What’s in your food – the BfR MEAL Study
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In what quantities do we ingest undesired substances on average with our food? Is food contaminated differently depending on region, season or production method? And what health effects does the preparation method have on the food?

The BfR MEAL Study helps to answer these and other questions. Experts at the German Federal Institute for Risk Assessment (BfR) examine on a large scale which substances in which concentrations are contained in prepared foods. The aim is to identify possible food-related health risks for the population even better.

The BfR MEAL Study is a so-called Total Diet Study. It is a method recommended by the Food and Agriculture Organisation (FAO) of the United Nations and the World Health Organisation (WHO) to estimate mean levels of substances in the average human diet. In combination with information from consumption studies, which determine the average consumption of foods of the population in Germany, the average total intake level of substances via food can be determined reliably and in detail.
Compared to other Total Diet Studies, the BfR MEAL Study is one of the most comprehensive studies worldwide regarding the number of foods examined connected to the number of substances. In the course of the study, around 60,000 foods are analysed for almost 300 desired and undesired substances including heavy metals, mycotoxins, plant protection residues and nutrients. The study represents German eating habits by covering at least 90 percent of the foods consumed in Germany. In addition, rarely eaten foods are included, such as cod liver or boletus mushrooms, which can have particularly high levels of some undesired substances.

Before being analysed, the foods are prepared as they are usually consumed in German households – potatoes, for example, as mashed potatoes, chips or fried potatoes. The reason: levels of substances can change during preparation. Vitamins can degrade during cooking, while some potentially harming substances such as acrylamide only occur during preparation through intense heating. Additionally, substances can be leaching into the water for example arsenic compounds during washing and cooking of rice.

Similar foods are grouped into pools in order to determine mean levels and to reasonably limit the effort of analysis. During pooling, various product types, types of consumption and cultivation methods for similar foods are considered in accordance with their frequency, such as honey of different trees or flowers or rice from various origins. For a single food, more than one pool sample can also be compiled and investigated. Apples, for example, are analysed in several pools regarding different regions, seasons, methods of farming (conventional/organic) and preparation types (e.g. apple puree).

The BfR MEAL Study is the first German Total Diet Study and very comprehensive by worldwide comparison.
The BfR MEAL Study (meals for exposure assessment and analysis of foods) is the first Total Diet Study for Germany. It determines which substances and what concentration our foods have after processing and preparation.

1. **Shopping list**
   - To compile the BfR MEAL shopping list, it was determined which food products are eaten most frequently by consumers in Germany.

2. **Cooking like at home**
   - In the BfR MEAL kitchen, meals are prepared by using typical kitchen utensils and recipes the same way German consumers do in their private households.

3. **Homogenisation / Pooling**
   - The BfR MEAL team prepares common samples of similar foods for analysis in the lab. Those samples are homogenised – in other words, mixed as in a smoothie blender.

4. **Analysis in the laboratory**
   - Couriers transport the samples to the lab, where they are analysed for nine substance groups – including nutrients, additives and substances migrating from food packaging.

5. **Evaluation**
   - At the BfR, the BfR MEAL team assesses which concentrations of substances consumers take in daily. The findings are used to derive recommendations for consumers.
### Nominated Substances for the BfR MEAL Study

(Stand: 2022)

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<th>Category</th>
<th>Substances</th>
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| **Core module** (elements and environmental contaminants) | - Elements: aluminium, antimony, arsenic, barium, lead, cadmium, cobalt, lithium, methyl mercury, nickel, nitrate, mercury, silver, thallium, vanadium, tin
- Arsenic species: inorganic arsenic, arsenobetaine (AsB), dimethylarsinic acid (DMA), monomethylarsonic acid (MMA)
- Organotin compounds: tetrabutyltin (TeBT), tributyltin (TBT), dibutyltin (DBT), monobutyltin (MBT), triphenyltin (TPT), diphenyltin (DPT), monophenyltin (MPT)
- Dioxins/furans, dioxin-like polychlorinated biphenyls (di-PCB), non-dioxin-like polychlorinated biphenyls (ndi-PCB)
- Polybrominated diphenyl ethers (PBDE) |
| **Perfluoroalkyl substances (PFAS)** | - Perfluorooctane sulfonic acid, perfluorooctanoic acid |
| **Mycotoxins** | - Aflatoxins, alternaria toxins, beauvericin, citrinin, enniatins, ergot alkaloids, fumonisins, ochratoxin A, patulin, type A trichotheccenes, type B trichotheccenes, zearalenone |
| **Process contaminants** | - Acrylamide, glycidol, polycyclic aromatic hydrocarbons (PAH), 2- and 3-MCPD group |
| **Food additives** | - Benzoylates: benzoic acid, calcium benzoate, potassium benzoate, sodium benzoate
- Nitrates: potassium nitrate, sodium nitrate
- Sorbates: potassium sorbate, sorbic acid
- Sulphites: calcium hydrogen sulphite, calcium sulphite, potassium hydrogen sulphite, potassium metabisulphite, sodium hydrogen sulphite, sodium metabisulphite, sodium sulphite, sulphur dioxide |
| **Nutrients** | - Vitamins: vitamin A (retinol), vitamin E (tocopherols), vitamin K1, vitamin K2, β-carotene, folic acid
- Bulk elements: calcium, chloride, potassium, magnesium, sodium, phosphorus
- Trace elements: chromium, copper, fluoride, iodine, mangan, molybdenum, selenium, zinc |
| **Pesticide residues** | - Boscalid, captan/tetrahydrophthalimide, chlorate, chlormequat, chlorpyrifos, cyantraniliprole, cypermethrin, cyproconazole, deltamethrin, difenoconazole, dimethoate, ethylhexylthioura (ETU), fluopyram, glyphosate/aminoxyphosphonic acid (AMPA), hexachlorobenzene, hexythiazox, imazalil, indoxacarb, iprodione, lambda-cyhalothrin, myclobutanil, omeprazole, perchlorate, pirimicarb, pirimicarb-desmethyl, propylenethioura (PTU), pyraclostrobin, pyrimethanil, spinosad, thiafendoxil, thiabendazole, thiachlorid, triflumuron, 1,2,4-triazole, triazole acetic acid, triazole alaneine, triazole lactic acid |
| **Pharmacologically active substances** | - Aminoglycosides: dihydrostreptomycin, gentamycin, neomycin, spectinomycin, streptomycin
- Amphenicols: florfenicol
- Chinolones: ciprofloxacin, danofloxacin, enrofloxacin, marbofloxacin
- Diaminopyrimidine derivate: trimethoprim
- Coccidiostats: dinitrocarbanilides, lasalocid, maduramycin, monensin, narasin
- Macrolides: erythromycin, gamithromycin, tildipirosin, tilimicosin, tulathromycin, tyllosin
- Penicillins: amoxicillin, benzylpenicillin
- Sulfonamides: sulfadiazine, sulfadimethoxine, sulfadimidine, sulfadoxine, sulfathiazol
- Tetracyclines: chlortetracycline, doxycycline, epi-chlortetracycline, epi-tetracycline, epi-oxytetracycline, oxytetracycline, tetracycline |
| **Substances migrating from food contact materials** | - Mineral oil saturated hydrocarbons (MOSH), mineral oil aromatic hydrocarbons (MOAH)
- Plasticisers
- 2,4-di-tert-butylphenol |
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More information on the BfR MEAL Study at: www.bfr-meal-studie.de