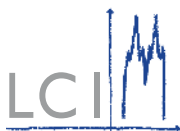


# MCPD and Glycidyl Esters – An Update

Thermal reaction products are mostly generated within the course of the Maillard reaction and count among the process contaminants (so-called "foodborne toxicants"). Such substances, which until a little while ago would only have concerned bodies of experts, are today also of public interest and can form either in the foodstuff itself or in its raw material components. The former is termed as endogenous formation, the latter as exogenous supply.



Food Chemistry  
Institute of  
the Association  
of the German  
Confectionery Industry

Institute Director:  
Prof. Dr.  
Reinhard Matissek

Adamsstraße 52 - 54  
51063 Köln

phone  
+49 221 62 30 61  
fax  
+49 221 61 04 77  
web  
www.lci-koeln.de

## What are MCPDE and GE actually?

3-monochloro-1,2-propanediol (3-MCPD) was first detected in 1978, in foods such as soy sauces, seasonings, and broths. Like 2-monochloro-1,3-propanediol (2-MCPD), it belongs to the chloropropanols and is termed a "free MCPD". For almost 10 years now, "bound" MCPD has also been known

rides to form MCPDE. By contrast, GE form from monoglycerides and diglycerides as of temperatures of 230°C.

Particular high content levels of 3-MCPDE and GE were detected in refined palm fats and palm oils whereas native and other non-heat-treated fats and oils, such as cocoa butter, are free of MCPDE.

as genotoxic in various animal studies. The risk assessment of glycidol is determined by applying the margin of exposure (MoE).

## How are MCPDE and GE analytically detected?

Currently three methods devised by the American Oil Chemists' Society (AOCS) are

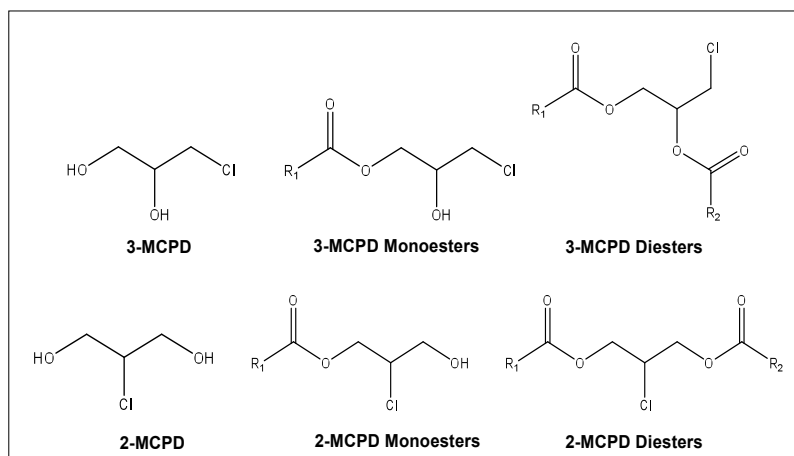


Diagram 1 - Structural formulas of the monochloropropanediols and their esters

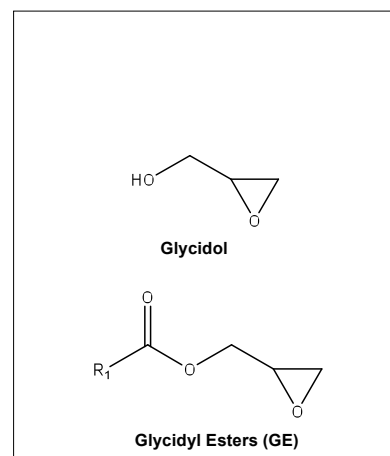


Diagram 2 - Structural formulas of glycidol and glycidyl esters

in the form of monoesters or diesters of various fatty acids (3-MCPDE, cf. Diagram 1).

As additional relevant substances in this context, the glycidyl esters (GE) (cf. Diagram 2) were identified in the course of developing the methods for analysing 3-MCPDE.

MCPDE and GE form during the last step of the fat refining process, deodorisation. Since they are formed during foodstuff processing, they are termed the so-called "foodborne toxicants".

The deodorisation of edible fats and oils involves steam distillation at temperatures of 200 to 270°C to remove undesirable flavouring substances and odorous substances. From chloride-containing components naturally present in oil seeds, chloride ions can decompose at as of temperatures above 180°C and react with triacylglyce-

A current LCI study has shown that there is no endogenous formation of 3-MCPDE and GE during the industrial deep-frying of potato crisps in high-oleic sunflower oils (HOSO)<sup>1</sup>.

## How toxic are MCPDE and GE?

Studies conducted by the Federal Institute for Risk Assessment (BfR) have shown that 3-MCPDE are hydrolysed almost completely into free 3-MCPD by digestion enzymes after oral intake. There is also a quantitative release of glycidol from glycidyl esters. Free MCPD and free glycidol were respectively classified by the International Agency for Research on Cancer (IARC) as "probably or possibly carcinogenic to humans" (category 2b and category 2a). Hence a group-TDI (tolerable daily intake) of 0.8 µg/kg body weight per day was set for free and bound 3-MCPD. Glycidol was additionally described

used as state-of-the-art analytical methods to determine 3-MCPDE, 2-MCPDE, and GE. What all three methods have in common is cleavage of the fatty acid esters and the following analysis of the released compounds after derivatisation using phenylboronic acid via GC/MS. If the ester cleavage is conducted under mild conditions, simultaneous quantification of 2-MCPDE, 3-MCPDE, and GE is possible (AOCS-Cd 29a 13, AOCS Cd 29b 13). The three AOCS methods in each case determine the total amount of respective esters regardless of the fatty-acid residue.

<sup>1</sup> Dingel A, Matissek R (2015) Esters of 3-monochloropropane-1,2-diol and glycidol: no formation by deep-frying during large-scale production of potato crisps. Eur Food Res Technol 241:719–723