



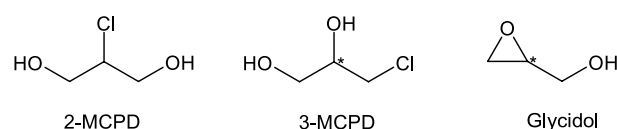
MCPD and glycidyl fatty acid esters

There has been a growing interest in the analysis of food for 3-monochloropropanediol (3-MCPD)¹ and glycidyl fatty acid esters² in recent years. These fatty acid ester artefacts are formed during production and heating of oils and fats, and are thought to be harmful when consumed at a high level. Consequently, they are a great concern to health authorities,³ fuelling a demand for analytical methods to monitor levels in foods, accompanied by appropriate regulation.

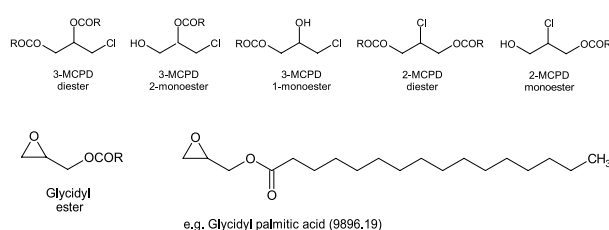


What are MCPD and glycidyl fatty acid esters?

MCPD and its esters are chemical food contaminants that are suspected to be carcinogenic. The majority of MCPD is bound to a variety of fatty acids – resulting in a complex mixture of 3-MCPD-esters comprising 1- and 2-monoesters, and 1,2-diester – with only a small percentage available as the free form. Minor quantities of 2-MCPD esters may also occur. Glycidyl fatty acid esters are derivatives of glycidol and a fatty acid.^{4,5,6}



Free MCPD and glycidol



MCPD and glycidyl fatty acid esters

History⁴

3-MCPD was identified as a food processing contaminant in hydrolysed vegetable proteins (HVP) as far back as 1978. Subsequently, data on the occurrence of 3-MCPD fatty acid esters in various types of processed food was published in 2004, followed by the identification of glycidyl esters in palm oil in 2008. There is currently no evidence that significant levels of free MCPDs or glycidol are present in refined oils and fats¹⁹⁻²¹.

The toxicology of these compounds is still being evaluated, but they are thought to be harmful if consumed at high levels. The European Community recommends monitoring the presence of MCPD, MCPD esters and glycidyl esters in vegetable oils and fats.

Where are they found?

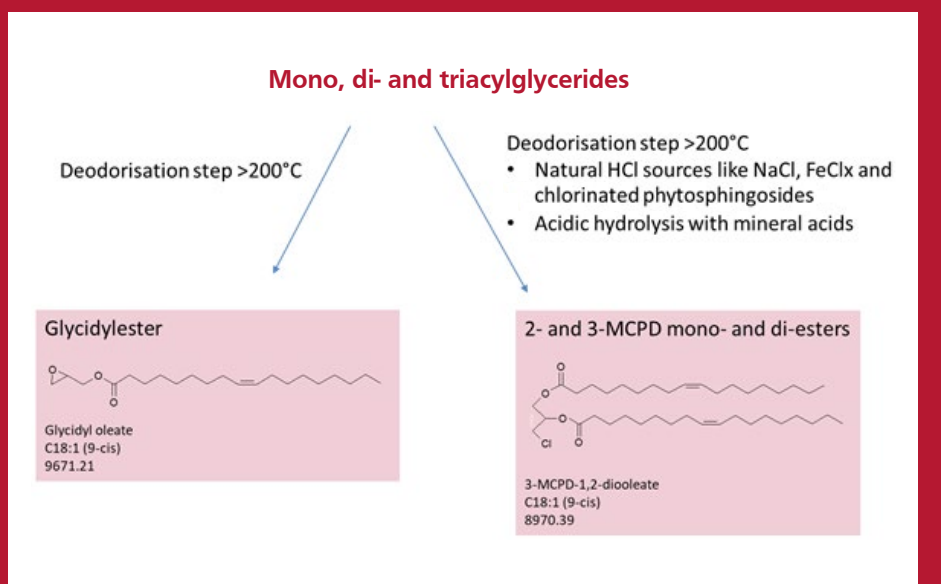
3-MCPD and glycidyl esters are present in refined fats and oils, primarily in palm oil; due to the high levels of diglycerides, and foods derived from these products, such as cakes and pastries, as well as modified starches.⁴ They can be found in infant formulae, and milk powders due to the use of refined vegetable oils. Neither 3-MCPD or glycidyl esters are found in virgin oils⁴. They may occur in food that has been in contact with epichlorohydrin-based resins.⁵



How are they formed?

MCPD and glycidyl esters are mainly formed during high temperature processing of fat-containing matrices, particularly during the deodorisation step of the refining process.⁷

MCPD and related products are also formed by acid hydrolysis of residual lipids in the raw material,⁴ and can be formed during domestic food preparation, for example, by grilling, frying or barbequing.⁸



What are the concerns?

Toxicological data on MCPD and glycidyl esters is limited. The main concern is the potential for free 3-MCPD and glycidol to be released during digestion. Free 3-MCPD is a known carcinogen (International Agency for Research on Cancer, IARC, group 2A)¹⁰ that is suspected to be non-genotoxic and to have a male anti-fertility effect in humans.³ In most foodstuffs, it is predominantly ester-linked with fatty acids, with minimal amounts of the free form present. However, these esters are assumed to be 100 % metabolised to free 3-MCPD by a lipase-catalysed hydrolysis.^{1,11} Glycidyl esters are a greater health concern, as they are much more commonly present in oils. These esters are metabolised into free glycidol – a compound that has been classified as potentially carcinogenic (IARC group 2A)¹⁰ – within the digestive tract.³



Regulations

The European Union Commission Regulation (EC) 1881/2006 specifies a tolerable daily intake (TDI) of 2 µg/kg body weight/day for 3-MCPD and its esters combined.¹² The UN's Joint FAO/WHO Expert Committee on Food Additives [JECFA] established a TDI of 4 µg/kg in 2016.¹³ This led the European Food Safety Authority (EFSA) to reassess its recommended 0.8 µg/kg TDI, increasing it two-and-a-half-fold to 2 µg/kg in 2017.¹⁴ The EFSA has not currently set safe limits for 2-MCPD or glycidol.

Commission Regulation (EC) 1881/2006 sets a maximum level of 20 µg/kg 3-MCPD in HVP and soy sauce,¹² while EFSA recommended the establishment of maximum levels of 3-MCPD (2 mg/kg) and glycidyl esters (1 mg/kg) in vegetable oils and fats in 2017.¹⁶ In 2020, Commission Regulation (EC) 1881/2006 was amended by Commission Regulation (EU) 2020/1322, which specifies maximum levels for 3-MCPD, 3-MCPD fatty acid esters and glycidyl fatty acid esters in specific food products.¹⁷

Collection of data on chemical contaminants occurrence

The European Commission mandate (M-2010-0374) authorises EFSA to collect all available data on the occurrence of chemical contaminants, including 3-MCPD, 3-MCPD esters, 2-MCPD esters and glycidyl esters, in food and feed.¹⁶ National food authorities, research institutions, academia, food business operators and other stakeholders are invited to submit this data, which then forms the basis of future EFSA scientific opinions and reports.



Methodology

The assessment of 2-, 3-MCPDs and glycidol in fats and oil:

The 2- and 3-MCPDs and glycidyl esters are complex mixtures of various fatty acid esters, making direct analysis complicated. Therefore, methods have been developed where the content of the MCPDs and glycidyl ester are converted into unbound 2- and 3-MCPD and glycidol. The current established methods are based on

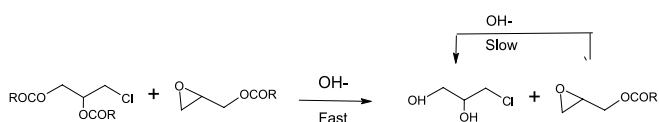
derivatization to boronic acid derivatives before GC-MS analysis.

Three new ISO methods for MCPD and glycidyl ester analysis were published between 2015-2018¹⁹⁻²¹ and are based on the previous AOAC method from 2013, a DGF method from 2013 and a method published by Ermacora and Hrnčirik (2013)²².

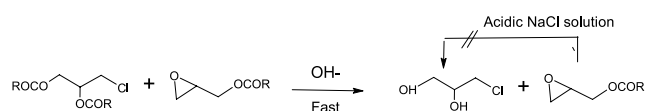
ISO 18363-1¹⁹. This method is identical to AOAC Official Method 29C-13 and the DGF standard C-VI 18 (10) method.

This method is differential.

Part A allows the determination of the total content of MCPDs and glycidyl esters by fast hydrolysis of the esters by alkalic catalysis and conversion of the glycidol to 3-MCPD.



Part B allows the determination of genuine 3-MCPD by stopping the conversion by addition acidified chlorine salt solution.

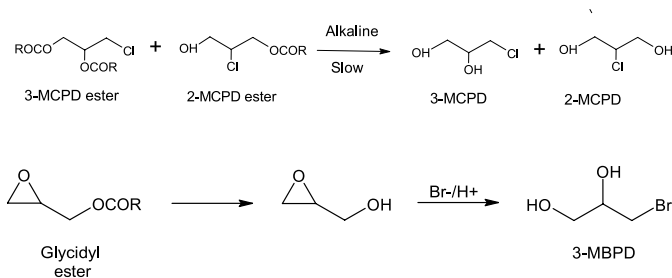


The determination of glycidol esters is calculated by the difference between both assays. The method can be modified for the determination of 2-MCPD in addition.

Chiron No.	Chiron Name (<i>Method Name</i>)	Synonym (<i>Method Synonym</i>)	CAS
Standards required for ISO 18363-1			
3873.3	3-Chloro-1,2-propanediol	3-MCPD	96-24-2
3874.3	3-Chloro-1,2-propanediol-d5	3-MCPD-d5	342611-01-2
8968.35	3-Chloro-1,2-propanediol-dipalmitoleate (3-MCPD-1,2-bis-palmitoyl ester)	3-MCPD-di16:1 (PP-3-MCPD)	1613232-85-1
8982.35	3-Chloro-1,2-propanediol-dipalmitate-d5 (propyl-d5) (3-MCPD-d5-1,2-bis-palmitoyl ester)	3-MCPD-di16:0-d5 (PP-3-MCPD-d5)	1185057-55-9
9899.21	Glycidyl stearate	glycidyl C18:0; Gly-S	7460-84-6
13414.21	Glycidyl stearate-d5 (glycidyl d5)	glycidyl C18:0-d5; Gly-S-d5	1346598-19-3
Alternatives to 8968.35			
8969.39	3-Chloro-1,2-propanediol-distearate (3-MCPD-1,2-bis-stearoyl ester)	3-MCPD-di18:0 (SS-3-MCPD)	72468-92-9
8970.39	3-Chloro-1,2-propanediol-dioleate (3-MCPD-1,2-bis-oleoyl ester)	3-MCPD-di18:1 (OO-3-MCPD)	69161-73-5
Alternatives to 8982.35			
13763.35	3-Chloro-1,2-propanediol-dipalmitate-13C3 (propyl-13C) (3-MCPD-13C3-1,2-bis-palmitate ester)	3-MCPD-di16:0-13C3 (PP-3-MCPD-13C3)	51930-97-3 (unlabelled)
8978.39	3-Chloro-1,2-propanediol-distearate-d5 (propyl-d5) (3-MCPD-d5-1,2-bis-palmitate ester)	3-MCPD-di18:0-d5 (SS-3-MCPD-d5)	1246818-85-8
14895.39	3-Chloro-1,2-propanediol-dioleate-d5 (propyl-d5) (3-MCPD-d5-1,2-bis-oleoyl ester)	3-MCPD-di18:1 (OO-3-MCPD-d5)	69161-73-5 (unlabelled)

ISO 18363-2²⁰ is identical to the AOAC Official Method Cd 29b-13. It allows the simultaneous determination of 2- and 3-MCPD and glycidyl esters.

It is based on the slow alkaline release of MCPDs and glycidol from the ester derivatives. Glycidol is subsequently converted to 3-MBPD.



Chiron No.	Chiron Name (Method Name)	Synonym (Method Synonym)	CAS
Standards required for ISO 18363-2			
10030.3	2-Chloro-1,3-propanediol	2-MCPD	497-04-1
10792.3	2-Chloro-1,3-propanediol-d5	2-MCPD-d5	1216764-05-4
10559.39	2-Chloro-1,3-propanediol-distearate (2-MCPD-1,3-bis-stearoylester*)	2-MCPD-di18:0 (SS-2-MCPD)	26787-56-4
10770.39	2-Chloro-1,3-propanediol-distearate-d5 (propyl-d5) (2-MCPD-d5-bis-stearoylester*)	2-MCPD-di18:0-d5 (SS-2-MCPD-d5)	1329796-49-7
3873.3	3-Chloro-1,2-propanediol	3-MCPD	96-24-2
3874.3	3-Chloro-1,2-propanediol-d5	3-MCPD-d5	342611-01-2
8968.35	3-Chloro-1,2-propandiol-dipalmitoleate (3-MCPD-1,2-bis-palmitoylester*)	3-MCPD-di16:1 (PP-3-MCPD)	1613232-85-1
8982.35	3-Chloro-1,2-propandiol-dipalmitate-d5 (propyl-d5) (3-MCPD-d5-1,2-bis-palmitoylester*)	3-MCPD-di16:0-d5 (PP-3-MCPD-d5)	1185057-55-9
9671.21	Glycidyl oleate*	Glycidyl C18:1 (9-cis) (Gly-O)	5431-33-4
12294.21	Glycidyl oleate-d5 (glycidyl d5)*	Glycidyl C18:1-d5 (Gly-O-d5)	1426395-63-2

*Other commercially available fatty acid esters of the analytes may be substituted

ISO 18363-3²¹:

This method represents AOAC Official Method Cd 29a-13. It is based on the conversion of glycidyl esters to 3-MBPD esters, and the slow acidic catalysed release of the 2- and 3-MCPDs and 3-MBPD from the ester derivatives.

Chiron No.	Chiron Name (Method Name)	Synonym (Method Synonym)	CAS
Standards required for ISO 18363-3			
10523.35	2-Chloro-1,3-propanediol-dipalmitate (1,2-dipalmitoyl-2-chloropropanediol)	2-MCPD-di16:0 (PP-2-MCPD)	169471-41-4
10771.35	2-Chloro-1,3-propanediol-dipalmitate-d5 (propyl-d5) (Pentadeuterated 1,2-dipalmitoyl-2-chloropropanediol)	2-MCPD-di16:0-d5 (PP-2-MCPD-d5)	1426395-62-1
8968.35	3-Chloro-1,2-propandiol-dipalmitoleate (1,2-dipalmitoyl-3-chloropropanediol)	3-MCPD-di16:1 (PP-3-MCPD)	1613232-85-1
8982.35	3-Chloro-1,2-propandiol-dipalmitate-d5 (propyl-d5) (Pentadeuterated 1,2-dipalmitoyl-3-chloropropanediol)	3-MCPD-di16:0-d5 (PP-3-MCPD-d5)	1185057-55-9
9674.19	Glycidyl palmitate	Glycidyl C16:0; (Gly-P)	7501-44-2
10524.19	Glycidyl palmitate-d5 (glycidyl d5) (Pentadeuterated glycidyl palmitate)	Glycidyl C16:0-d5 (Gly-P-d5)	1794941-80-2
Alternatives to 8968.35			
8970.39	3-Chloro-1,2-propandiol-dioleate (1,2-dioleoyl-3-chloropropanediol)	3-MCPD-di18:1 (OO-3-MCPD)	69161-73-5
8969.39	3-Chloro-1,2-propandiol-distearate	3-MCPD-di18:0 (SS-3-MCPD)	72468-92-9
Alternatives to 8982.35			
14895.39	3-Chloro-1,2-propandiol-dioleate-d5 (propyl-d5) (Pentadeuterated 1,2-dioleoyl-3-chloropropanediol)	3-MCPD-di18:1 (OO-3-MCPD-d5)	69161-73-5 (unlabelled)
8978.39	3-Chloro-1,2-propandiol-distearate-d5 (propyl-d5)	3-MCPD-di18:0-d5 (SS-3-MCPD-d5)	1246818-85-8
14023.39	3-Chloro-1,2-propandiol-distearate-13C3 (propyl-13C)	3-MCPD-di18:0-13C3 (SS-3-MCPD-13C3)	72468-92-9 (unlabelled)
Alternatives to Glycidyl palmitate			
9671.21	Glycidyl oleate	Glycidyl C18:1 (9-cis) (Gly-O)	5431-33-4
12294.21	Glycidyl oleate-d5 (glycidyl d5)	Glycidyl C18:1-d5 (Gly-O-d5)	1426395-63-2

Derivatization before GC-MS analysis:

The above methods are based on the conversion of the MCPDs and MBPD to PBA derivatives using phenylboronic acids.

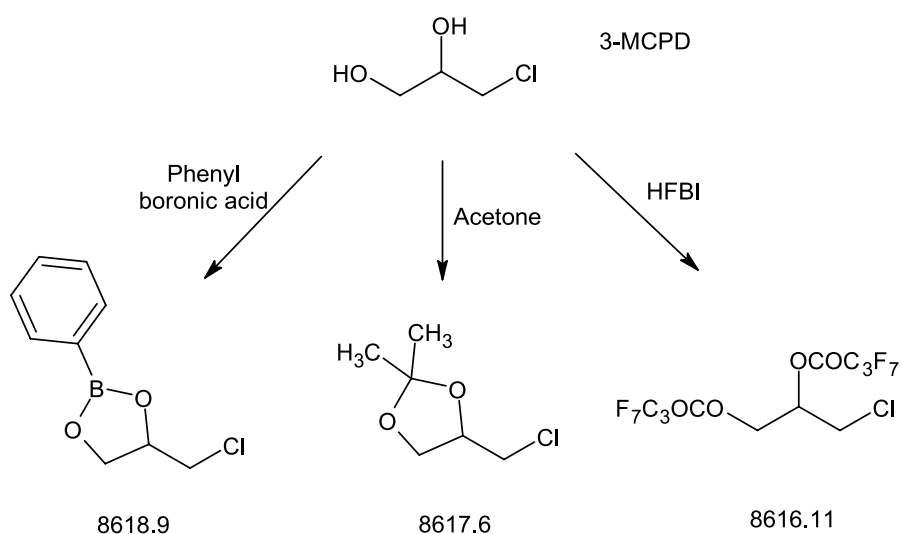
Other alternative derivatization methods include the conversion to acetonides using acetone or heptafluorobutyryl esters using heptafluorobutyrylimidazole (HFBI).

Analysis of bound 2-, 3-MCPDs and glycidol:

Fatty ester bound 2-, 3-MCPDs and glycidol are best analysed by LC-MS.³ This is a complicated matrix and the analysis is complex requiring analytical standards.

Elemental analysis of chlorine species in process intermediates can help to assess the potential for elevated levels of 3-MCPD in the end product, allowing early intervention to minimize the risk.²³

Derivatization methods for MCPD



What does Chiron offer?

Chiron has been among the frontrunners in developing standards for 2- and 3-MCPDs, their mono and diesters and internal standards, as well as native and labelled glycidol esters. The relevant standards for the ISO methods are given above.

Pure MCPD and glycidol esters of the most common fatty acids are available.



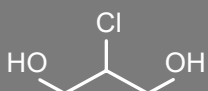
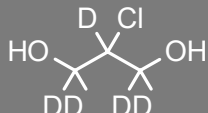
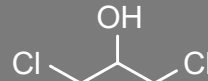
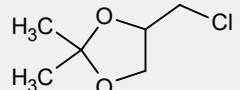
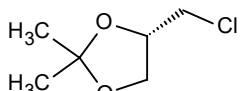
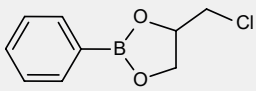
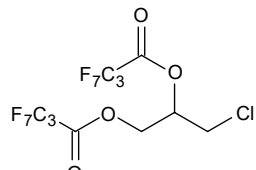


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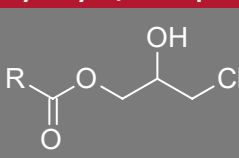
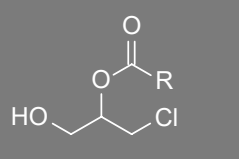
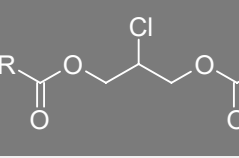
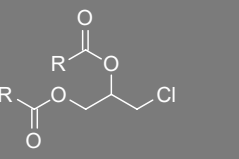
MCPD and glycidyl fatty acid esters product listing



Chiron No.	Name	Synonym / Example Structure	CAS
2- and 3-Monochloropropanediols		 <i>2-MCPD</i>	
10030.3	2-Chloro-1,3-propanediol	2-MCPD	497-04-1
3873.3	3-Chloro-1,2-propanediol	3-MCPD	96-24-2
8607.3	(R)-(-)-3-Chloro-1,2-propanediol	(R)-3-MCPD	57090-45-6
Labelled Monochloropropanediols		 <i>2-MCPD-d5</i>	
10792.3	2-Chloro-1,3-propanediol-d5	2-MCPD-d5	1216764-05-4
3874.3	3-Chloro-1,2-propanediol-d5	3-MCPD-d5	342611-01-2
Other Chloropropanols		 <i>1,3-Dichloro-2-propanol</i>	
8609.3	1,3-Dichloro-2-propanol		96-23-1
14608.3	1,3-Dichloro-2-propanol-d5		1173020-20-6
8612.3	1-Chloro-2-propanol + 2-Chloro-1-propanol		127-00-4
8611.3	1-Chloro-3-propanol		627-30-5
Volatile derivatives for GC-analysis			
8617.6	4-Chloromethyl-2,2-dimethyl-1,3-dioxolane		4362-40-7
9343.6	(S)-(-)-3-Chloro-1,2-propandiol acetonide		60456-22-6
8618.9	4-Chloromethyl-2-phenyl-1,3-dioxo-2-borolane		93114-32-0
8616.11	3-Chloropropane-1,2-di(heptafluoro)butyrate		N/A

MCPD and glycidyl fatty acid esters product listing



Chiron No.	Name	Synonym / Example Structure	CAS
3-MCPD-1-monoesters			
			<i>General</i>
8949.19	3-Chloro-1,2-propandiol-1-monopalmitate	3-MCPD-1-16:0	30557-04-1
8950.19	3-Chloro-1,2-propandiol-1-monopalmitoleate	3-MCPD-1-16:1 (9-cis)	N/A
8951.21	3-Chloro-1,2-propandiol-1-monostearate	3-MCPD-1-18:0	22094-20-8
8952.21	3-Chloro-1,2-propandiol-1-monooleate	3-MCPD-1-18:1 (9-cis)	10311-82-7
8953.21	3-Chloro-1,2-propandiol-1-monolinoleate	3-MCPD-1-18:2 (9,12-dicis)	74875-98-2
8954.23	3-Chloro-1,2-propandiol-1-monoarachidate	3-MCPD-1-20:0	N/A
8955.23	3-Chloro-1,2-propandiol-1-monogadolenate	3-MCPD-1-20:1 (11-cis)	N/A
8956.25	3-Chloro-1,2-propandiol-1-monobehenate	3-MCPD-1-22:0	72165-56-1
8957.25	3-Chloro-1,2-propandiol-1-monoerucidate	3-MCPD-1-22:1 (13-cis)	N/A
3-MCPD-2-monoesters			
			<i>General</i>
8958.19	3-Chloro-1,2-propandiol-2-monopalmitate	3-MCPD-2-16:0	20618-92-2
8959.19	3-Chloro-1,2-propandiol-2-monopalmitoleate	3-MCPD-2-16:1	N/A
8960.21	3-Chloro-1,2-propandiol-2-monostearate	3-MCPD-2-18:0	1329611-08-6
8961.21	3-Chloro-1,2-propandiol-2-monooleate	3-MCPD-2-18:1	915297-48-2
8962.21	3-Chloro-1,2-propandiol-2-monolinoleate	3-MCPD-2-18:2	1470071-08-9
8963.23	3-Chloro-1,2-propandiol-2-monoarachidate	3-MCPD-2-20:0	N/A
8964.23	3-Chloro-1,2-propandiol-2-monogadolenate	3-MCPD-2-20:1	N/A
8965.25	3-Chloro-1,2-propandiol-2-monobehenate	3-MCPD-2-22:0	N/A
8966.25	3-Chloro-1,2-propandiol-2-monoerucidate	3-MCPD-2-22:1	N/A
2-MCPD-diester			
			<i>General</i>
10523.35	2-Chloro-1,3-propanediol-dipalmitate	2-MCPD-di16:0; PP-2-MCPD	169471-41-4
10559.39	2-Chloro-1,3-propanediol-distearate	2-MCPD-di18:0; SS-2-MCPD	26787-56-4
3-MCPD-diester			
			<i>General</i>
8967.35	3-Chloro-1,2-propandiol-dipalmitate	3-MCPD-di16:0; PP-3-MCPD	51930-97-3
8968.35	3-Chloro-1,2-propandiol-dipalmitoleate	3-MCPD-di16:1; PP-3-MCPD	1613232-85-1
8969.39	3-Chloro-1,2-propandiol-distearate	3-MCPD-di18:0; SS-3-MCPD	72468-92-9
8970.39	3-Chloro-1,2-propandiol-dioleate	3-MCPD-di18:1; OO-3-MCPD	69161-73-5
8971.39	3-Chloro-1,2-propandiol-dilinoleate	3-MCPD-di18:2	74875-96-0

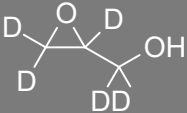
MCPD and glycidyl fatty acid esters product listing



Chiron No.	Name	Synonym / Example Structure	CAS
8972.43	3-Chloro-1,2-propandiol-diarachidate	3-MCPD-di20:0	N/A
8973.43	3-Chloro-1,2-propandiol-digadolinate	3-MCPD-di20:1	N/A
8974.47	3-Chloro-1,2-propandiol-dibehenate	3-MCPD-di22:0	72165-58-3
8975.47	3-Chloro-1,2-propandiol-dierucidate	3-MCPD-di22:1	N/A
Labelled MCPD-esters and glycerol esters		<p style="text-align: center;"><i>2-MCPD-di16:0-d5</i></p>	
10771.35	2-Chloro-1,3-propanediol-dipalmitate-d5 (propyl-d5)	2-MCPD-di16:0-d5; PP-2-MCPD-d5	1426395-62-1
10770.39	2-Chloro-1,3-propanediol-distearate-d5 (propyl-d5)	2-MCPD-di18:0-d5; SS-2-MCPD-d5	1329796-49-7
8981.19	3-Chloro-1,2-propandiol-1-monopalmitate-d5 (propyl-d5)	3-MCPD-1-16:0-d5	N/A
8976.21	3-Chloro-1,2-propandiol-1-monostearate-d5 (propyl-d5)	3-MCPD-1-18:0-d5	N/A
8977.25	3-Chloro-1,2-propandiol-1-monobehenate-d5 (propyl-d5)	3-MCPD-1-22:0-d5	N/A
8982.35	3-Chloro-1,2-propandiol-dipalmitate-d5 (propyl-d5)	3-MCPD-di16:0-d5; PP-3-MCPD-d5	1185057-55-9
13763.35	3-Chloro-1,2-propandiol-dipalmitate-13C3 (propyl-13C)	3-MCPD-di16:0-13C3; PP-3-MCPD-13C3	51930-97-3 (unlabelled)
14023.39	3-Chloro-1,2-propandiol-distearate-13C3 (propyl-13C)	3-MCPD-di18:0-13C3; SS-3-MCPD-13C3	72468-92-9 (unlabelled)
8978.39	3-Chloro-1,2-propandiol-distearate-d5 (propyl-d5)	3-MCPD-di18:0-d5; SS-3-MCPD-d5	1246818-85-8
14895.39	3-Chloro-1,2-propandiol-dioleate-d5 (propyl-d5)	3-MCPD-di18:1; OO-3-MCPD-d5	69161-73-5 (unlabelled)
8979.47	3-Chloro-1,2-propandiol-dibehenate-d5 (propyl-d5)	3-MCPD-di22:0-d5	N/A
Glycidyl fatty acid esters		<p style="text-align: right;"><i>General</i></p>	
9714.3	(+/-)-Glycidol		556-52-5
13954.7	Glycidyl butyrate	Glycidyl C4:0; 2-Oxiranylmethyl butyrate	2461-40-7
9674.19	Glycidyl palmitate	Glycidyl C16:0; Gly-P	7501-44-2
9896.19	Glycidyl palmitoleate	Glycidyl C16:1 (9-cis)	213738-77-3
9899.21	Glycidyl stearate	Glycidyl C18:0; Gly-S	7460-84-6
9671.21	Glycidyl oleate	Glycidyl C18:1 (9-cis); Gly-O	5431-33-4
9673.21	Glycidyl linoleate	Glycidyl C18:2 (9-cis; 12-cis)	24305-63-3
9672.21	Glycidyl linolenate	Glycidyl C18:3 (9-cis; 12-cis; 15-cis)	51554-07-5
9897.23	Glycidyl arachidate	Glycidyl C20:0	95490-89-4

MCPD and glycidyl fatty acid esters product listing



Chiron No.	Name	Synonym / Example Structure	CAS
9900.23	Glycidyl gondolenate	Glycidyl C20:1 (11-cis)	N/A
9898.25	Glycidyl behenate	Glycidyl C22:0	14338-53-5
Labelled glycidyl esters		 (+/-)-Glycidol-1,1,2,3,3-d5	
10551.3	(+/-)-Glycidol-1,1,2,3,3-d5		1246819-20-4
10524.19	Glycidyl palmitate-d5 (glycidyl d5)	Glycidyl C16:0-d5; Gly-P-d5	1794941-80-2
9924.19	Glycidyl palmitate-d31 (palmitate d31)	Glycidyl C16:0-d31; Gly-P-d31	1246819-24-8
13951.23	Glycidyl arachidate-d5 (glycidyl d5)	Glycidyl C20:0-d5	95490-89-4 (unlabelled)
13952.23	Glycidyl gondolenate-d5 (glycidyl d5)	Glycidyl C20:1 (11-cis)-d5	N/A
13414.21	Glycidyl stearate-d5 (glycidyl d5)	Glycidyl C18:0-d5; Gly-S-d5	1346598-19-3
12294.21	Glycidyl oleate-d5 (glycidyl d5)	Glycidyl C18:1-d5; Gly-O-d5	1426395-63-2
13953.25	Glycidyl behenate-d5 (glycidyl d5)	Glycidyl C22:0-d5	14338-53-5 (unlabelled)

MCPD and glycidyl fatty acid esters mixes

Chiron No.	Name	Composition (Synonym) [CAS]	Concentration / Solvent
S-4980-50-T	MCPD Mix 1	10523.35 2-Chloro-1,3-propanediol-dipalmitate [169471-41-4] 8967.35 3-Chloro-1,2-propandiol-dipalmitate [51930-97-3] 9674.19 Glycidyl palmitate [7501-44-2]	50 µg/mL in Toluene
S-4981-50-T	MCPD Internal Standard Mix 1	10771.35 2-Chloro-1,3-propanediol-dipalmitate-d5 (propyl-d5) [1426395-62-1] 8982.35 3-Chloro-1,2-propandiol-dipalmitate-d5 (propyl-d5) [1185057-55-9] 10524.19 Glycidyl palmitate-d5 (glycidyl d5) [1794941-80-2]	50 µg/mL in Toluene

For ordering and information about prices and delivery in your country, please contact your local distributor:



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