



Bundesamt für
Verbraucherschutz und
Lebensmittelsicherheit



Monitoring Survey on the presence of 3-MCPD esters and related compounds in food

Introductory remarks

- 2- and 3-MCPD/glycidyl fatty acid esters are
- Heat-induced process contaminants found **at highest levels in refined vegetable oils**
- Therefore, **refined oils** and **all foods containing refined oils** may
 - potentially be contaminated and
 - represent major contributors to dietary MCPD and glycidol exposure
- Reliable occurrence data for accurate exposure assessment and possible elaboration of further risk management measures are only available on a limited basis
- Therefore, the **European Commission** recommends the **monitoring** of 2,3-MCPD, its fatty acid esters and Glycidyl fatty acid esters levels in food

Comm recommendation 2014/661/EU

Member States should monitor **vegetable oils** and fats **as well as**:

- vegetable oil containing foods/
foods produced with vegetable oils such as
- margarine and similar products
- fine bakery wares, bread and rolls
- potato- or cereal-based snacks
- other fried potato-based products
- foods intended for **infants and young children**,
including infant- and follow on formulae



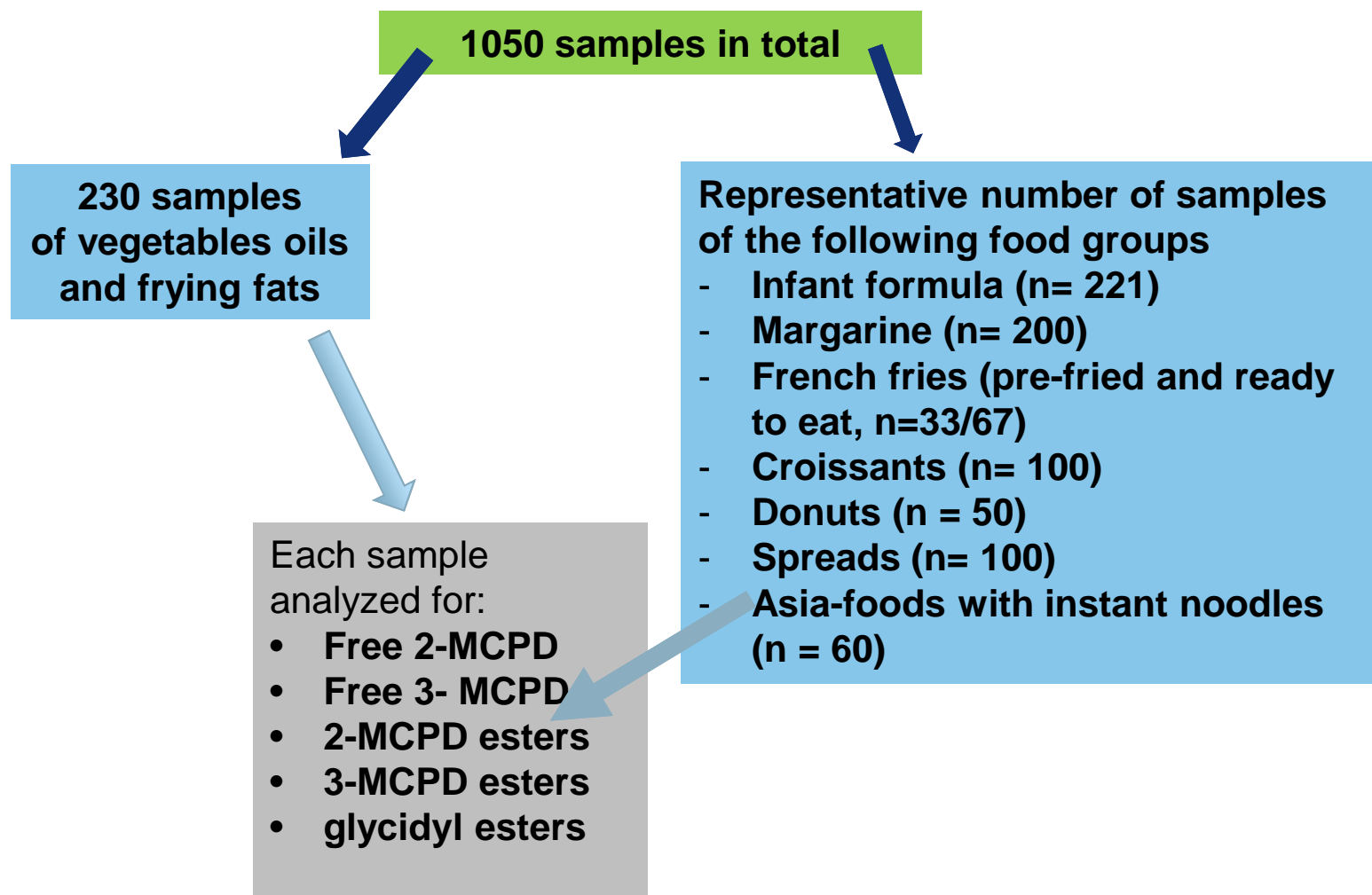
- EFSA scientific opinion on the **human health risks** related to the presence of 3-/2-MCPD(esters) and glycidyl fatty acid esters in food published in 2016
- EFSA risk assessment was based on
 - 7,175 occurrence data results, more than half of which were derived from oils and fats.
 - Data collected with numerous different analysis techniques; (problem as regards reliability and comparability of data?)
- Analysis of complex food matrices **other than oils** is very **challenging**
- No official **reference method**, which has been validated in collaborative studies, is available so far
- Comparatively low amount of data available for more **complex/compound foods produced with vegetable oils**

* EFSA Journal 2016;14(5):4426

National monitoring survey

- National monitoring survey performed by **SGS Germany** during Feb. 2016 and Oct. 2016 within the framework of a research project **funded by the Federal Ministry for nutrition and agriculture**
- Head of project: Dr. Jan Kuhlmann
- Primary objectives: Enhancement of data basis in view of better exposure assessment and possible development of suitable risk management strategies
- Monitoring focused on refined oils and relevant vegetable oil containing food groups

Design of National monitoring survey



National Monitoring Survey

Sampling procedures

- Samples purchased at retail level (e.g. supermarkets, drugstores etc.) and the **eating out sector** (e.g. snack bars for french fries, bakeries etc.)
- Selection of foods made on a representative basis under consideration of market shares including up to
- 10 lots per product

Analytical issues

- In-house validated, so called „5 in 2“-method
- Based in principal on validated AOCS Official Method Cd 29b-13
- Had to be modified with regard to
- testing of complex composed foods
- separate determination of free and ester-bound analytes
- reaching particularly low LOQs (5 to 10 µg/kg)

Data processing/ transmission to EFSA

- Data transmitted to Federal Office for Consumer Protection and Food Safety (BVL) as national competent authority for central data collection in Germany
- Data communicated to EFSA in Oct. 2016

results for vegetable oils

Measuring parameter	Results > LOQ	Mean	Median	P90	P95	Max
Free 3-MCPD	1%	< 5	< 5	< 5	< 5	11
3-MCPD-Esters	98%	610	300	1210	1560	20930
Free 2-MCPD	0%	--	--	--	--	---
2-MCPD-Esters	95%	270	125	550	680	9770
Glycidyl esters	97%	400	290	860	1340	1800

Results given in µg/kg

- All samples of refined vegetable oils contained quantifiable levels of bound MCPD and glycidol above the LOQ
- Presence of **free** MCPD-compounds **not relevant** in refined oils
- Content of MCPD- and glycidyl esters in vegetable oils not uniform **but highly variable**

results for different oils

Type of oil	Measuring parameter	Results > LOQ	Mean	Median	P90	P95	Max
rapeseed oil n= 50	3-MCPD-Esters	100%	170	70	400	510	1680
	2-MCPD-Esters	92%	70	25	180	250	670
	Glycidyl esters	100%	180	<u>160</u>	310	340	350
sunflower oil n= 58	3-MCPD-Esters	100%	380	320	730	820	1200
	2-MCPD-Esters	100%	180	130	350	395	580
	Glycidyl esters	100%	410	<u>300</u>	770	955	1800
Other oils n = 42	3-MCPD-Esters	93%	1450	570	2920	3520	20940*
	2-MCPD-Esters	90%	650	190	1420	1620	9770
	Glycidyl esters	90%	510	430	1220	1360	1560

* quantified in one sample of hazelnut oil

Results given in µg/kg

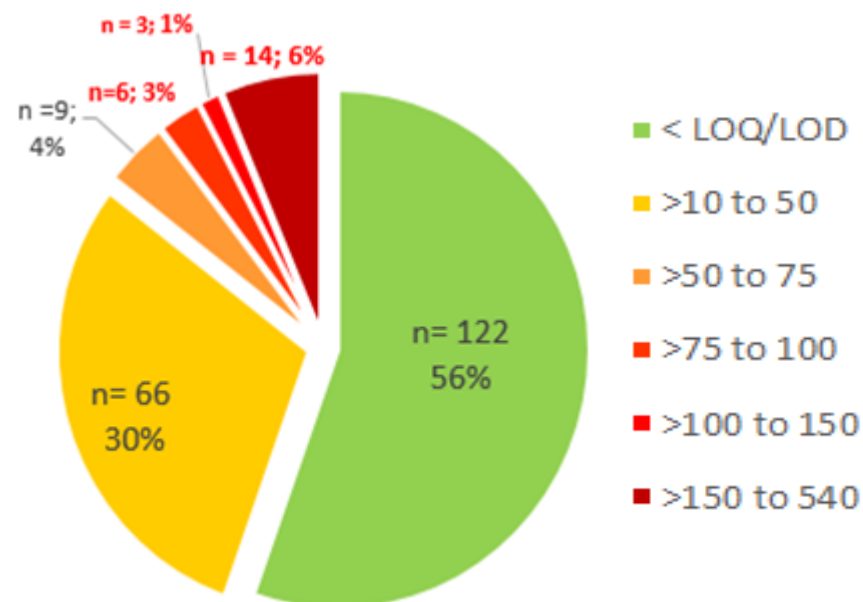
Results on vegetable oils: Key findings

- Significantly higher MCPD- and glycidol-contamination levels detected for sunflower oils compared to rapeseed oils
- None of the rapeseed oils exceeded a glycidol/3-MCPD content of 1 and 2 mg/kg, respectively
- Elevated/extremely high contamination levels identified for “specialty” oils (e.g. hazelnut oils)
- In the group of “specialty” oils a considerable number of samples **exceeded** a glycidol/3-MCPD content of **1 or 2 mg/kg**
- Awareness for implementation of appropriate mitigation strategies may presumably be less advanced in case of oils with lower market shares

Glycidyl esters in infant formula

- Fortunately, glycidyl ester levels for majority of the analyzed 221 samples of infant formula **were below the LOQ**
- In case of genotoxic carcinogens exposure should be at a level of "no concern" (**MoE higher than 25.000**)
- In order to ensure a chronic exposure at a **level of no concern**, infant formula should not exceed a glycidol level of **17 µg/kg** according to a risk assessment of the BfR
- **In most samples this value was not exceeded!**
- Successful mitigation strategies for specific reduction of glycidyl ester seem to have been developed over recent years
- However, considerable higher levels could be determined for some products as also being reflected in the asymmetric distribution of results (**mean three times > median**)

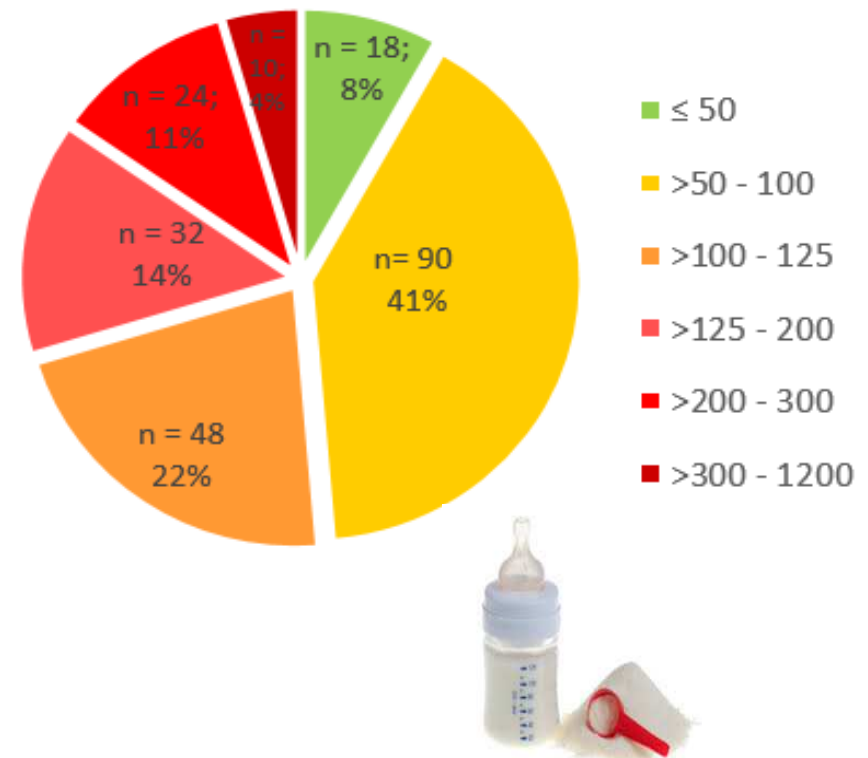
Distribution (%) of glycidyl ester contents in infant formula (µg/kg)



3-MCPD esters in infant formula

- Significant proportion of samples in the higher concentration range (above 125 µg/kg)
- In order to provide sufficient health protection to infants solely fed on infant formula and follow-on formula, their exposure should be **below** the health based guidance value (**TWI of 0,8 µg/kg bw**, currently established by EFSA)
- infant formula should not exceed a 3- MCPD level of **33 µg/kg** according to BfR. For the vast majority of samples this low level **could not be achieved**
- In contrast to glycidyl esters mitigation measures for MCPD esters seem to be more challenging and technically demanding

Distribution (%) of 3-MCPD-contents in infant formula (µg/kg)




results for margarine and frying fats

Food commodity	Measuring parameter	Results > LOQ	Mean	Median	P90	P95	Max
Margarine N = 200	Free 3-MCPD	3%	< 5	< 5	--	--	44
	3-MCPD-Esters	100%	400	380	680	700	1040
	Free 2-MCPD	0%	--	--	--	--	--
	2-MCPD-Esters	100%	190	180	320	340	500
	Glycidyl esters	100%	220	200	360	380	1100
Frying fats n= 50	3-MCPD-Esters	100%	1930	1570	2320	2860	3400
	2-MCPD-Esters	100%	760	710	1150	1380	1540
	Glycidyl esters	100%	1480	1010	3930	4440	8700

- **Frying fats** showed highest levels for 3-MCPD/glycidyl esters within the category of fat/oils due to the use of **palm oil as main ingredient**
- High contamination with **glycidyl esters particularly high which is of health concern**
- The relatively low data variance observed for margarine may be attributable to successful quality control systems;

french fries

Food commodity	Measuring parameter	Results > LOQ	Mean	Median	<u>P95</u>	Max
French fries pre-fried n = 33	3-MCPD-Esters	88%	17	16	26	35
	2-MCPD-Esters	48%	6	--	13	13
	Glycidyl esters	67%	10	12	21	22
French fries ready to eat n = 67 	Free 3-MCPD	52%	26	6	110	620
	3-MCPD-Esters	99%	110	90	400	560
	Free 2-MCPD	24%	9	5	51	272
	2-MCPD-Esters	99%	70	50	210	290
	Glycidyl esters	96%	120	80	350	590

- No significant contamination for pre-fried french fries identified; however, higher levels found in fries ready-to-eat probably due to the frying process (frying oil may already be contaminated)
- Analysis revealed the presence of **free 3-MCPD** in more than **50 % of samples**, some of which even exceeded the levels of bound 3-MCPD

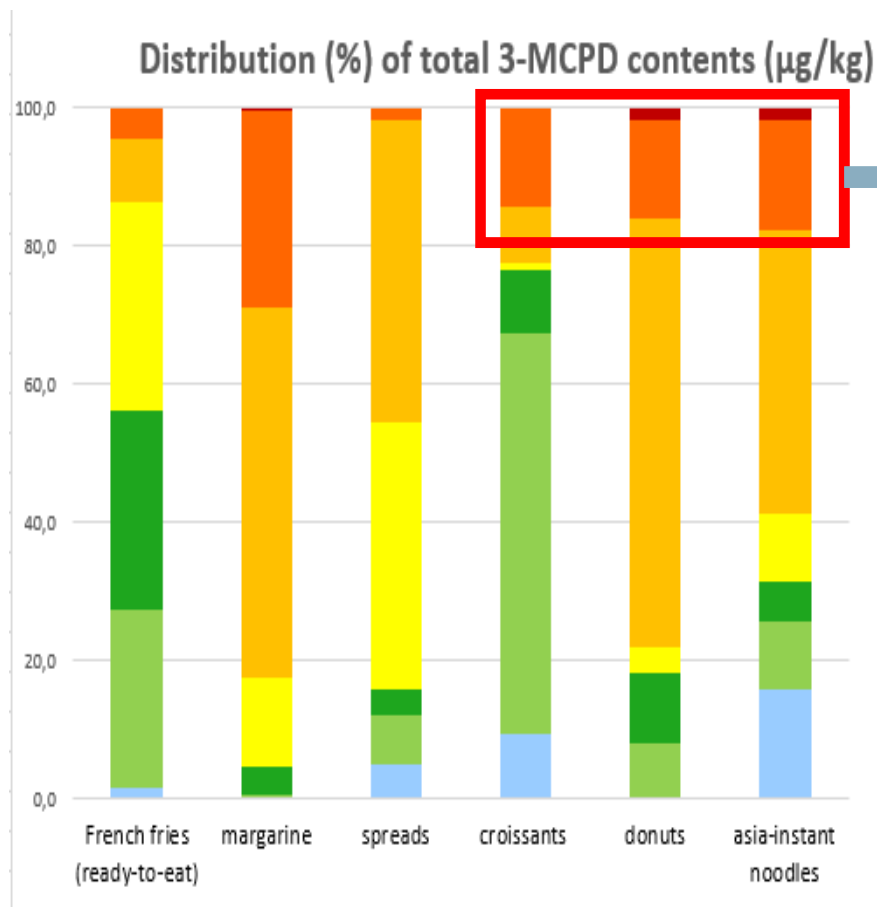
results for croissants



Measuring parameter	Results > LOQ	Mean	Median	P90	P95	Max
free 3-MCPD	90%	20	10	29	42	400
3-MCPD Esters	53%	140	14	610	730	980
free 2-MCPD	11%	5	5	6	7	103
2-MCPD- Esters	34%	50	< 10	210	290	330
Glycidyl esters	41%	110	10	410	680	1170

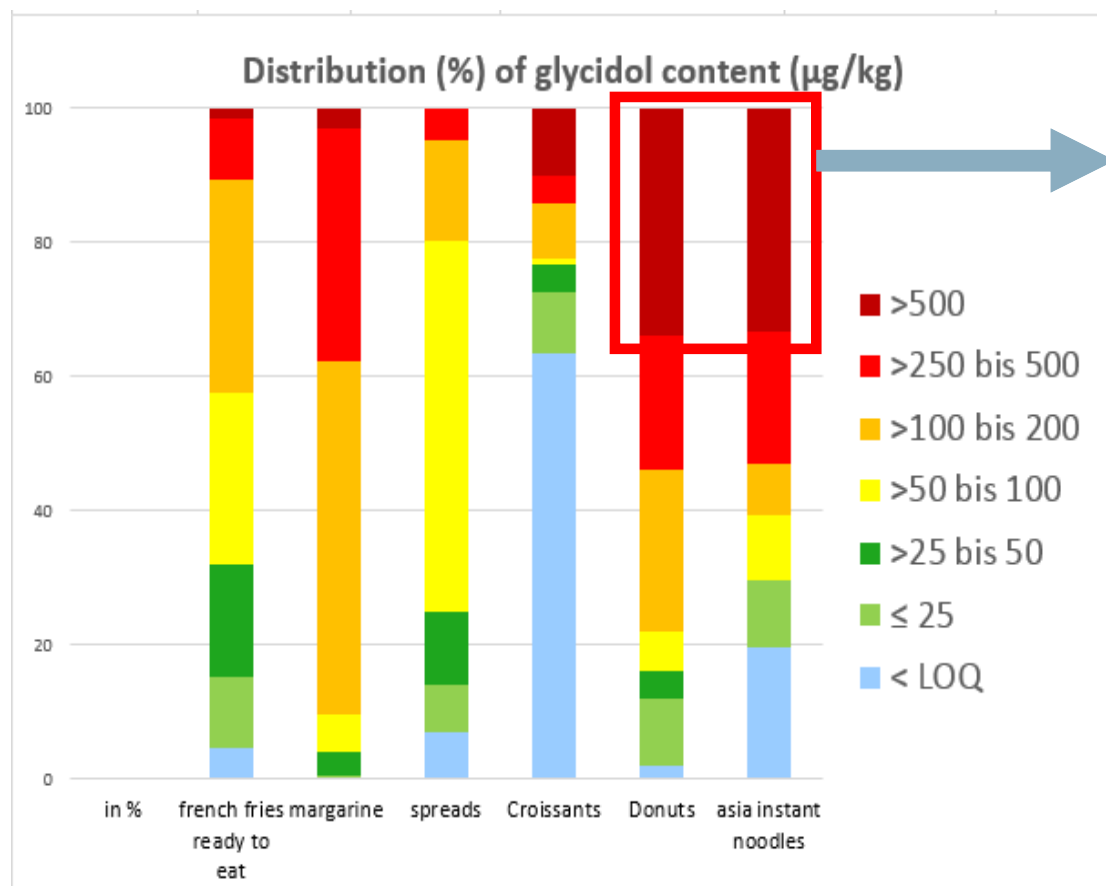
- significant amount of data < LOQ due to use of butter instead of refined oils as fat ingredient
- However, in croissants produced exclusively with refined oils the amount of MCPD-/glycidyl esters can be extraordinary high.
- Corresponding contents in the fat fraction are **often > 1 mg/kg for glycidol and 2 mg/kg for 3-MCPD**
- **Occurrence of Free 3/2-MCPD** could be attributable to heat-induced formation during baking

Overview: 3-MCPD levels in different compound foods



- significant percentage of samples (~ 15 - 20%) already contained levels of 3-MCPD as high as **500 – 1000 $\mu\text{g/kg}$** on **product basis**
- Nearly **all food categories** investigated contained bound analytes in **significant concentrations**
- corresponding levels expressed on **fat basis** **considerably high** in some foods groups

Overview: glycidyl levels in different compound foods



in more than 30% of tested donuts and asia-instant-food samples levels $> 500 \mu\text{g}/\text{kg}$ were detected

Calculated content on **fat basis** would be **by far above 1 mg/kg**

envisaged **establishment of Max. Levels** for **3-MCPD and Glycidol** in refined oils at European level:

would be an effective instrument to ensure that high contaminated refined oils are not used as an ingredient for further food production

Summary and concluding remarks

- German monitoring survey has provided valuable data on the occurrence of 3-MCPD esters and related compounds to be used as enhanced basis for refined exposure assessment for the German market
- Useful data in view of possible establishment of further risk management measures
- Nearly all food groups investigated contained more or less MCPD- and glycidyl esters, indicating different impacts such as selection of high or low contaminated oils, implementation of mitigation measures and food preparation

Summary and concluding remarks

- Occurrence of significant **free MCPD** analytes in food appears to be associated with thermal processing and needs to be taken account **for future exposure assessment**
- Compound foods produced with high contaminated fats/oils may contribute considerably to dietary exposure even in cases of lower fat contents (e.g. donuts, instant snacks, croissants)
- It can be assumed that foods which had already been examined in the past show lower contamination levels compared to foods receiving less attention over recent years (e.g. by official authorities, media, consumer organizations etc.)

Aspects for future work

- Amount of bound 2-MCPD is approximately 30% of total bound MCPD (but can also be significantly higher, e.g. in asia dishes)
- therefore further research on toxicological mode of action of 2-MCPD would be of paramount importance
- Need for testing for 2-MCPD in the future?
- Considerable contamination levels of 3-MCPD/glycidyl analytes were also identified in foods which so far have not been in the focus of attention (e.g. asia instant noodles, donuts)
- Such foods may contribute significantly to dietary MCPD/glycidol exposure
- Therefore, the central question arises whether this is also the case for other - less investigated - food groups (e.g. potato snacks, confectionary, other instant food etc.)
- Further monitoring activities may address this question

Thank you for your attention!

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