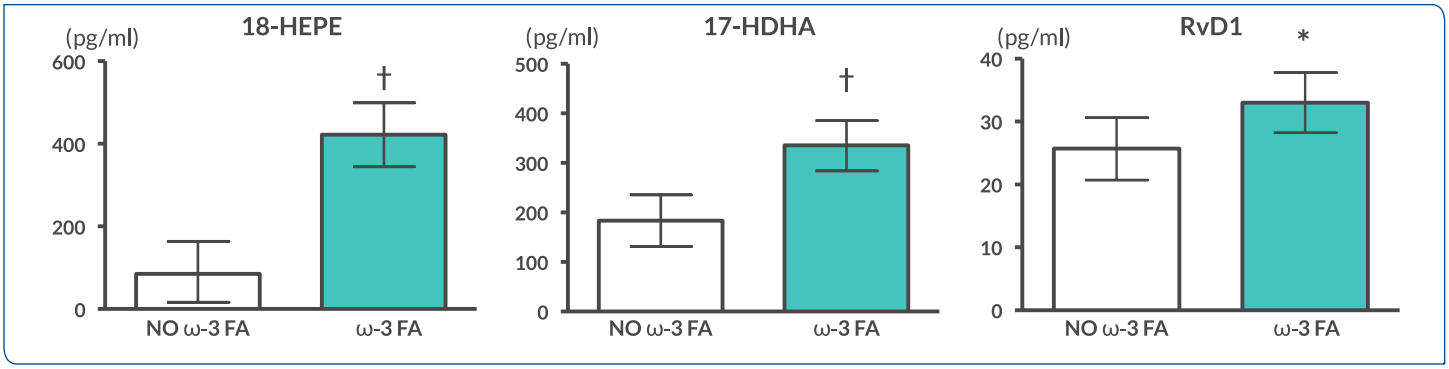

Figure 2. Post-intervention concentrations of plasma 18-HEPE, 17-HDHA, and RvD1 in patients with chronic kidney disease who received no ω-3 fatty acids (NO ω-3 FA) or were supplemented with ω-3 fatty acids (ω-3 FA) for eight weeks.

†p<0.001 or *p<0.05 for between group differences after adjusting for baseline SPMs

Our studies consistently show that ω-3 fatty acid supplementation can elevate plasma levels of the E- and D-series resolvins and their precursors 18-HEPE and 17-HDHA, respectively, as well as 14-HDHA, the upstream metabolite of the maresin family. After ω-3 fatty acid supplementation, many of the SPMs in plasma are present at concentrations shown to have biological activity. Given that SPMs are regarded as autocoids released at the sites of inflammation, one would anticipate the levels measured at the inflammatory site would be even higher than that in blood. The pro-resolving actions of ω-3 fatty acids after supplementation add further support to the overall attenuation of inflammation after an insult, and are likely important in the overall concept of the protective effects of ω-3 fatty acids. ■

References

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RESEARCHER SPOTLIGHT

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Trevor Mori, Ph.D. and Anne Barden, Ph.D.

Professors, University of Western Australia

Q: What attracted you to conduct research at the University of Western Australia's School of Medicine and Pharmacology?

A: The Cardiovascular Research Centre within the University of Western Australia's School of Medicine and Pharmacology is located at Royal Perth Hospital. The Centre is one of the leading cardiovascular research units in Australia and is internationally known for conducting diet, lifestyle, and non-pharmacological trials, underpinned by laboratory expertise, that aims to elucidate mechanisms. The Centre comprises world-renowned scientists and clinicians.

Q: Is there a key experiment/finding that stands out in your mind in the study of lipid mediators?

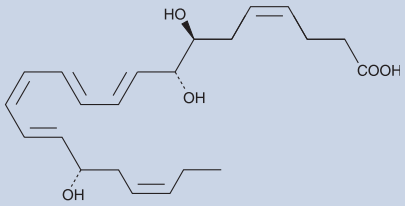
A: Our laboratory was the first to describe a panel of specialized pro-resolving lipid mediators in humans taking ω-3 fatty acid supplements. This research showed that ω-3 fatty acid supplementation increased specialized pro-resolving lipid mediators and identified a new mechanism by which fish and fish oil supplements benefit conditions associated with inflammation in humans.

Q: What is a key question in your research?

A: To be able to demonstrate the relevance of specialized pro-resolving lipid mediators to clinical outcomes.

D-SERIES RESOLVINS

Resolvins are a family of potent lipid mediators derived from both EPA and DHA. They are produced by the COX-2 pathway, especially in the presence of aspirin, and have been shown to prevent the production and transportation of inflammatory cells and chemicals to sites of inflammation. In addition to being anti-inflammatory, resolvins promote the resolution of the inflammatory response back to the non-inflamed state.



Resolvin D1 (Item No. 10012554)

Item No.	Product Name	Summary
10012554	Resolvin D1	A product of the action of 15- and 5-LO on DHA
11182	Resolvin D1-d_5	An internal standard for the quantification of RvD1
13060	17(R)-Resolvin D1	An aspirin-triggered epimer of RvD1
10007279	Resolvin D2	A product of the action of 15- and 5-LO on DHA
11184	Resolvin D2-d_5	An internal standard for the quantification of RvD2

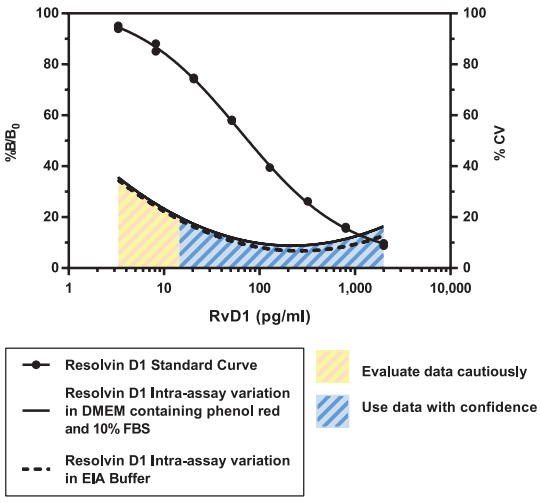
To view a complete list of D-series resolvins, including methyl ester forms, visit us online at www.caymanchem.com.

Resolvin D1 EIA Kit 500380

Sensitivity (80% B/B_0): 10-20 pg/ml

Summary: Cayman's Resolvin D1 EIA Kit is a competitive assay that can be used for quantification of RvD1. Due to the number and variation of potential sample types, this assay has been validated in Cayman's EIA Buffer Concentrate (10X) (Item No. 400060) diluted to 1X and DMEM containing phenol red and 10% FBS.

96 wells
480 wells

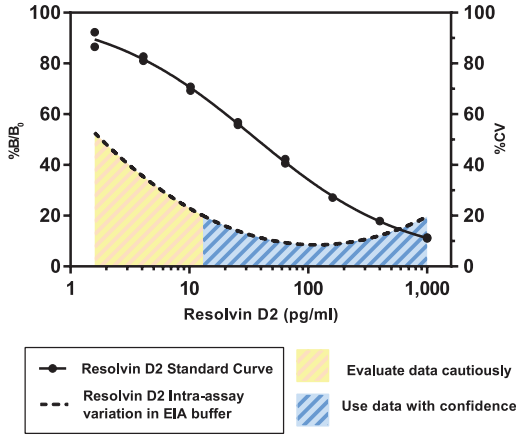


Resolvin D2 EIA Kit 501120

Sensitivity (80% B/B_0): 10-20 pg/ml

Summary: Cayman's Resolvin D2 EIA Kit is a competitive assay that can be used for quantification of RvD2. Due to the number and variation of potential sample types, this assay has been validated in Cayman's EIA Buffer Concentrate (10X) (Item No. 400060) diluted to 1X, human plasma, and human serum.

96 wells
480 wells



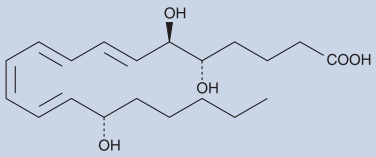
ask Cayman
QUESTIONS FROM THE FIELD

Q: How do LC/MS and EIA compare for measuring the same lipid mediator?

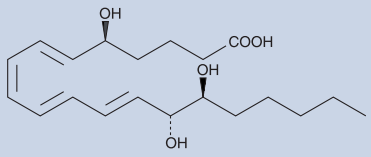
A: EIA values often trend closely to those obtained by LC/MS but it is not uncommon for immunoassays to report higher analyte concentrations. While LC/MS analysis measures distinct molecule species, antibodies used in immunoassays sometimes recognize not only the target molecule, but also structurally related molecules, including biologically relevant metabolites. In many cases, measurement of both the parent molecule and metabolites is more representative of the overall biological response than is the measurement of a short-lived parent molecule.

LIPOXINS

Lipoxin A_4 and B_4 are generated from arachidonic acid, an ω-6 fatty acid. Their brief appearance generally signals the resolution of inflammation. At least four distinct isomers have been identified: 5(S),6(S), 5(S),6(R), and the 11-*trans* and 11-*cis* isomers of each of these.



5(S),6(R)-Lipoxin A_4 (Item No. 90410)



5(S),14(R)-Lipoxin B_4 (Item No. 90420)

Item No.	Product Name	Summary
90410	5(S),6(R)-Lipoxin A_4	Produced by the metabolism of 15-HETE or 15-HpETE with leukocytes
10007737	5(S),6(R)-Lipoxin A_4-d_5	An internal standard for the quantification of 5(S),6(R)-LXA_4
10007271	5(S),6(R)-Lipoxin A_4 Lipid Maps MS Standard	Designed for the convenient, precise quantification of 5(S),6(R)-LXA_4
90415	5(S),6(R),15(R)-Lipoxin A_4	An aspirin-triggered lipoxin
10049	5(S),6(S)-Lipoxin A_4	One of several lipoxin isomers
90420	5(S),14(R)-Lipoxin B_4	A positional isomer of LXA_4

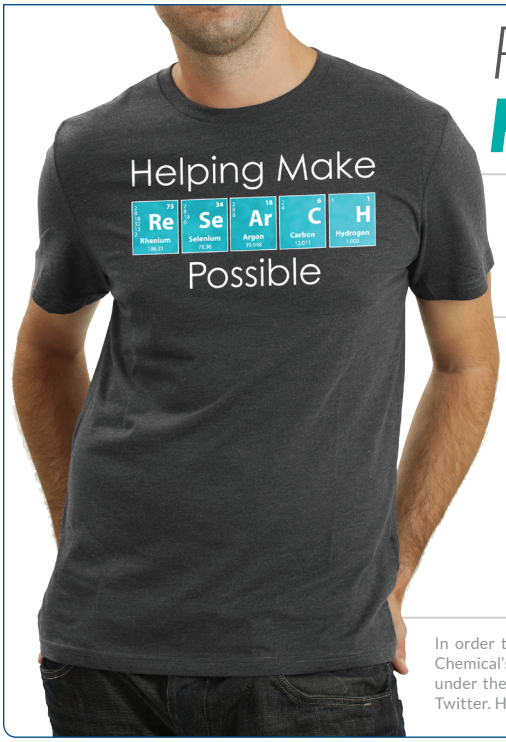
To view a complete list of lipoxins, including methyl ester forms, visit us online at www.caymanchem.com.

ask Cayman

QUESTIONS FROM THE FIELD

Q: Are there any precautions that should be taken when working with lipoxins, protectins, and resolvins?

A: Lipoxins, protectins, and resolvins are air, light, and temperature sensitive. When working with these molecules, it is recommended to prepare a daily ethanol stock solution while storing the concentrated primary ethanol stock solution at -20°C to -80°C. A stream of nitrogen should be passed over the primary stock solution before closing the vial to minimize oxidative degradation. These compounds can isomerize and degrade when exposed to freeze/thaw conditions or when stored in DMF or DMSO. Aqueous solutions of these products should be discarded immediately after use.



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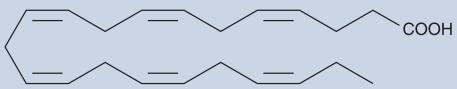
DHA & RELATED 22-CARBON ω-3 FAs

DHA is an essential fatty acid and the most abundant ω-3 fatty acid in retinal and neural tissues. In humans, DHA is either obtained from the diet or may be converted in small amounts from EPA *via* docosapentaenoic acid (DPA) as an intermediate. Supplementation of dietary DHA using fish oil is thought to generate a variety of beneficial health effects.



Docosahexaenoic Acid (Item No. 90310)

Item No.	Product Name	Summary
90310	Docosahexaenoic Acid	An essential fatty acid
17950	Single-Use Docosahexaenoic Acid (peroxide free)	Peroxide-free DHA supplied in individual, sealed ampules to eliminate damage due to oxidation
10005057	Docosahexaenoic Acid-d_5	An internal standard for the quantification of DHA
10006829	Docosahexaenoic Acid Quant-PAK	Designed for the convenient, precise quantification of DHA
9000328	Docosahexaenoyl Glycine	DHA with glycine attached at its carboxy terminus
90312	4,5-dehydro Docosahexaenoic Acid	A novel analog of DHA in which the double bond closest to the carboxyl group has been substituted with a triple bond
9000346	17-keto-4(Z),7(Z),10(Z),13(Z),15(E),19(Z)-Docosahexaenoic Acid	A metabolite of lipoxygenase-mediated oxidation of DHA
10878	Maresin 1	A 7,14-dihydroxy DHA produced by macrophages
13161	7-*epi* Maresin 1	An epimer of the active Maresin 1
10008128	10(S),17(S)-DiHDHA	A DHA metabolite, also referred to as protectin DX
10007001	(±)19,20-DiHDPA	An epoxygenase metabolite of DHA
10174	16(17)-EpDPA	A DHA congener of 14,15-EpETrE
10175	19(20)-EpDPA	A DHA epoxygenase metabolite
15253	14(S)-HDHA	An oxygenation product of DHA that serves as a precursor to Maresin 1
10005099	17(R)-HDHA	A primary mono-oxygenation product of DHA and precursor to 17(R)-resolvins
10009799	17(S)-HDHA	A primary mono-oxygenation product of DHA and precursor to 17(S)-resolvins
13185	17(S)-HpDHA	A mono-oxygenation product of DHA

To view a complete list of DHA-related lipids, including metabolites, visit us online at www.caymanchem.com.

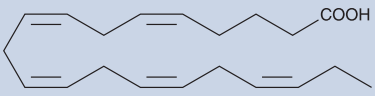
SINGLE-USE, PEROXIDE-FREE PUFAs

Polyunsaturated fatty acids (PUFAs) are highly susceptible to oxidative damage when exposed to oxygen, resulting in the generation of peroxide-containing PUFAs. Oxidation of PUFAs can be particularly problematic in samples stored in capped vials for prolonged periods, even at low temperatures. Cayman's peroxide-free fatty acids are packaged in small aliquots in individual, oxygen-free, sealed ampules. These single-use PUFAs are intended for analytical and research applications where absence of oxidized adducts is desired.

Item No.	Product Name
17948	Single-Use Arachidonic Acid (peroxide free)
17950	Single-Use Docosahexaenoic Acid (peroxide free)
17949	Single-Use Eicosapentaenoic Acid (peroxide free)
17951	Single-Use Linoleic Acid (peroxide free)

EPA & RELATED 20-CARBON ω-3 FAs

EPA is an ω-3 fatty acid abundantly available in marine organisms and serves as a precursor to DHA. The human body converts α-linolenic acid (ALA) to EPA; however, absorption of EPA from consuming fish oil is much more efficient. EPA has been shown to offer protection against coronary heart disease, thrombosis, ischemic brain injury, scaly dermatitis, and some inflammatory diseases.



Eicosapentaenoic Acid (Item No. 90110)

Item No.	Product Name	Summary
90110	Eicosapentaenoic Acid	An ω-3 fatty acid found in fish oil
17949	Single-Use Eicosapentaenoic Acid (peroxide free)	Peroxide-free EPA supplied in individual, sealed ampules to eliminate damage due to oxidation
10005056	Eicosapentaenoic Acid-d_5	An internal standard for the quantification of EPA
13048	Eicosapentaenoic Acid Quant-PAK	Designed for the convenient, precise quantification of EPA
10467	5,6-DiHETE	A possible metabolite produced from EPA following epoxidation of the α-5 double bond
10006998	(±)14,15-DiHETE	An epoxygenase pathway product produced from EPA
10006999	(±)17,18-DiHETE	An epoxygenase pathway product produced from EPA
32210	5(S)-HEPE	A fatty acid produced by 5-LO oxidation of EPA
32350	8(S)-HEPE	A monohydroxy fatty acid produced by LO oxidation of EPA
32410	9(S)-HEPE	A monohydroxy fatty acid derived from EPA
32505	11(R)-HEPE	Produced by the oxidation of EPA by 11(R)-LO
32510	11(S)-HEPE	A monohydroxy fatty acid derived from EPA
32545	12(R)-HEPE	A monohydroxy fatty acid synthesized from EPA
32550	12(S)-HEPE	A monohydroxy fatty acid derived from EPA
32710	15(S)-HEPE	A monohydroxy fatty acid synthesized from EPA by the action of 15-LO
42210	5(S)-HpEPE	Produced by the action of 5-LO on EPA
42550	12(S)-HpEPE	A 12-LO product derived from EPA
42710	15(S)-HpEPE	Produced by the action of 15-LO on EPA
10470	8(9)-EpETE	An epoxygenase metabolite of EPA
10462	11(12)-EpETE	An epoxygenase metabolite of EPA
10173	14(15)-EpETE	An epoxygenase metabolite of EPA
50861	17(18)-EpETE	An epoxygenase metabolite of EPA

To view a complete list of EPA-related lipids, including metabolites, visit us online at www.caymanchem.com.

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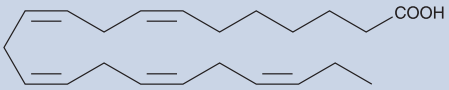
QUESTIONS FROM THE FIELD

Q: How does LC/MS/MS compare to EIA in terms of sensitivity?

A: Cayman's EIAs for eicosanoids are the most sensitive assays on the market, and LC/MS/MS has had to play catch up in this regard. LC/MS/MS sensitivity will depend largely on the instrumentation being employed, with the newest instruments eclipsing the performance of those manufactured just 1-2 years earlier. Experiments performed at Cayman in which we analyzed primary eicosanoids (PGE_2, PGD_2, TxB_2, 6-keto PGF_{1a}, and PGF_{2a}) from mouse liver samples using a Waters Acquity UPLC with Xevo TQD triple-Quad MS detection, revealed that LC/MS/MS sensitivity, in this case, rivals that of our best EIAs, often reaching into the ~10-20 pg/ml range.

DPA & RELATED 21- AND 22-CARBON ω-3 FAs

DPA is an ω-3 fatty acid found in fish oils. It is a minor constituent of the total serum unsaturated fatty acids in humans, ranging from 0.1 to 1%, and increases on dietary supplementation.



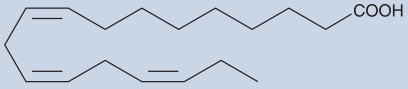
Docosapentaenoic Acid (Item No. 90165)

Item No.	Product Name	Summary
90165	Docosapentaenoic Acid	An ω-3 fatty acid found in fish oils
10546	7(S),17(S)-dihydroxy-8(E),10(Z),13(Z), 15(E),19(Z)-Docosapentaenoic Acid	A metabolite of DPA with anti-inflammatory properties
9000347	17-keto-7(Z),10(Z),13(Z),15(E),19(Z)-Docosapentaenoic Acid	A metabolite of DPA with anti-inflammatory properties
10670	Heneicosapentaenoic Acid	A 21:5 ω-3 fatty acid
10570	Heneicosapentaenoic Acid-d_6	An internal standard for the quantification of HPA

To view a complete list of DPA-related lipids, including methyl esters, visit us online at www.caymanchem.com.

ALA & RELATED 18-CARBON ω-3 FAs

ALA is an essential fatty acid found in leafy green vegetables. ALA helps prevent cardiovascular disease by decreasing blood pressure, serum cholesterol levels, and platelet aggregation.



α-Linolenic Acid (Item No. 90210)

Item No.	Product Name	Summary
90210	α-Linolenic Acid	An essential fatty acid
9000433	α-Linolenic Acid-d_{14}	An internal standard for the quantification of ALA
39420	9(S)-HOTrE	A product of the action of 5-LO on ALA
39620	13(S)-HOTrE	A 15-LO product derived from ALA
45220	13(S)-HpOTrE	A product of 15-LO metabolism of ALA
90320	Stearidonic Acid	A dietary precursor to EPA and DHA
9000327	Stearidonoyl Glycine	Stearidonic acid conjugated with glycine

To view a complete list of ALA-related lipids, including methyl esters, visit us online at www.caymanchem.com.

FAHFAs: NEWLY DISCOVERED ENDOGENOUS LIPIDS

PRODUCT SPOTLIGHT

Cayman Chemical scientists have synthesized a novel family of branched fatty acid hydroxy fatty acids (FAHFAs) that may be the next 'good' fat. While ω-3 fatty acids are known to have numerous positive actions, FAHFAs are a group of newly-discovered lipids with unexplored potential that are now available from Cayman for research applications.

FAHFAs are a class of bioactive lipids that offer the potential to improve blood sugar, protect against diabetes, and reduce inflammation. Scientists at Beth Israel Deaconess Medical Center in Boston and at the Salk Institute in La Jolla identified FAHFAs as being produced naturally in adipose tissue and associated with insulin sensitivity.[1] PAHSA, the combination of palmitic acid and hydroxy stearic acid (see figure below), was abundantly found in the fat of diabetes-resistant mice and was significantly reduced in humans with early stages of diabetes.[1] When fed to obese diabetic mice, 9-PAHSA was reported to contribute to glucose-insulin homeostasis and to elicit anti-inflammatory effects.[1] At least a dozen related family members remain to be studied.

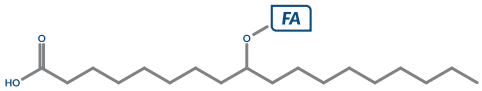
While FAHFAs do exist at low levels within certain foods, the scientists who discovered them believed that they are mainly synthesized in the body. Detection of low FAHFA levels in the blood may become a reliable, early biomarker for the onset of diabetes. Potential exists for the discovery of new therapeutics that would target the pathways that make or break down lipids to control FAHFA levels. Much work remains to determine if the restoration of these lipids will reduce the risk of developing diabetes or prevent the disease altogether. Next steps of the research will need to pinpoint the signaling pathways involved.

Reference

1. Yore, M.M., Syed, I., Moraes-Vieira, P.M., *et al.* Discovery of a class of endogenous mammalian lipids with anti-diabetic and anti-inflammatory effects. *Cell* **159(2)**, 318-332 (2014).

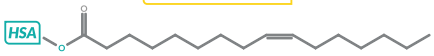
THE CHEMISTRY OF FAHFAs

FA + HFA



HSA Hydroxy Stearic Acid

POHSAs

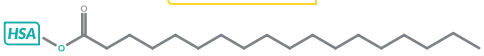


PO Palmitoleic Acid

PALMITOLEIC ACID-BASED

Item No.	Product Name
17114	5-POHSA
17196	5-POHSA-d_{14}
17040	9-POHSA
17105	12-POHSA
17111	13-POHSA

SAHSAs

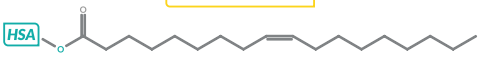


SA Stearic Acid

STEARIC ACID-BASED

Item No.	Product Name
17113	5-SAHSA
17109	9-SAHSA
17106	12-SAHSA
17110	13-SAHSA

OAHSAs

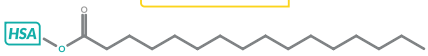


OA Oleic Acid

OLEIC ACID-BASED

Item No.	Product Name
17115	5-OAHSA
17198	5-OAHSA-d_{17}
17039	9-OAHSA
17108	12-OAHSA
17195	12-OAHSA-d_{17}
17112	13-OAHSA

PAHSAs



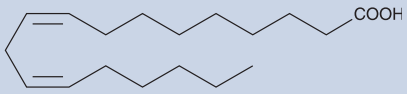
PA Palmitic Acid

PALMITIC ACID-BASED

Item No.	Product Name
17043	5-PAHSA
17197	5-PAHSA-d_{31}
17037	9-PAHSA
17725	9-PAHSA $^{13}C_4$
17724	9-PAHSA-d_4
17397	9-PAHSA-d_{31}
17107	12-PAHSA
17194	12-PAHSA-d_{31}

LINOLEIC ACID & RELATED PRODUCTS

Linoleic acid is an essential fatty acid and one of the most abundant PUFAs in the western diet. Deficiencies in linoleic acid are linked to defective wound healing, growth retardation, and dermatitis.



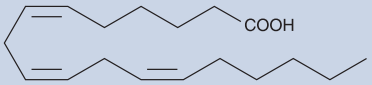
Linoleic Acid (Item No. 90150)

Item No.	Product Name	Summary
90150	Linoleic Acid	An essential fatty acid abundant in the Western diet
17951	Single-Use Linoleic Acid (peroxide free)	Peroxide-free linoleic acid supplied in individual, sealed ampules to eliminate damage due to oxidation
10010623	Linoleic Acid-biotin	An affinity probe for linoleic acid binding proteins
390150	Linoleic Acid-d_4	An internal standard for the quantification of linoleic acid
10006834	Linoleic Acid Quant-PAK	Designed for the convenient, precise quantification of linoleic acid
90370	9(E),11(E)-Conjugated Linoleic Acid	An isomer of linoleic acid
90140	9(Z),11(E)-Conjugated Linoleic Acid	An isomer of linoleic acid
90145	10(E),12(Z)-Conjugated Linoleic Acid	An isomer of linoleic acid
38405	9(R)-HODE	A monohydroxylated product derived from linoleic acid
38410	9(S)-HODE	A lipoxygenase product of linoleic acid
338410	9(S)-HODE-d_4	An internal standard for the quantification of 9(S)-HODE
38605	13(R)-HODE	An enantiomer of 13(S)-HODE
38610	13(S)-HODE	Product of 15-LO metabolism of linoleic acid
338610	13(S)-HODE-d_4	An internal standard for the quantification of 13(S)-HODE

To view a complete list of linoleic acid-related lipids, including metabolites, visit us online at www.caymanchem.com.

γ-LINOLENIC ACID & RELATED PRODUCTS

γ-Linolenic acid (GLA) is an ω-6 fatty acid that can be elongated to arachidonic acid for endogenous eicosanoid synthesis. It has anti-inflammatory properties.



γ-Linolenic Acid (Item No. 90220)

Item No.	Product Name	Summary
90220	γ-Linolenic Acid	An ω-6 fatty acid
90230	Dihomo-γ-Linolenic Acid	An ω-6 fatty acid intermediate
10458	Dihomo-γ-Linolenic Acid-d_6	An internal standard for the quantification of DGLA

To view a complete list of GLA and related fatty acids, visit us online at www.caymanchem.com.

HPLC & LC/MS MIXTURES

The HPLC and LC/MS mixtures are composed of either the major lipoxygenation products of some ω-3 fatty acids or a broad collection of saturated, monounsaturated, or polyunsaturated fatty acids. All compounds are supplied in ethanol as aliquots for convenient use as analytical standards in fatty acid research.

Item No.	Product Name
34003	ω-3 Hydroxy Acid HPLC Mixture
17941	Polyunsaturated Fatty Acid LC/MS Mixture
17942	Saturated/Monounsaturated Fatty Acid LC/MS Mixture

SCREENING LIBRARIES

These lipid screening libraries contain a variety of fatty acids or lipids with diverse biological activities in a 96-well Matrix tube rack format as stock solutions in DMSO. They are suited for use in screening, target validation, new assay validation, and for routine pharmacological applications. The composition of the libraries will always vary somewhat depending upon our inventory.

Item No.	Product Name
10506	Bio-active Lipid I Screening Library (96-Well)
10507	Bio-active Lipid II Screening Library (96-Well)
10504	Fatty Acid Screening Library (96-Well)

European Platform

Tel: +33 (0)139 306 036
Email: bioreagent@bertinpharma.com
Website: www.bertinpharma.com

Helping Make Research Possible

1180 E. Ellsworth Road
Ann Arbor, MI 48108
www.caymanchem.com

CONTACT US

PHONE: (800) 364-9897 (USA and Canada only)
(734) 971-3335

FAX: (734) 971-3640

WEB: www.caymanchem.com

EMAIL: Sales: sales@caymanchem.com
Customer Service: custserv@caymanchem.com
Technical Support: techserv@caymanchem.com