BfR MEAL Study
First German Total Diet Study

BfR MEAL Study
What's in your food

Irmela Sarvan, Oliver Lindtner

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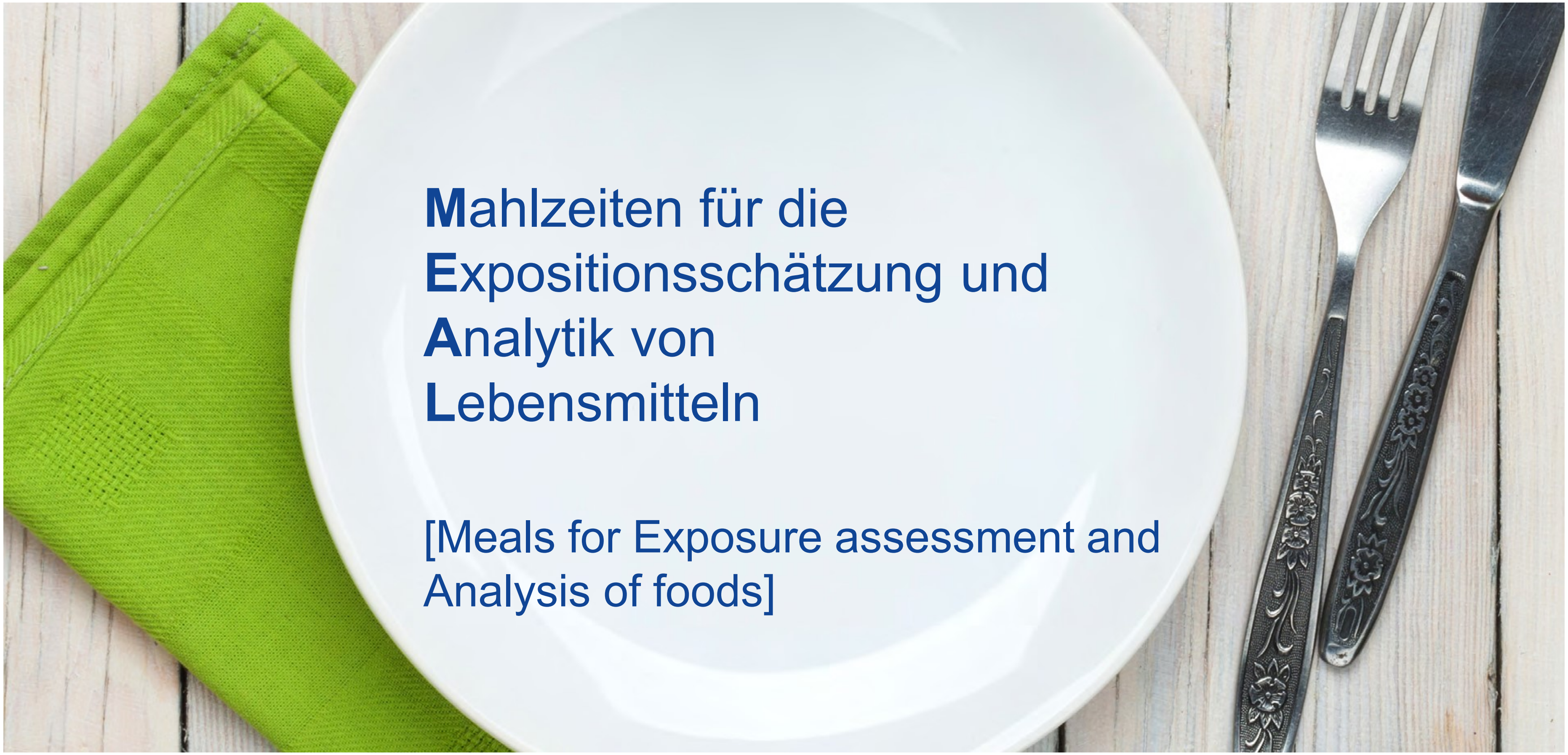


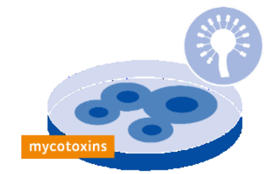
Mahlzeiten für die Expositionsschätzung und Analytik von Lebensmitteln

[Meals for Exposure assessment and Analysis of foods]

Modular structure of the BfR MEAL Study

Substances to be analyzed were grouped into nine modules:

- Same pools for different modules were used (synergic effect)



2017
2019
2020

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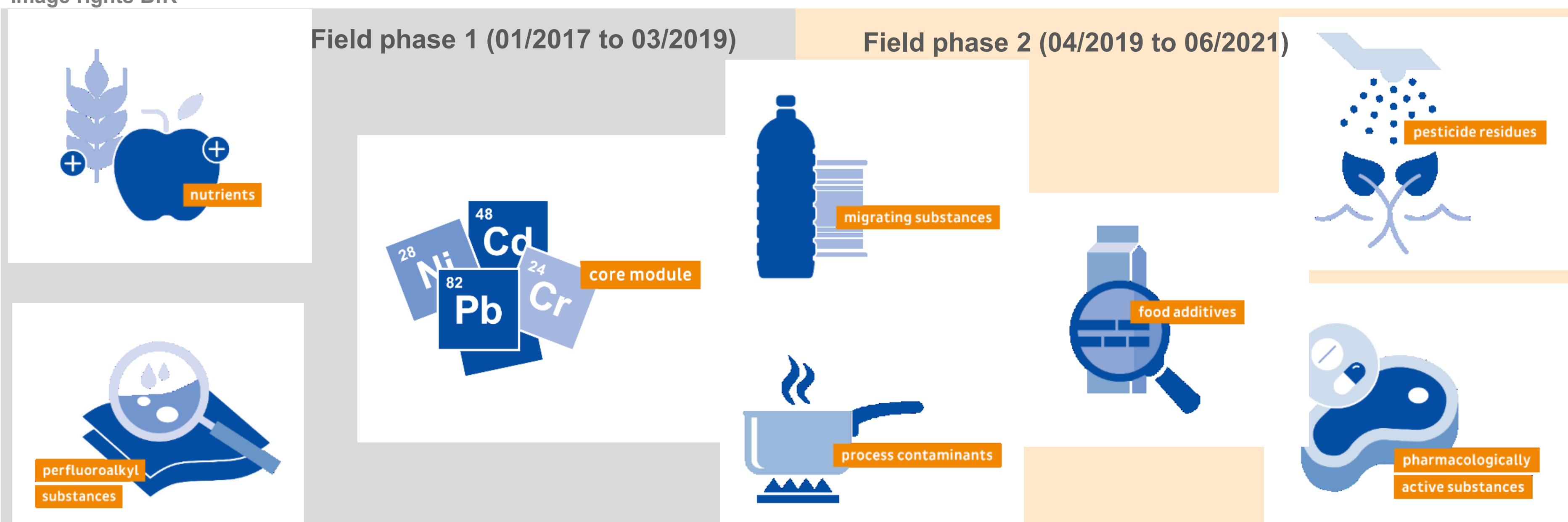

Steps of the BfR MEAL Study

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Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Selection of foods	Shopping on national level	Preparation and processing	Pooling and homogenisation	Analysis	Evaluation and exposure assessment

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Step 1: Food selection

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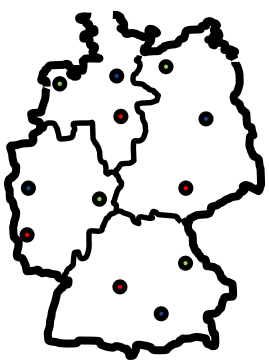
19
- Main Food Groups (FoodEx II-Codes, EFSA)

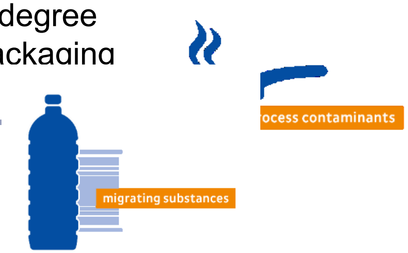
356
- Food Groups in BfR MEAL **Food List**

3408
- Pools, division in:
  - Regionality
  - Seasonality
  - Organic / conventional



- Selected modules:

+ Browning degree
+ Type of packaging



Step 2: Shopping on national level

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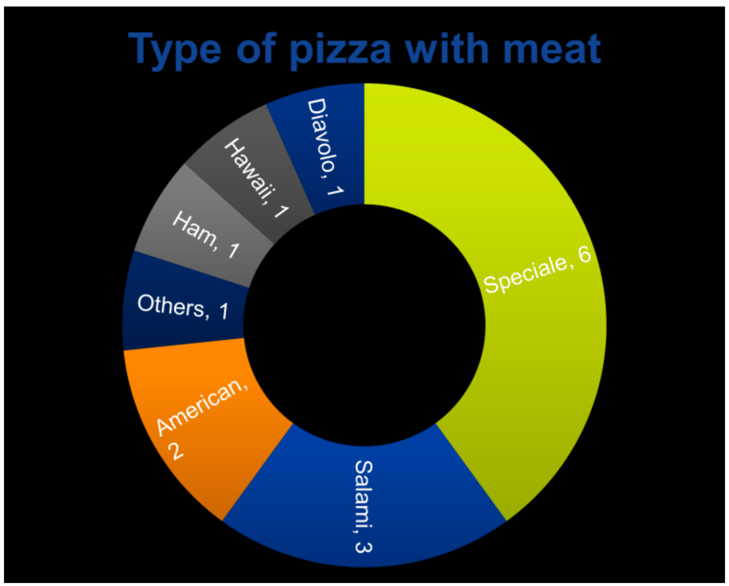
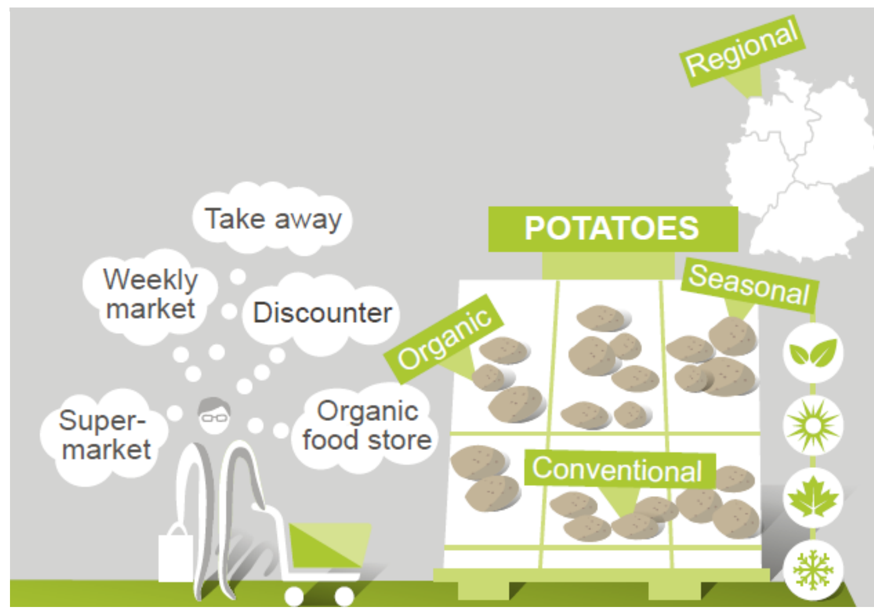
- Market data used, to represent consumer shopping behaviour
  - Panel with 30,000 households over one year
  - Parameters selected: brand, production method, type of packaging, origin…
- Expert consultation to decide on distinction of pools by season, region and production type





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Step 3: Preparation of foods

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Representative household behaviour due to:

- Market data on foods for origin, production method,
- Market data on recipe books and most visited cooking homepages
- Surveys on
  - kitchen utensils (N=1.008)
  - preparation of foods (N=1.008)
  - Degree of browning (N=2.003)

15-20 pooled samples homogenised

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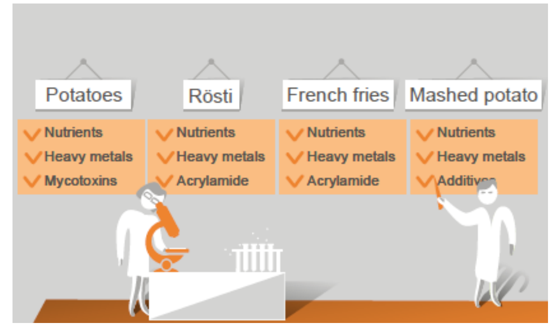
Analysis



Laboratories

- Commercial laboratory
- Federal chemical investigations offices
- Only for very few selected substances: in-house

Quality parameters in tender

- Monitored cooled transport and storage till analysis
- Implemented quality concept with e.g.
    - Quality control cards with reference material
    - Analysis of blanc values
    - Registration for interlaboratory comparisons

Samples were sent to laboratorys twice, to check precision of the measurement

Close communication with laboratories and audit of selected laboratories

Schedule

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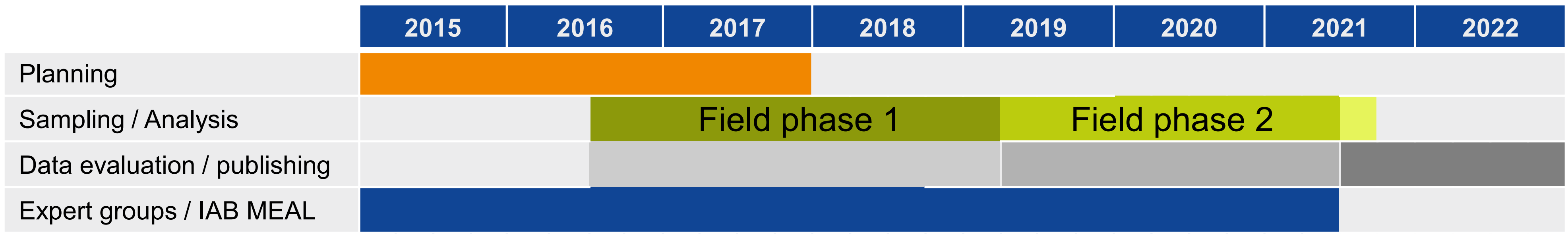

ANSES

Health Canada

Federal chemical investigations offices

Universities

Institutes

MRI Max Rubner-Institut

efsa European Food Safety Authority

Bundesamt für Verbraucherschutz und Lebensmittelsicherheit

Food and Agriculture Organization of the United Nations

Outcome occurrence data so far

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Schendel, S. et al (accepted). Results of the BfR MEAL Study: Highest levels of **retinol** found in animal livers and of **β-carotene** in yellow-orange and green leafy vegetables

Stadion, M. et al (accepted). The first German Total Diet Study (BfR MEAL Study) confirms highest levels of **dioxins and dioxin-like polychlorinated biphenyls** in foods of animal origin.

Fechner, C. et al (2022). Results of the BfR MEAL Study: In Germany, **mercury** is mostly contained in fish and seafood while **cadmium, lead, and nickel** are present in a broad spectrum of foods. *Food Chemistry: X 14*.

Schwerbel, K. et al. (2022). Results of the BfR MEAL Study: The food type has a stronger impact on **calcium, potassium and phosphorus** levels than factors such as seasonality, regionality and type of production. *Food Chemistry: X 13*.

BfR (2021): Rückläufige **Jod**zufuhr in der Bevölkerung: Modellszenarien zur Verbesserung der **Jod**aufnahme. Stellungnahme des BfR vom 9. Februar 2021.

Sarvan, I. et al. (2021). Exposure Assessment of **methylmercury** in samples of the BfR MEAL Study. *Food and Chemical Toxicology 149.*

Hackethal, C. et al. (2021): Total **arsenic and water-soluble arsenic species** in foods of the first German total diet study (BfR MEAL Study). *Food Chemistry 346*.

Report to the ministry (2001): „*Bestimmung der Gehalte verschiedener Süßungsmittel in marktrelevanten Erfrischungsgetränken*“ [Occurrence concentration of **sweeteners** in soft drinks relevant for the German market]

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Substances with high concentrations near to MPLs

ndlPCB: Dog fish

Aflatoxins & OTA: Buck wheat

Chlorate: butter, meat and meat products, salad dressings, rice pudding, cakes

Chlorpyrifos: dates

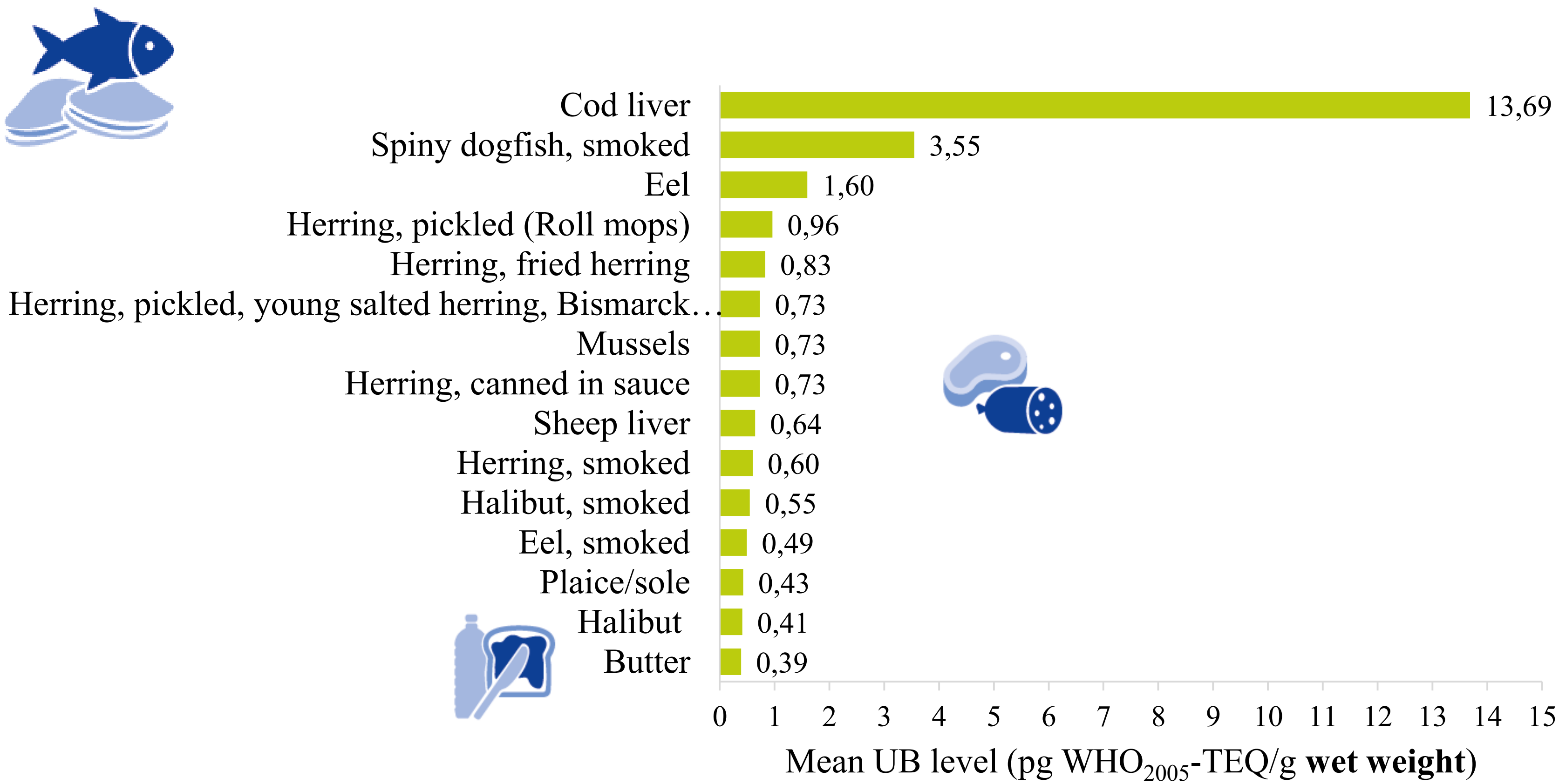
Copper: beef liver, sheep liver, game meat, chia-seeds und honey

Benzoates: Fish products

Sulfites: Shrimps/ prawns

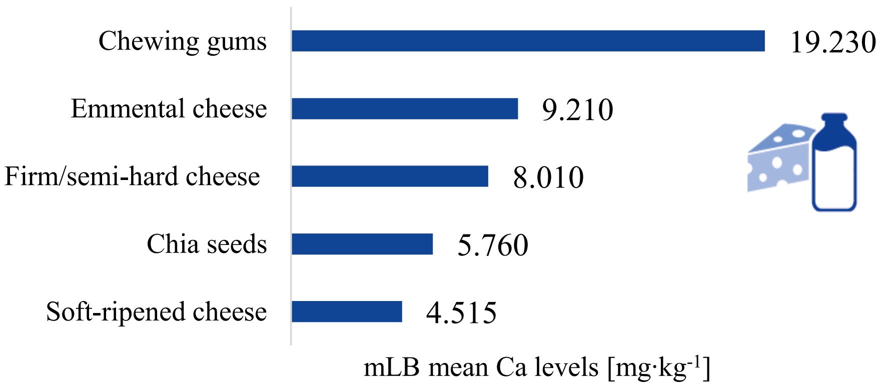
Soft drinks
- Acesulfam K, Cyclamat, Benzoate (MPL)
- Cyclamat, Saccharin, Aspartam/ Saccharin (not declared)

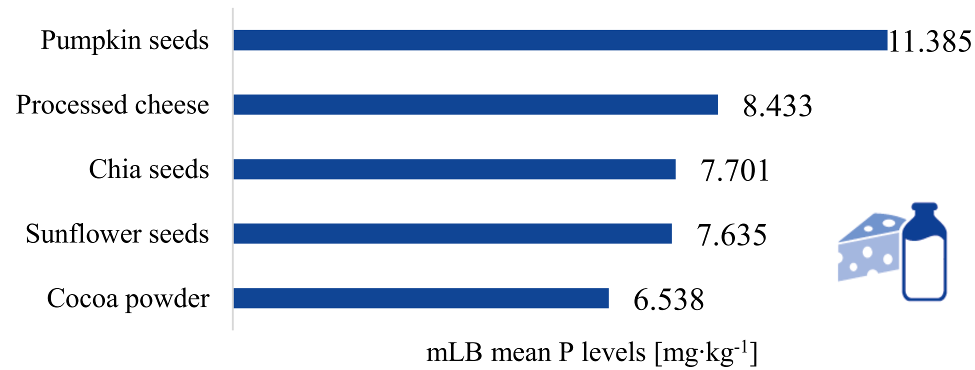
Mean levels of the sum of PCDD/Fs and DL-PCBs in the 15 MEAL foods (wet weight)

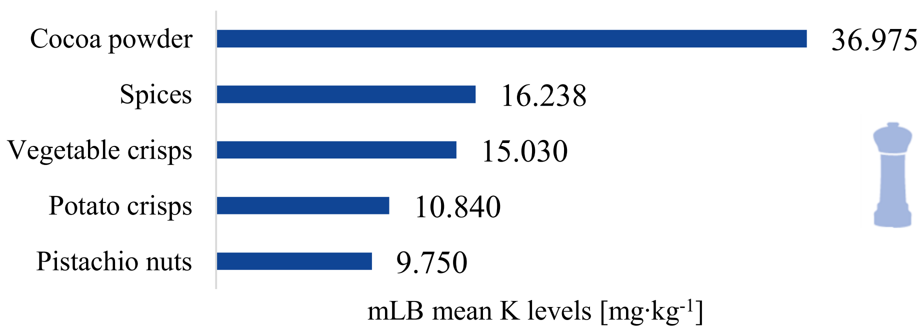


adapted from Stadion et al., *Food Chem X.*, 2022

Pools with highest levels of P, Ca, K





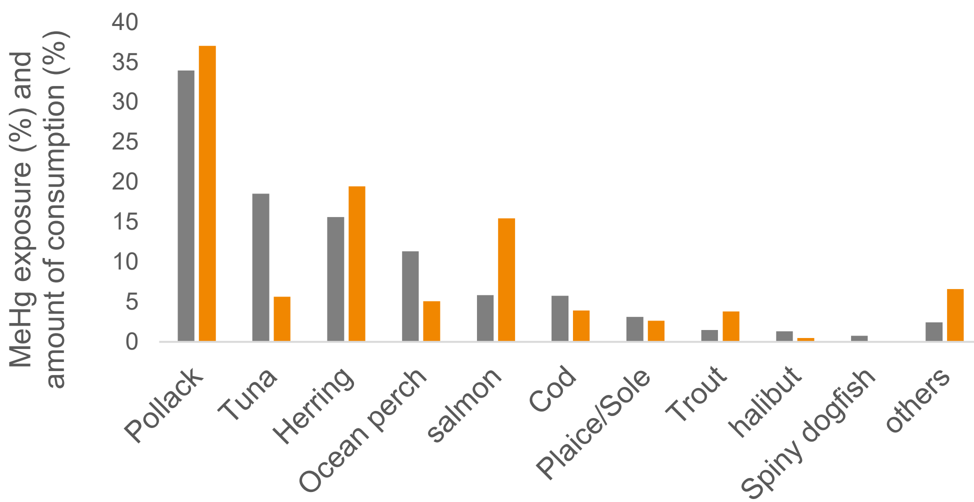


adapted from Schwerbel et al., *Food Chem X.*, 2022

Results methylmercury

Analysis of methylmercury (MeHg) in fish, mushrooms and their products:

- Measurement of MeHg and not derivation of total Hg
- About a quarter of the adult German population ingests MeHg via fish and seafood
- pollock, tuna, ocean perch and herring are particular contributors to exposure



- exposure of pollack and herring is mainly due to high consumption
- exposure from tuna and ocean perch is mainly caused by high levels

Figure 1: MeHg exposure in adults (all subjects, in %) with upper bound (UB) approach (green bars) and amount of consumption calculated in g/kg bw/d for consumers (in % of total consumption, yellow bars).

Exposure estimation of methylmercury (MeHg) in fish and fish products.

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- Exceedances of the health limit (TWI 1.3µg/kg bw) may occur especially in 14-25 year olds with high consumption (P95)
- Tuna plays an important role among 14-25 year olds
- Ocean perch and cod contribute more to exposure in 65-79 year olds

I. Sarvan et al. *Food and Chemical Toxicology 149 (2021) 112005*

Table 3
Exposure of MeHg in adults (consumers) with upper bound (UB) and lower bound (LB) approach (µg kg^{-1} bw week^{-1}).

		Total	Sex		Age groups						
			Male	Female	14-<18 Years	18-<25 Years	25-<35 Years	35-<45 Years	45-<55 Years	55-<65 Years	65-<80 Years
Exposure (UB)	Valid N	2916	1449	1466	68	184	363	561	527	508	705
	P 50	0.185	0.194	0.177	0.180	0.201	0.154	0.159	0.207	0.186	.187
	Mean	0.339	0.335	0.343	0.473	0.398	0.334	0.308	0.324	0.352	.338
	P 95	1.059	1.027	1.059	2.175	1.530	1.037	0.999	0.944	1.114	1.030
Exposure (LB)	Valid N	2916	1449	1466	68	184	363	561	527	508	705
	P 50	0.184	0.193	0.176	0.180	0.201	0.154	0.159	0.207	0.186	0.187
	Mean	0.335	0.330	0.340	0.461	0.386	0.328	0.303	0.322	0.350	0.336
	P 95	1.059	1.027	1.059	2.175	1.530	1.037	0.999	0.944	1.114	1.030

Contribution of food groups to the total iodine intake

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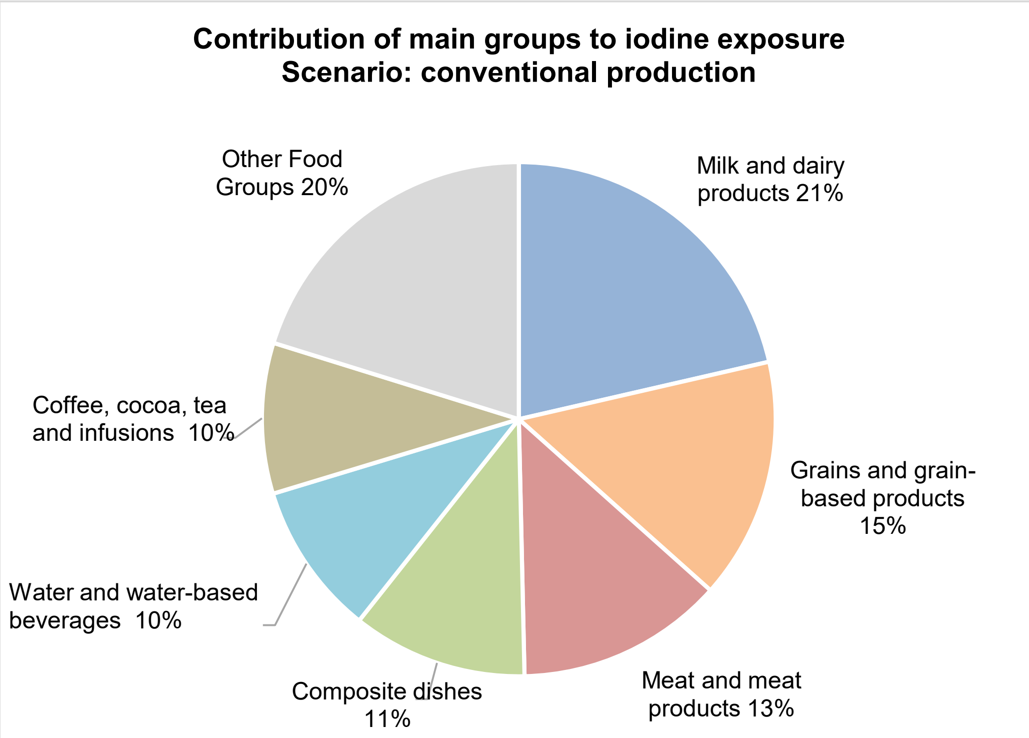

www.bfr.bund.de
BfR Bundesinstitut für Risikobewertung
DOI 10.17590/20210209-100743

Rückläufige Jodzufuhr in der Bevölkerung: Modellszenarien zur Verbesserung der Jodaufnahme

Stellungnahme Nr. 005/2021 des BfR vom 9. Februar 2021

Pools with highest contribution to mean iodine intake
* No use of iodized salt in the households

Conventional production	
Anteil (%)	Food
8,9	Cow milk, plain
6,2	Mineral water
3,7	Wheat bread and roll, white (refined flour)
3,7	Yoghurt/yoghurt drink, cow milk, flavored
3,0	Instant coffee, prepared with water
2,6	Coffee, prepared with water
2,6	Drinking water (tap water)
2,2	Salami-type sausage (pork, beef)
2,1	Henn eg
1,9	Appel

Lessons learned for iodine intake

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- In comparison to requirements, part of the population ingests **too little iodine** via food.
- **Daily consumption of milk and dairy products** helps to reach an adequate iodine intake.
- Same for consumption of sea **fish once or twice a week**.
- **Iodised table salt should be preferred** in the kitchen and in pre-packaged foods.
- According to model scenarios based on BfR MEAL data, the currently discussed **increase of iodine levels in salt of 5 mg/kg can be assumed to be safe**.
- Moreover, the results show that also the level of **industrially and handcrafted products containing iodised salt needs to be increased to around 40 percent**, to reach an adequate intake also for women in childbearing age.

How does food monitoring and BfR-MEAL-Study complement each other?

Food Chemistry: X 13 (2022) 100240

Contents lists available at ScienceDirect

Food Chemistry: X

journal homepage: www.sciencedirect.com/journal/food-chemistry-x

ELSEVIER

Collection of occurrence data in foods – The value of the BfR MEAL study in addition to the national monitoring for dietary exposure assessment

Anna Elena Kolbaum *, Anna Jaeger, Sebastian Ptok, Irmela Sarvan, Matthias Greiner, Oliver Lindtner

** figures and tables at the next slides were taken from:*
Kolbaum, A. E. et al. (2022): Collection of occurrence data in foods – The value of the BfR MEAL study in addition to the national monitoring for dietary exposure assessment, Food Chemistry: X, Volume 13, https://doi.org/10.1016/j.fochx.2022.100240

Example of one substance per category

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		Cadmium				PCB 126				Iodine			
		BfR MEAL Study		National Monitoring		BfR MEAL Study		National Monitoring		BfR MEAL Study		National Monitoring	
No.	Main Food Group	N foods	n samples*	N foods	n samples	N foods	n samples*	n foods	n samples	N foods	n samples*	n foods	n samples
1	Grains and grain-based products	40	1540 (97)	14	1934	38	1490 (94)	0	0	40	1540 (97)	0	0
2	Vegetables and vegetable products	34	2306 (152)	42	4077	18	911 (60)	1	50	34	2306 (152)	2	161
3	Starchy roots or tubers and products thereof, sugar plants	8	410 (26)	1	122	7	245 (15)	0	0	8	410 (26)	0	0
4	Legumes, nuts, oilseeds and spices	20	440 (24)	22	2544	20	440 (24)	8	185	20	440 (24)	0	0
5	Fruit and fruit products	22	1010 (64)	18	1609	8	175 (10)	0	0	22	1010 (64)	0	0
6	Meat and meat products	35	1578 (101)	24	2673	35	1578 (101)	18	1458	35	1578 (101)	0	0
7	Fish, seafood, amphibians, reptiles and invertebrates	30	720 (39)	16	1832	30	720 (39)	7	454	30	720 (39)	0	0
8	Milk and dairy products	23	635 (37)	12	1282	23	635 (37)	1	129	23	640 (37)	3	301
9	Eggs and egg products	2	150 (10)	1	102	2	150 (10)	2	182	2	150 (10)	0	0

Added value of BfR MEAL Study to number of substances with significant more information


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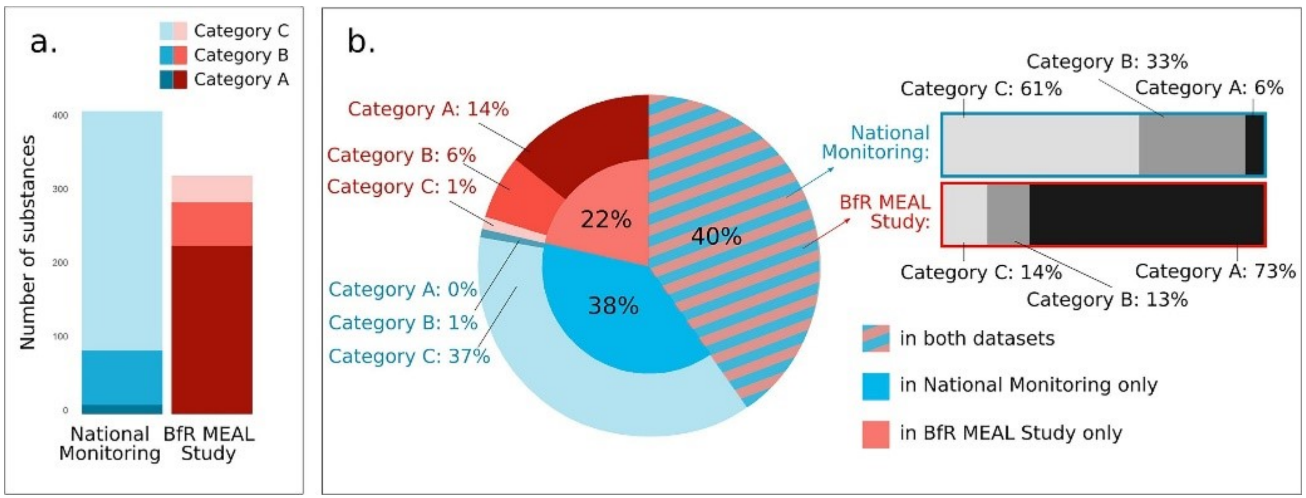

Fig. 1. Distribution of substances grouped by the number of foods analysed within the National Monitoring (2011–2019) and the BfR MEAL Study (2016–2021)

(a) Number of substances allocated to categories A (> 100), B (25–100) and C (< 25)

(b) Portions of substances covered exclusively in datasets and respective allocation to categories among the groups (% of 512 substances)

- MEAL adds > 100 substances not covered by German food monitoring
- MEAL expands the list of investigated foods for many substances that are only analysed in a limited food list within the German food monitoring

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Decision tree: How food monitoring and BfR-MEAL-Study will complement each other

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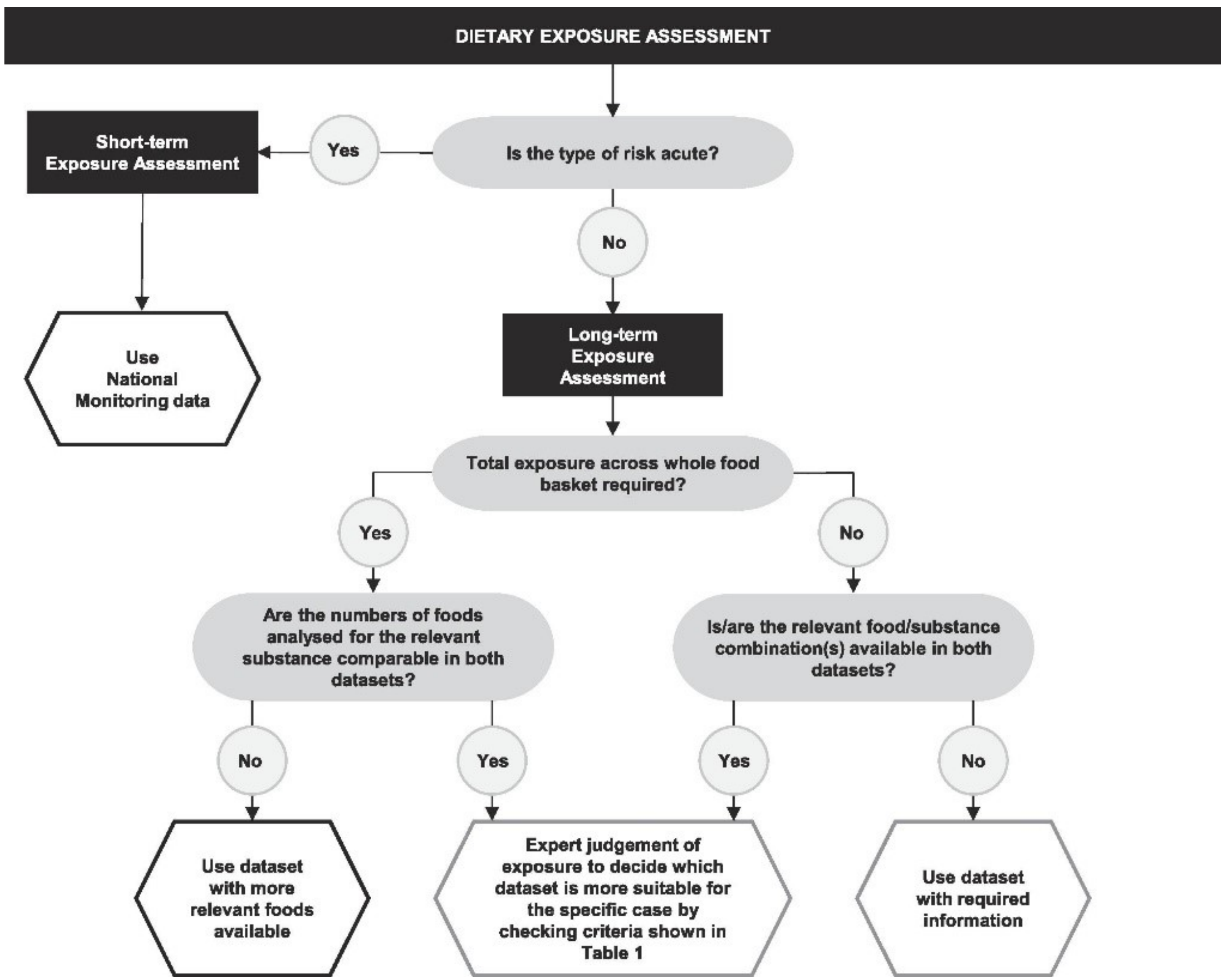

New monitoring projects to follow up on BfR MEAL results

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Nickel in nuts

Quelle: wikimedia commons, public domain, Vicki Nunn

Elements in chia seeds

Quelle: wikimedia commons, Autor: formulatehealth.com

Do you want to know more about the BfR MEAL study?

BfR MEAL Study
What's in your food

Visit our kitchen! (https://www.bfr.bund.de/meal-studie/EN/vr.html)

Identify Risks – Protect Health

With support from
Federal Ministry of Food and Agriculture
by decision of the German Bundestag

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Thank you for your attention!

Oliver Lindtner and Irmela Sarvan

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