



3-MCPD and Related Compounds

Process contaminants as a result of high temperature treatment and/or refinement of vegetable fats and oils

Free 2- and 3-monochloropropanediol (MCPD) may occur in food which is rich in fat and salt after exposition to high temperatures, e.g. during the manufacturing of soy and seasoning sauces or hydrolysed vegetable protein, baking of pastries or during barbecuing and smoking of meat and fish products. Further chloropropanols like 1,3- and 2,3-dichloropropanol (1,3-DCP, 2,3-DCP) evolve in small quantities as byproducts. Traces of 3-MCPD may also be formed during the manufacturing of glycerol.

2-MCPD-, 3-MCPD- and glycidyl fatty acid esters (MCPD-FE and G-FE) may be formed during refinement of fats and oils. The content of MCPD-FE and G-FE depends on the intensity of the industrial procedures. But also the raw material is of major importance. For example, palm oils contain high levels of diglycerides and are therefore especially bound to form MCPD-FE and G-FE. Refined fats and oils are not only consumed directly, but are also commonly used in various areas of industrial food production, such as mayonnaise, bakery products, spreads, antipasti, pesto or as a component of infant food.

Toxicology

The EFSA confirmed the nephron- and testicular toxicity of 3-MCPD in 2016. The tolerable daily intake (TDI) was raised to 2 µg/kg body weight in January 2018.

3-MCPD is a potential marker substance for all other chloropropanols. 1,3-DCP and glycidol, are classified as genotoxic carcinogens. According to an EFSA consumption study, some age/consumption groups absorb questionable amounts of glycidol in the form of G-FE. No risk assessment has been performed for 2-MCPD and its esters due to insufficient toxicological data. EFSA recommends further studies.

All three groups of esters (2-MCPD-, 3-MCPD- and G-FE) are completely cleaved into the free compounds in the human organism. Therefore, the German Federal Institute for Risk Assessment (BfR) recommends to minimise the contents of 3-MCPD esters in food as much as possible.

Food Law

The main sources for the diet-related intake of free 3-MCPD are soy sauce and soy sauce-based products. A maximum of 50 µg/kg dry matter (Regulation (EU) 2023/915) applies to 3-MCPD in hydrolysed vegetable protein and soy sauce.

A number of different foodstuffs consumed in high quantities like bread and pasta, may also contribute to the uptake of 3-MCPD. However, this is rather caused by the large quantities usually consumed than by their high content of 3-MCPD.

Maximum levels for G-FE and total 3-MCPD (free and bound) in fats, oils and baby food have been added to Regulation (EU) 2023/915.

EU Regulation No. 231/2012 on specifications for food additives sets a maximum level for 3-MCPD in glycerol of 0.1 mg/kg.

For 1,3- und 2,3-DCP as well as 2-MCPD and 2-MCPD-FE, there is no regulation on maximum levels so far.

Analysis

The analysis of the various MCPD and glycidyl esters in food is extremely complex. Eurofins offers various methods for the determination.

All methods are characterized by the fact that the compounds are determined after a cleavage of the esters (FE) in order to minimise the multitude of MCPD-FE and G-FE.

The newly implemented “Zwagerman” method proves itself through various methodological advances. It offers the possibility for a high degree of automation and the advantage of direct determination of glycidol. The latter results in a lower measurement uncertainty for glycidol compared to other commercially available methods.

An essential difference of the “DGF” method is the determination of the glycidol, which is calculated indirectly as a difference.

Parameter	Direct Methods	Indirect Methods (Glycidol)
Free 3-MCPD, free 2-MCPD	GC-MS/MS Internal Method	
2- and 3-MCPD esters and glycidyl esters	Zwagerman AOCS Method Cd 29d-20 DIN EN ISO 18363-4: 2021	DGF C-VI 18 (10) A,B AOCS Method Cd 29c-13 DIN EN ISO 18363-1: 2017

Tab.1: Analytical strategy for 2-MCPD, 3-MCPD and glycidyl esters in fats and oils

