Bundesamt für
Verbraucherschutz und
Lebensmittelsicherheit

# Abstract Report on the National Monitoring 2022

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# Abstract Report on the National Monitoring 2022

This Abstract Report presents a short overview about the findings of the analyses of foods, cosmetic products and commodities carried out in 2022. A full version of the Report on the National Monitoring 2022 is available in German from http://www.bvl.bund.de/monitoring. Abstract Reports on the National Monitoring from previous years can be downloaded from www.bvl.bund.de/monitoring_abstracts.

## 1 Summary

The Monitoring programme is a system of repeated representative measurements and assessments of substances that are not desirable from a health point of view, such as residues of plant protection products, pesticides, and veterinary medicines, as well as of heavy metals, mycotoxins and other contaminants in and on food, cosmetics and consumer products.
Further details about the Monitoring Programme are available from http://www.bvl.bund.de/monitoring_EN. In accordance with the *General Administrative Provisions for the Monitoring Programme* (AVV Monitoring), investigations in 2022 included the following foodstuffs, cosmetic products and consumer goods from the German population's representative shopping basket ('shopping basket monitoring'):

### 1.1 Food of animal origin

- Eel/piece of eel (including frozen)
- Eel, smoked
- Fallow deer meat (including frozen)
- Salmon, freshwater fish (including frozen)
- Liver, lamb/sheep (including frozen)
- Pork, meat cuts (including frozen)
- Tuna, canned (in its own juice)
- Whole milk

### 1.2 Food of plant origin

- Pineapple
- Apples
- Supplementary food for infants and toddlers
- Strawberries (including frozen)
- Barley grains, whole barley flour
- Oat grains, whole oat flour
- Raspberries (including frozen)
- Millet grains
- Ginger, fresh
- Ginger, dried
- Red/black currant nectar
- Cocoa powder, high-oil/low-oil
- Head lettuce, leaf lettuce, Romaine lettuce, iceberg lettuce, oak leaf lettuce, batavia lettuce, lollo rosso, lollo bianco
- Cilantro, fresh
- Pumpkin seeds, not roasted, without shell
- Mango
- Milk chocolate (without additives)
- Peaches/Nectarines
- Plums
- Leek
- Quinoa grains
- Sesame
- Sunflower seeds, with shell, not salted
- Sunflower oil (including cold pressed)
- Asparagus, white/green
- Spinach (including frozen)
- Tomatoes
- Wine, red/white
- White cabbage, pointed cabbage
- Zucchini

Depending on the potential occurrence of undesirable substances, the foodstuffs were analysed for residues of plant protection products and pest control agents or for contaminants (e.g. dioxins and polychlorinated biphenyls (PCBs), perfluorinated and polyfluorinated alkyl substances (PFAS), polycyclic aromatic hydrocarbons (PAHs), elements, mycotoxins, nitrate).

## 1.3 Cosmetic products

- Antimony and other elements in decorative cosmetics with glitter for children
- Formaldehyde in hair gels and hair straightening products
- Elements in tattoo inks

## 1.4 Consumer goods

- Migration of chloropropanols (1,3-DCP and 3-MCPD) from picture books and puzzles
- Migration of chloropropanols (1,3-DCP and 3-MCPD) from food contact articles made of paper/cardboard/carton
- Element release from daily use metal products (including coated/enamelled)

In addition to the market basket monitoring, the programme treated the following seven special food safety problems (project monitoring):

Project 1: Ochratoxin A in matured ham
Project 2: Ethylene oxide in oilseeds and oilseed-containing foods
Project 3: Determination of cadmium and lead and other elements in dry tea products for infants and young children
Project 4: Quinolizidine alkaloids in lupine seeds
Project 5: Elements in selected nuts
Project 6: Elements in chia seeds
Project 7: Determination of the mineral oil components MOSH and MOAH in infant formulae and follow-on formulae
Project 8: Pesticide residues in fish from aquaculture
Project 9: Aflatoxins and ochratoxin A in rarely consumed edible oils
Project 10: Alternaria toxins in pomegranate juice

Where comparisons with results from previous years were possible, these were taken into account in the interpretation of the findings. The statements and assessments made in this report concerning the occurrence of substances undesirable from a health point of view relate solely to the products and substances or substance groups examined in 2022. It is not possible to estimate the total exposure to certain substances, since only part of the product basket can be examined per year, and the substances in question may also be present in other products.
Overall, the results of the 2022 monitoring underscore the recommendation to have a balanced and varied diet, as this is the most likely way to minimise the sometimes unavoidable dietary intake of undesirable substances.
A total of 9,918 samples of products of domestic and foreign origin were examined in the basket and project monitoring in 2022, including 8,725 samples of foodstuffs, 498 samples of cosmetic products and 695 samples of consumer goods. The results are presented in the following chapters.

# 2 Food

## 2.1 Residues of plant protection products and pesticides

### 2.1.1 Foodstuffs of animal origin

A total of 322 samples of foods of animal origin were analysed for residues of plant protection products and pesticides. Residues were quantifiable in 20.2% of the 84 samples of fallow deer meat tested and in 12.6% of the 119 samples of whole milk tested. In pork, no quantifiable residues were detected in any of the 119 samples. The levels determined in game and milk were all below the maximum residue levels specified in Regulation (EC) No 396/2005.

As in previous years, the majority of findings in all products of animal origin tested were residues of ubiquitous persistent organochlorine compounds.

The residues did not indicate any health risk for consumers.

### 2.1.2 Foodstuffs of plant origin

4,242 samples of foods of plant origin were analysed for plant protection product and pesticide residues. Product groups with the highest proportions of samples with quantifiable residues below the MRL were pineapple (92.3%), peaches/nectarines (89.8%) and apples (84.3%). The lowest proportions of samples with residues occurred in sunflower oil (1.0%), sunflower seeds (2.9%) and baby food (5.3%). The highest rates of non-compliant residues – that is, residues exceeding the MRL – were found in cilantro (8.2%) and ginger (7.3%). Pineapple and spinach also had high rates with residues exceeding MRLs (3.6% both).

In barley grains/flour, millet, currant nectar and wine, none of the samples tested exceeded the maximum residue levels.

Products originating in Germany had 0.5% samples with residues of active substances use of which was not approved in the respective crop in Germany in 2022 (2021: 1.6%).

According to the Federal Institute of Risk Assessment (BfR), an adverse health effect cannot be ruled out for a total of 19 of the 4,242 samples of foods of plant origin examined (0.45%). For all other residue levels found, there were no indications of an acute health risk for consumers.

The residue levels found in complementary foods for infants and young children (fruit and vegetable preparations) are not expected to cause adverse health effects.

**Project 2: Ethylene oxide in oilseeds and oilseed-containing foods.**

This project analysed samples of the categories muesli, muesli bars/bites, fine bakery products made from oilseed pulp, and oilseed breads for ethylene oxide. The project was carried out with the aim of monitoring the further development of residue findings here and to be able to estimate consumer exposure resulting from the consumption of sesame-containing products.

A total of 99 samples were analysed for ethylene oxide (sum of ethylene oxide and 2-chloroethanol) under this project. No sample was found with ethylene oxide at quantifiable level. Despite this encouraging result, ethylene oxide and its degradation products should continue to be subject to routine testing because of its mutagenic and carcinogenic effects.

**Project 8: Pesticide residues in fish from aquaculture**

A total of 220 fish samples were analysed for pesticide residues. No residues were detected in 86 of the 220 samples (39.1%). Quantifiable residues were found in 134 samples (60.9%).
Overall, an acute health risk could be practically ruled out for most of the products tested. Substances such as benzalkonium chloride (BAC), chlorate and zinc were partly found with high detections and high concentrations. However, a health risk for consumers is practically excluded on the basis of the chlorate concentrations found in fish.

## 2.2 Quaternary ammonium compounds

Levels of the quaternary ammonium compounds benzalkonium chloride (BAC) and dialkyldimethylammonium chloride (DDAC) were quantifiable in 36 of the 2,782 samples of vegetal and animal foods tested.
At the residue levels found, no health risk to consumers is assumed.

## 2.3 Chlorate

A total of 1,896 samples of vegetal and animal foods were analysed for chlorate. 155 (8.2%) of the samples showed quantifiable chlorate residues. The highest proportions of samples with quantifiable chlorate levels were found in cilantro (45.0%), spinach (also frozen, 40.2%) and zucchini (30.8%).
The specific maximum residue levels in force since June 28, 2020 (Regulation (EU) 2020/749) were exceeded in 17 samples (0.84%).

## 2.4 Perchlorate

Perchlorate was not quantifiable in the 212 tested samples of whole milk and of fruit and vegetable foods for infants and young children, except in one sample each from both product groups (1.01% for whole milk and 0.88% for fruit and vegetable foods).

## 2.5 Dioxins and polychlorinated biphenyls (PCB)

Levels of dioxin and dioxin-like PCBs were inconspicuous in the 131 samples of eel (including smoked) and salmon subject to examination. Compared to previous investigations in 2015, farmed salmon showed lower levels in these parameters.
The 81 samples of lamb/sheep liver showed significantly lower levels of dioxin and dl PCBs, compared to the last investigations in 2016. A comparison of mean dioxin levels established in the present study, differentiated by free-range and indoor animal keeping, did not reveal any noteworthy differences for these types of holding.
Considering all three food groups examined, levels of the sum parameter for the 6 non-dl PCBs were consistently low in all samples of salmon and lamb liver, and slightly increased in the eel samples. Regarding mean levels of dl PCBs in lamb/sheep liver, a differentiation between free-range and indoor animal keeping did not produce any significant differences, as we have already seen above in the investigations regarding dioxins.

## 2.6 Per- and polyfluorinated alkyl substances (PFAS)

The tested foods whole milk (86 samples), farmed salmon (99 samples) and tuna in its own juice (119 samples) showed only low levels of the 4 single PFAS substances evaluated by EFSA about their health effects in foods (perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorooctanesulfonic acid (PFOS), perfluorohexanesulfonic acid (PFHxS)).
In all 54 samples of red wine and all 64 samples of white wine, the contents were below the achievable analytical limit of quantification for the sum parameter EFSA PFAS-4 listed above.
Persistent organic compounds from the environment are known to accumulate in high-fat foods and organ meat. This can also be observed in the PFAS sum parameter measured in the present samples: the foodstuffs smoked eel (26 samples) and lamb/sheep liver (46 samples) had on average the highest PFAS contents (based on fresh weight) compared to the samples mentioned above. However, the present data did not deliver valid processing factors for the process of smoking eel.

## 2.7 Polycyclic aromatic hydrocarbons (PAH)

Sunflower oil and milk chocolate had lower levels of benzo(a)pyrene and the sum of the 4 PAH lead substances than the samples of cocoa powder and ginger spice that were also tested.
Three of 98 samples (3.06%) of ginger spice stemming from conventional production exceeded the EU maximum levels for benzo(a)pyrene and the cumulative PAH-4 maximum level applicable to dried spices. These findings could be a reason to pay more attention to investigating PAHs in ginger spices in the framework of risk-oriented food controls in future.

**Project 7: Determination of the mineral oil components MOSH and MOAH in infant formulae and follow-on formulae**

Intake of mineral oil aromatic hydrocarbons (MOAH) should be minimised due to their possible carcinogenic potential. The focus of the project was therefore on the total MOAH content (C10-50). A total of 165 samples (99 samples of infant formula and 66 samples of follow-on formula) were analysed for MOAH. In one sample only, MOAH (C10-50) were quantifiable, that is, at a level higher than the analytic method's minimum required performance limit (MRPL) of 1 mg/kg.

## 2.8 Mycotoxins

### 2.8.1 Aflatoxins B1, B2, G1, G2

Quantifiable levels of aflatoxins were found in 60 of a total of 521 samples of millet grains, quinoa grains, ginger spice, and whole milk. Six samples in total exceeded the maximum level.
62 samples of barley grains/flour and 67 samples of pumpkin seeds which were also tested for aflatoxins showed no quantifiable aflatoxin levels.

### 2.8.2 Ochratoxin A (OTA)

Levels of ochratoxin A (OTA) in 708 foodstuff samples tested - barley grains/flour, oat grains/flour, millet grains, quinoa grains, pumpkin seeds and sesame seeds - were in the majority below the limit of quantification (80.1% of samples). Where levels were quantifiable, these were very low. OTA was quantifiable in 36 of 102 samples of ginger spice, in 46 of 71 samples of cocoa powder, and in 42 of 131 samples of red wine. However, none of the samples exceeded the respective maximum level, if such were applicable.

**Project 1: Ochratoxin A in matured ham**

Since OTA has so far been detected mainly in traditionally produced ham with a long maturing period, investigations under this project focused mainly on ham of the designations "Serrano" and "Parma" ham, supplemented by cured, air-dried, unsmoked ham.
In total, OTA was quantifiable in 18 of 139 ham samples. Thereby, "Serrano ham" (64 samples) showed slightly higher OTA levels than "Parma ham" (38 samples), while no OTA was quantifiable in the samples of "Ham (cured, air-dried, unsmoked)" (37 samples). The findings indicate that in particular cured hams (Serrano and Parma hams) may significantly contribute to consumers' exposure to OTA. So it is recommended to generate further data on the occurrence of OTA in these, as well as in other cured meat products.

**Project 9: Aflatoxins and ochratoxin A in infrequently consumed edible oils**

This project analysed peanut oil, coconut oil/fat, and sesame oil (all both as cold-pressed and conventional product) for aflatoxins and ochratoxin A for the first time in the framework of the monitoring, in order to close data gaps in exposure estimation. The project followed on one in the year before which had examined pumpkin seed oil and linseed oil for aflatoxins and ochratoxin A.
In total, 48 samples of coconut oil or coconut fat, 45 samples of peanut oil and 60 samples of sesame oil were analysed for aflatoxins and ochratoxin A. In the 153 samples, there were no, or only very low quantifiable levels of aflatoxins and ochratoxin A, so that there is no recommendation for the time being to continue the investigations into peanut oil, coconut oil/fat, or sesame oil.

### 2.8.3 Deoxynivalenol (DON)

Analyses of 206 samples of barley grains/flour, oat grains/flour, and millet grains for deoxynivalenol (DON) did not produce any conspicuous findings. Samples which were additionally tested for the modified forms DON-3-glucoside, 3-acteyl-DON, and 15-acteyl-DON did not show any quantifiable levels of these.

### 2.8.4 T-2 toxin, HT-2 toxin

Examination of the foodstuffs barley grains/flour (65 samples) and oat grains/flour (90 samples) revealed low levels of T-2, HT-2 toxin and of both together. Comparatively, the number of samples with quantifiable levels, and their average levels, was higher in oat grains/meal than in barley grains/meal. The respective guideline values of the EU Commission Recommendation 2013/165/EU were not exceeded in any of the samples.

### 2.8.5 Zearalenone (ZEN)

The foodstuffs millet grains (51 samples) and quinoa grains (63 samples) which were tested for the Fusarium toxin zearalenone did not show quantifiable levels, apart from 2 samples of barley grains, which had quantifiable levels that were significantly below the established maximum levels.

### 2.8.6 Alternaria toxins

Since only few foodstuffs have been examined for Alternaria toxins under the monitoring programme to date, there are no comparative data at hand from previous years about the examined foodstuffs millet grains (51 samples), pumpkin seeds (57 samples) and sesame seeds (53 samples). Levels of tenuazonic acid are significantly higher than those of the other Alternaria toxins of the current parameter spectrum. Pumpkin seeds are an exception. Here it is the content of tentoxin which is highest.

For reasons of precautionary consumer protection, further efforts should be made to minimise the widespread distribution of Alternaria toxins in food, even though their health assessment is currently still characterised by a high degree of uncertainty, due to the insufficient data basis about toxicity.

**Project 10: Alternaria toxins in pomegranate juice**

A total of 115 beverage samples with different pomegranate juice concentrations were analysed. In addition to 56 pure pomegranate juices, samples included 10 nectars, 7 multi-fruit juices and 42 fruit juice beverages. The juice content of the beverages ranged from 5% to 50% pomegranate juice. Alternaria toxin levels quantified in the pomegranate juices tested were high. Even in the nectars and fruit juice products, Alternaria toxins were quantifiable in more than half of the samples. The findings may provide reason for further risk-oriented investigations of Alternaria toxins in pomegranate products in future, in order to further develop the data situation and to be able to derive European harmonised risk management measures.

**Project 4: Quinolizidine alkaloids in lupine seeds**

For this project, 4 different matrices (vegan/vegetarian lupine-based meat substitute products, lupine flour, lupine meal and lupine coffee) were analysed for 10 quinolizidine alkaloids. 5 participating official laboratories submitted the test results of 48 samples in total, all of which contained quinolizidine alkaloids. To further improve the data basis on the occurrence of quinolizidine alkaloids in lupin seeds suitable for human consumption and in industrially manufactured, lupin seed-based foods, more test results are needed, in particular about those analytes that were detected in a small number of samples. Therefore, it is recommended to continue the investigations.

## 2.9 Elements

The investigations produced low contents of the analysed elements, in the majority. Compared to previous years, measured contents were mainly at a comparable or lower level. Regulation (EU) 2021/1317 and Regulation (EU) 2021/1323 *amending Regulation (EC) No 1881/2006 with regard to the European maximum levels for lead and cadmium* reduced the legal maximum levels for these two heavy metals in a number of foods. Although maximum levels for lead and cadmium are now lower, they were not exceeded in almost any of the product groups investigated, with the exception of a few single cases.

Regarding infant and toddler foods based on vegetable and fruit preparations, measured levels of lead and cadmium were well below the EU-wide maximum levels in all samples tested. This is positive in view of the increased sensitivity of infants and young children to lead and cadmium.

**Project 3: Determination of cadmium and lead and other elements in dry tea products for infants and young children**

In the framework of this project, a total of 117 samples of dry tea-like products specifically intended for infants and young children were analysed for their element contents. The samples consisted of 13 samples of instant drink powders with extracts of tea-like products, and 104 samples of dried tea-like products.
Lead, nickel and copper levels were higher than those of all other elements measured in dried tea-like products intended for infants and young children.
In addition to that, the data collected shows that dry tea products for infants and young children contain considerable concentrations of aluminium. The infusions, however, contained only very low element levels yet. So, the element compounds present in the dry tea products migrate only to little extent into the prepared tea beverage.
The 13 instant beverage powders with extracts of tea-like products tested were inconspicuous as regards their element levels.
The data collected in this project can serve as an important basis for decision-making in further deliberations on maximum levels for infants' and young children's teas at the European level.

**Project 5: Elements in selected nuts**

Under this project, a total of 201 samples were analysed for contents of various elements. Of these, 60 samples were cashew nuts, 58 samples were Brazil nuts, 48 samples were pecans and 35 samples were macadamia nuts.
In general, the element contents of nuts determined in this project are in the same order of magnitude as comparative values from the literature.
Due to sometimes considerable fluctuations in element contents, it seems recommendable to vary the consumption of different kinds of nuts. Given the increasing popularity of nuts in the diet and the recommendations for nut consumption from a nutritional point of view, a regular monitoring of element contents seems appropriate.

**Project 6: Elements in chia seeds**

A total of 170 samples of chia seeds were analysed for contents of selected elements. Element contents in chia seeds were found in the same range as shown by previously published data. Data of the BfR's MEAL study have shown that chia seeds partly contain significantly higher element levels than other representatives of the pseudocereals group.
The results of this project can be used for further exposure estimations. Given the great number of samples not complying with established maximum levels of copper (168 of 170 samples tested [98.8%], with classification as pseudocereals), it seems appropriate to continuously monitor levels of the substances of concern in chia seeds.

## 2.10 Nitrate

In 2022, nitrate was measured in the foodstuffs cilantro, green and white asparagus, white cabbage/pointed cabbage, and zucchini. Cilantro showed relatively high nitrate levels. Findings in white cabbage and zucchini were at comparatively lower levels; however, these foods may represent a remarkable portion of the dietary nitrate exposure. Findings in white cabbage hardly decreased compared to the last time of testing in 2016. So, we keep up the recommendation to take appropriate action to reduce nitrate levels in this food. According to a BfR compilation of questions and answers on nitrate and nitrite in food, consumers should by no means reduce their consumption of vegetables, but should pay attention to a varied selection of vegetables.

# 3 Cosmetic products

## 3.1 Elements in tattoo products

Tattooing products, including permanent make-up, are subject to the regulations of the German Food and Feed Code (LFGB), the national Regulation on Tattooing Products, and Regulation (EC) No 1907/2006 (REACH Regulation). Such products must be safe for consumers and must not harm human health. Substances such as the elements antimony, arsenic, barium, lead, cadmium, chromium, cobalt, copper, nickel and mercury, which are examined here, have therefore been restricted in tattooing products in the European Union since January 5, 2022, following the publication of Regulation (EU) 2020/2081 amending Annex XVII of Regulation (EC) No 1907/2006. 87.4% of the 143 samples examined complied with these specifications.
The remaining 12.6% were found to exceed the concentration limits for cobalt, lead, nickel, arsenic and/or antimony, mainly with one element per sample, but in some cases also with up to 4 elements. Account must be taken of the fact that due to the analytical method used, the contents determined for chromium and copper may represent excess findings.
The percentage of non-compliant samples was higher in the separately examined permanent make-up products than in the tattooing products and similarly, higher in the samples drawn from online retailers compared to the samples from stationary trade. However, it must be taken into account here that a significantly lower number of permanent make-ups (25 samples) were examined compared to the other tattooing products (118 samples) and a significantly lower number of samples from online retailers (13 samples) compared to the samples from stationary retailers (130 samples).
Tattoo inks of the black colour group had a strikingly higher poportion of non-compliant samples than inks of the “multiple colours” group.
Consequently, this subject should be given furthermore attention in the context of official routine controls.

## 3.2 Antimony and other elements in decorative cosmetics with glitter for children

According to Regulation (EC) No 1223/2009, cosmetic products must not contain a number of heavy metals and their compounds. Based on monitoring data from 2010 to 2012, it was possible to derive guidance values for arsenic, lead, cadmium, antimony, and mercury in various cosmetic products, exceeding of which can be considered technically avoidable.
In the current investigations, the levels of these heavy metals were below these guidance values in 65.1% of the 146 samples tested of children's decorative cosmetics with glitter.
The remaining 34.9% of the samples were found to exceed orientation values for antimony, lead, cadmium and/or arsenic, mainly with one element per sample, but partly also with up to 3 elements.
The results of the studies confirmed that use of terephthalates (PET or PBT) can lead to higher antimony levels in cosmetic products.
A comparison with the lip cosmetics and eye shadows with glitter examined in 2019 and 2021 shows that one has to expect that even more of the corresponding children’s products exceed the orientation values for arsenic, lead and cadmium. As these substances are banned in the production of cosmetics, heavy metal levels should continue to be lowered through responsible raw material selection and good manufacturing practice.

### 3.3 Formaldehyde in hair gels and hair straightening products

Formaldehyde was previously used in cosmetic products as a preservative because it effectively kills bacteria. Due to its classification as a category 1B carcinogen, use of formaldehyde has been banned in cosmetic products since 2019. Nevertheless, formaldehyde may be present in cosmetic products, for example, when formaldehyde-releasing preservatives are used. For these substances, the EU Cosmetics Regulation specifies maximum levels and labelling requirements. The 2022 monitoring programme placed the focus on the investigation of hair gels and hair straightening agents.
Quantifiable amounts of formaldehyde were determined in 17.4% of the hair gels and 22.4% of the hair straighteners tested. As it was to be expected, use of the formaldehyde releasers DMDM-hydantoin (1,3-Bis(hydroxymethyl)-5,5-dimethylimidazolidin-2,4-dion) or diazolidinyl urea led to higher levels of formaldehyde in the product. The degree to which final formaldehyde levels depended on the amount of formaldehyde-releasing agent used was not considered here.
Formaldehyde levels found in hair gels amounted to up to 0.049%, and up to 0.074% in hair straightening products. Overall, the contents are to be regarded as very low. Due to the small number of samples (15), it is not possible to draw conclusions about a reference value for the declaration of formaldehyde releasers.

## 4 Consumer goods

### 4.1 Migration of chloropropanols (1,3-DCP and 3-MCPD) from food contact articles made of paper/cardboard/carton

The chloropropanols 3-chloro-1,2-propanediol (3-MCPD) and 1,3-dichloro-2-propanol (1,3-DCP) may be formed and subsequently migrate to food when epichlorohydrin-based wet strength agents are used in paper production. Wet-strength agents are used in particular in those papers that have much and long contact with moist foodstuffs, in order to prevent paper fibres in the moist paper from dissolving.
1,3-DCP is classified as a category 1B carcinogen under Regulation (EC) No 1272/2008 (CLP Regulation). 3-MCPD, too, can in high doses lead to cancer, and is also toxic to reproduction and to the kidneys. For both substances, the BfR has published, in its Recommendation XXXVI on papers, cartons, and cardboards intended for food contact, limits restricting the transition into the cold water extract, which is intended to simulate the transition to food.
The 2022 monitoring programme investigated in a representative manner consumer exposure to 3-MCPD and 1,3-DCP from food contact materials made of paper/cardboard/carton, taking up a recommendation from the 2020 Federal Monitoring Plan (BÜp) to consider this topic again in a later, possibly adapted programme. 92.9% of the 337 samples tested complied with the limits of BfR Recommendation XXXVI, footnote 15, for the release of chloropropanols into the cold water extract. 1,3-DCP was not detectable or not determinable in 92.9% of the water extracts tested, while 3-MCPD could not be detected or determined in 64.5% of the water extract samples. Higher amounts of 3-MCPD and 1,3-DCP above the limits provided by the BfR recommendations are released by those items in particular that are in contact with moist or liquid foods, and therefore have to be wet-strengthened to a higher degree (e.g. plates and bowls, drinking straws).

Different from the investigations under the 2020 Federal Monitoring Plan (BÜp), this year's testing procedure also considered the actual migrate of the product under investigation, in addition to the cold water extract according to DIN EN 645, for samples which were found and quantified with 1,3-DCP and/or 3-MCPD in the cold water extract. Here, the concentrations measured in the migrate were always lower than in the extract, with the exception of just one sample. If BfR Recommendation XXXVI was applied to the migrates, 5 of the 24 samples exceeding the BfR's recommended limit values in the cold water extract would also have exceeded at least one BfR recommended limit with their actual migrates.
While examinations in the 2020 BÜp included also coated samples, samples analysed in 2022 consisted only in paper without plastic coating. As regards the exceeding of the BfR recommended limits, no major differences were found to uncoated samples analysed under the 2020 BÜp.
Complementing the approach of the 2020 BÜp, the 2022 BÜp considered also samples provided by online retailers. A comparison of the samples stemming from online and those from stationary trade shows that the proportion of samples exceeding the BfR recommendations was higher in the samples from online trade, as were the statistical key figures and the proportions of quantifiable concentrations. While a tendency is recognisable here, account should be taken of the fact that the number of samples obtained from stationary trade was considerably higher (88% of the samples).
In addition to the study results of the 2020 BÜp, exposure assessment can now also draw on migration data that are more in line with real-world use conditions, especially for food contact materials such as drinking straws, as well as on a large number of data on food contact material samples without plastic coating, and on a representative consideration of samples provided by online retailers.

## 4.2 Migration of chloropropanols (1,3-DCP and 3-MCPD) from picture books and puzzles

The investigations prove that occurrence of 3-MCPD and 1,3-DCP in picture books and large cardboard puzzles is, in principle, technically avoidable: 81.9% of the 166 samples investigated complied with the requirements of BfR Recommendation XLVII, in conjunction with BfR Recommendation XXXVI footnote 15, regarding the release of chloropropanols into cold water extract. 1,3-DCP was not detectable or quantifiable in 79.6% of the water extracts tested, neither was 3-MCPD in 60.8% of the samples.
In addition to cold water extraction, those samples where 1,3-DCP and/or 3-MCPD were quantifiable above the assessment values (1,3-DCP: 2 µg/L; 3-MCPD: 12 µg/L) in the cold water extract, were to be analysed using the 'head over heels (HoH) migrate' method according to DIN EN 71-10. The extraction described in this standard simulates the dynamic migration of compounds from a material during a child's oral contact with toys. In these samples, 1,3-DCP and/or 3-MCPD contents measured were always lower in the migrate than in the extract, possibly also due to the different sample weights used in the tests in the migrate and in the cold water extract. If the BfR recommendations were also applied to the migrates, 7 samples would have exceeded recommended limits. This corresponds to a share of 30% of those samples only that were conspicuous with regard to 1,3-DCP and/or 3-MCPD in the cold water extract, and for which an analysis of the migrate was carried out.

In order to reduce the health risk to infants and young children from chloropropanols in toys, EU-wide regulations should be sought. It has to be clarified whether for this purpose the assessment of technical avoidability can be based on the assessment values of the BfR recommendation XXXVI footnote 15 or, if applicable, on the determined 90th percentiles of 5 µg/L 1,3-DCP and 18 µg/L 3 MCPD, as well as whether the 'Head-over-Heels (HoH) migrate' should be included in the methodology underlying such regulations.
The BfR recommends that 1,3-DCP - a genotoxic carcinogen for which no safe intake level can be derived - be reduced as far as technically possible in toys of paper, carton or cardboard which might probably be taken in the mouth by children under 36 months of age.
Furthermore, the BfR holds that migration of 3-MCPD from such toy materials into the cold water extract should be reduced as low as reasonable achievable as some children already ingest this substance to a potentially health-risky extent with food.

## 4.3 Element release from metal consumer goods (enamelled and uncoated)

The purpose was to test the release of elements from enamelled articles and from uncoated metal food contact articles, both fillable and non-fillable articles.
The results of the examinations of uncoated metal articles were assessed against the Council of Europe's Recommendations for Metals and Alloys published in 2013. 99.1% of the 112 samples examined complied with these assessment values in the third migrate. Only one sample was conspicuous. The remaining samples were still inconspicuous with a view to the revision of these Council of Europe recommendations, which is currently in draft status and includes partly new release limit values.
The results of the tests of enamelled articles were assessed on the basis of the limit values for the release of metal ions laid down in the standard DIN EN ISO 4531:2018. 79.7% of the 79 samples tested complied with these assessment values in the third migrate in the two food-simulating substances '4% acetic acid by volume' and '3% acetic acid by weight'. This makes clear that appropriate production of such products with low release rates of the elements is possible.
Standard limit values were exceeded in both simulants with regard to aluminium, barium, lead, cadmium, cobalt, lithium and manganese, in the 4 vol% acetic acid additionally with regard to antimony, chromium, vanadium, and in the 3 wt% acetic acid also with regard to nickel. In the majority, one element per sample exceeded the respective assessment value of, but in some cases, up to 9 elements exceeded the limit values in the 4 vol% acetic acid and up to 4 elements in 3 wt% acetic acid. As a matter of principle, manufacturers of enamelled consumer goods with food contact should take suitable measures to reduce metal release as far as possible.
The migration limit for aluminium was changed with the current edition of DIN EN ISO 4531:2022-08 after the start of the investigations described here. This lower migration limit of 1 mg/kg, introduced from a toxicological point of view, would have been exceeded by a large number of the enamelled samples (41.4 % in the simulant 3 wt% acetic acid). Further investigations would have to be carried out to determine whether manufacturers have adapted their production to the new regulations.
Increases in specific migration from the first to the third migrate were found in about 4 % of the tests (in about half of them, by a factor greater than 2), which means these items are not stable with respect to the element analysed and simulant used. Since the final level cannot be adequately predicted, conformity cannot be established even if the specific migration limit is not exceeded in any of the three tests. For assessing the stability of the material after multiple use, further migration tests, beyond the

third migrate, could be useful in individual cases. However, following the Plastic Materials Regulation (EU) No 10/2011, it can be assumed that if an increase in specific migration from the first to the third migrate is detected with analytical certainty, the material does not meet the requirements for its intended use, namely multiple use. Therefore, it can be questioned whether such products have been manufactured according to good manufacturing practice (GMP) within the meaning of Article 3(a) of Regulation (EC) No 2023/2006.