# Simultaneous Monitoring of 2-MCPD, 3-MCPD and Glycidyl esters in Oils and Fats



Monochloropropane-1,2-diol (MCPD) and its ester are food borne contaminants, mainly formed during high temperature processing of fat-containing matrices. Maximum levels of less than 2 µg MCPD per kilogram body weight per day have been established by Commission Regulation (EC) 1881/2006. The European Food Safety Authority (EFSA) Panel on Contaminants in the Food Chain (CONTAM) agreed with the estimate of 100 % release of 3-MCPD from its esters in humans.

Fatty acid esters of glycidol ("bound glycidol") are generated during the deodoration step of edible oil refining. Although the toxicological relevance of glycidyl fatty acid ester has not yet been fully elucidated, the glycidyl itself is categorized as a probable carcinogen in humans. Scientific studies indicate an almost entire release of glycidol from fatty acid esters within the digestive tract.

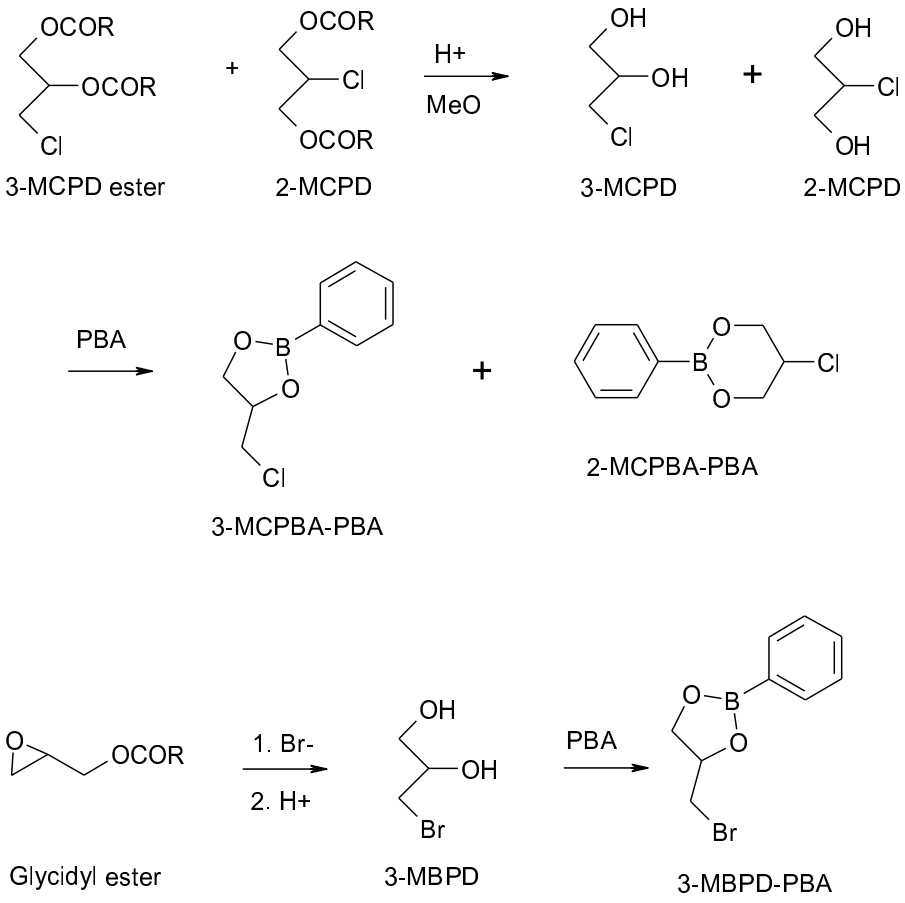
In 2013 EFSA published a scientific report on the analysis of occurrence of 3-MCPD in food in Europe and a preliminary expose assessment.

The European Commission therefore recommends the monitoring of the presence of MCPD, MCPD-esters and glycidyl esters in vegetable oils and fats. The preferred method for the determination of ester bound MCPD and glycidol is published by The American Oil Chemists' Society (AOAC).

AOAC official Method Cd 29a-13 is based on the method developed by Ermanova and Hrncirick and describes the simultaneous analysis of 2- and 3-MCPD fatty esters and dlycidyl fatty esters in edible oils and fats by acid transesterification:

The glycidyl esters are converted to 3-monobromopropandiol (3-MBDP) monoesters in an acid solution containing bromide salt. The 3-MBPD esters and the 2- and 3-MCPD esters, are then converted into free (non-esterified) form in acidic methanol solution. The fatty acid methyl esters generated during this reaction are extracted from the sample and 3-MBPD and 2- and 3-MCPD are then derivatised with phenylboronic acid prior to GC-MS analysis. Deuterated derivatives of glycidyl and 3-MCPD are used as internal standards.

Figure 1. Derivatization of 2-MCPD, 3-MCPD, 3-MBPD prior to GC-MS analysis




**Required Standards:**

High purity standards required for this method are offered by Chiron AS:

| Chiron Cat. No. | Name | Abbreviation | Concentration | Purity |
|---|---|---|---|---|
| 8967.35-K-T | 1,2-Dipalmitoyl-3-chloropropanediol | PP-3-MCPD | 1000µg/mL in toluenel | 99+ % |
| 10523.35-K-T | 1,3-Dipalmitoyl-2-chloropropanediol | PP-2-MCPD | 1000µg/mL in toluene | 98 % |
| 8982.35-K-T | 1,2-Dipalmitoyl-3-chloropropanediol-d5 | PP-3-MCPD-d5 | 1000µg/mL in toluene | 99+ % |
| 9674.19-K-T | Glycidyl palmitate | Gly-P | 1000µg/mL in toluene | 99+ % |
| 10524.19-K-T | Glycidyl palmitate-d5 | Gly-P-d5 | 1000µg/mL in toluene | 98 % |
| 9924.19-K-T | Glycidyl palmitate-d31 | Gly-P-d31 | 1000µg/mL in toluene | 97+ % |

**Boronic acid derivative:**

| | |
|---|---|
| 8618.9-K-ME | 4-Chloromethyl-2-phenyl-1,3-dioxa-2-borolane<br>1000µg/mL in methanol, 98% |

**Available standards for MCPD and glycidyl ester analysis:**

The following standards are available as either 10mg neat material, or in 1mL (minimum) of methanol (T) or isooctane (IO) at concentrations of 100µg/mL (100) or 1000µg/mL (K) as designated by the Chiron catalogue number.

| | **3-MCPD-1-monoesters** | |
|---|---|---|
| 8949.19-100-T | 3-Chloro-1,2-propandiol-1-monopalmitate | 3-MCPD-1-16:0 |
| 8950.19-100-T | 3-Chloro-1,2-propandiol-1-monopalmitoleate | 3-MCPD-1-16:1 (9-cis) |
| 8951.21-100-T | 3-Chloro-1,2-propandiol-1-monostearate | 3-MCPD-1-18:0 |
| 8952.21-100-T | 3-Chloro-1,2-propandiol-1-monooleate | 3-MCPD-1-18:1 (9-cis) |
| 8953.21-100-T | 3-Chloro-1,2-propandiol-1-monolinoleate | 3-MCPD-1-18:2 (9,12-dicis) |

| | **2-MCPD-diesters** | |
|---|---|---|
| 10523.35-K-T | 2-Chloro-1,3-propanediol-dipalmitate, PP-2-MCPD | 2-MCPD-di16:0 |
| 10559.39-K-T | 2-Chloro-1,3-propanediol-disterarate | 2-MCPD-di16:0 |

| | **3-MCPD-diesters** | |
|---|---|---|
| 8967.35-100-T | 3-Chloro-1,2-propandiol-dipalmitate, PP-3-MCPD | 3-MCPD-di16:0 |
| 8967.35-K-T | 3-Chloro-1,2-propandiol-dipalmitate, PP-3-MCPD | 3-MCPD-di16:0 |
| 8968.35-100-T | 3-Chloro-1,2-propandiol-dipalmitoleate | 3-MCPD-di16:1 |
| 8969.39-100-T | 3-Chloro-1,2-propandiol-distearate | 3-MCPD-di18:0 |
| 8969.39-K-IO | 3-Chloro-1,2-propandiol-distearate | 3-MCPD-di18:0 |
| 8970.39-100-T | 3-Chloro-1,2-propandiol-dioleate | 3-MCPD-di18:1 |
| 8971.39-100-T | 3-Chloro-1,2-propandiol-dilinoleate | 3-MCPD-di18:2 |

| | **Labelled MCPD-esters** | |
|---|---|---|
| 8981.19-100-T | 3-Chloro-1,2-propandiol-1-monopalmitate-d5 | 3-MCPD-1-16:0-d5 |
| 8976.21-100-T | 3-Chloro-1,2-propandiol-1-monostearate-d5 | 3-MCPD-1-18:0-d5 |
| 8977.25-100-T | 3-Chloro-1,2-propandiol-1-monobehenate-d5 | 3-MCPD-1-22:0-d5 |
| 8982.35-100-T | 3-Chloro-1,2-propandiol-dipalmitate-d5, PP-3-MCPD-d5 | 3-MCPD-di16:0-d5 |
| 8982.35-K-T | 3-Chloro-1,2-propandiol-dipalmitate-d5, PP-3-MCPD-d5 | 3-MCPD-di16:0-d5 |
| 8978.39-100-T | 3-Chloro-1,2-propandiol-distearate-d5 | 3-MCPD-di18:0-d5 |
| 8978.39-K-T | 3-Chloro-1,2-propandiol-distearate-d5 | 3-MCPD-di18:0-d5 |
| 8979.47-100-T | 3-Chloro-1,2-propandiol-dibehenate-d5 | 3-MCPD-di22:0-d5 |
| 8979.47-100-T | 3-Chloro-1,2-propandiol-dibehenate-d5 | 3-MCPD-di22:0-d5 |

| | **Glycidyl fatty acid esters** | |
|---|---|---|
| 9674.19-100-T | Glycidyl palmitate, Gly-P | glycidyl C16:0 |
| 9896.19-100-T | Glycidyl palmitoleate | glycidyl C16:1 (9-cis) |
| 9899.21-100-T | Glycidyl stearate | glycidyl C18:0 |
| 9671.21-100-T | Glycidyl oleate | glycidyl C18:1 (9-cis) |
| 9673.21-100-T | Glycidyl linoleate | glycidyl C18:2 (9-cis, 12-cis) |
| 9672.21-100-T | Glycidyl linolenate | glycidyl C18:3 (9-cis, 12-cis, 15-cis) |
| 9897.23-100-T | Glycidyl arachidate | glycidyl C20:0 |
| 9900.23-100-T | Glycidyl gondolenate | glycidyl C20:1 (11-cis) |
| 9898.25-100-T | Glycidyl behenate | glycidyl C22:0 |
| 9714.3-10MG | (+/-)-Glycidol | |
| 10551.3-10MG | (+/-)-Glycidol-1,1,2,3,3-d5 | |

| | **Labelled glycidyl esters** | |
|---|---|---|
| 10524.19-K-T | Glycidyl palmitate-d5, Gly-P-d5 | glycidyl C16:0-d5 |
| 9924.19-K-T | Glycidyl palmitate-d31, Gly-P-d31 | glycidyl C16:0-d31 |
| 9924.19-10MG | Glycidyl palmitate-d31, Gly-P-d31 | glycidyl C16:0-d31 |

*Please note: All details are without guarantee.*

Literature:

AOCS Official Method Cd 29a-13:
2- and 3-MCPD Fatty Acid Esters and Glycidol Fatty Acid Esters in Edible Oils and Fats by Transesterification.

AOCS Official Method Cd 29b-13:
Determination of Bound Monochloropropanediol- (MCPD-) and Bound 2,3-epoxy-1-propanol (glycidol) by Gas Chromatography/ Mass Spectrometry (GC/MS).

AOCS Official Method Cd 29c-13:
Fatty-acid-bound 3-chloropropane-1,2-diol (3-MCPD) and 2,3-epoxi-propane-1-ol (glycidol), Determination in Oil and Fats by GC/ MS (Differential Measurement).

European Commission, SANCO G (2014) 46514
Standing Committee on the Food Chain and Animal Health, 10 February 2014.

A.Ermacora and K.Hrncirik (2012), J. Am. Chem. Soc. 89, 211-217

A.Ermacora and K.Hrncirik (2013), J. Am. Chem. Soc. 90, 1-8

A Novel Method for Simultaneous Monitoring of 2-MCPD, 3-MCPD and Glycidyl Esters in Oils and Fats.