FAQs about aluminium in food and products intended for consumers

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Numerous foods and products intended for consumers contain aluminium and its compounds. In food, aluminium compounds can occur naturally or as part of food additives. In addition, aluminium ions can, under certain conditions, be transferred to food from food packaging and tableware.

In addition to food, cosmetic products, such as aluminium containing antiperspirants and toothpaste with whitening effect are a significant source of intake. Furthermore, aluminium compounds can also be contained in lipstick as colour pigments, in toothpaste in the form of aluminium fluoride, or as coating of nanoparticles in sun cream.

Both journalists and consumers frequently ask the German Federal Institute for Risk Assessment (BfR) questions about the possible health risks of aluminium in foods and consumer products. Against this background, the institute has summarised the most important information on the subject.

What is aluminium?
Aluminium is a light metal that occurs as the third most common element in the earth’s crust. In addition, it is released into the environment by other means, for example through industrial processes or oxidation of aluminium building components.

What are the sources of exposure?
Humans take up aluminium via food and drinking water. In addition, aluminium containing consumer products such as tableware and food packaging, cosmetic products like aluminium containing antiperspirants, lipsticks and sun cream, as well as drugs are a significant source of aluminium uptake.

What health risks can be associated with aluminium intake?
When considering the hazard potential of aluminium, the focus is on impairments of the nervous system, the mental and motor development of offspring and on damage to the kidneys and bones.

When aluminium is ingested via food, its acute toxicity is low. In healthy people, most of the aluminium absorbed is excreted via the kidneys. However, in persons suffering from kidney disease, especially chronic renal insufficiency, this excretion process does not work well enough, which can lead to aluminium accumulation in the body. But even in healthy people, the light metal can accumulate in the body if it is absorbed frequently and regularly, especially in the skeletal system, muscles, kidneys, liver and brain. Once “stored” in the body, aluminium is excreted only very slowly.

Why is aluminium contained in food?
As aluminium is naturally the third most common element in the earth’s crust, it can already be found in unprocessed foods. In addition, some aluminium compounds are used as food additives. Additional sources are food packaging and cooking utensils made of aluminium from which aluminium ions can be transferred to food.
What is the aluminium content of foods?
According to a recent BfR study, processed and ready-to-eat foods contain on average less than 5 milligrams (mg) of aluminium per kilogram (kg) of fresh mass. Concentrations of more than 20 mg/kg fresh mass are only found in a few products. It should be noted that even less contaminated food can lead to high absorption in the body if much of it is consumed.

Do consumers consume quantities of aluminium that pose a health risk?
In 2019, the BfR estimated the total aluminium intake of the German population for the first time (https://www.bfr.bund.de/cm/349/reducing-aluminium-intake-can-minimise-potential-health-risks.pdf, https://link.springer.com/article/10.1007/s00204-019-02599-z). Food, cosmetic products, food contact materials and drugs were included. In addition, the amount of the various aluminium sources for the population’s total aluminium exposure was assessed in terms of health.

On average, the majority of the population, especially adolescents and adults, already take up half of the tolerable weekly intake (TWI) of 1 mg aluminium per kg body weight through food. If contributions from cosmetics or food contact materials are also considered, this health-based guidance value can be clearly exceeded.

What can I do to reduce my aluminium intake?
For food, the potential risk to consumers can be reduced by taking into account the general recommendation on alternatives and variety when selecting foods. In this way, partial exposure to a wide variety of potentially harmful substances, the isolated occurrence of which must be expected in food, can be prevented.

Individual aluminium uptake via cosmetics can be notably reduced by not using aluminium containing antiperspirants. In addition, these kinds of products should not be applied to damaged skin (for instance directly after shaving or sunburn). Deodorants can be used as an alternative. These do not contain any aluminium salts and therefore cannot prevent perspiration itself; they only provide a more pleasant odour. If you do not want to renounce antiperspirants, there are now even aluminium-free products available.

The selection of foods and cosmetics should generally be varied. In this way, partial exposure due to high aluminium concentrations in individual products can be reduced.

Aluminium containing antiperspirants and whitening toothpaste contribute significantly to the total aluminium uptake. By reducing the use of these products or going without them completely, your exposure to aluminium can be significantly reduced.

Unnecessary aluminium intake from the improper use of aluminium foil, aluminium grill trays and uncoated aluminium menu trays can be avoided by consumers. In view of the increased solubility of aluminium under the influence of acids and salts, these kinds of products should not come into contact in particular with sour or salty foods, i.e. aluminium foil should not be used to wrap sour or salty foods. These include, for example, cut apples, tomatoes, rhubarb and salted herring, marinated fish or cheese. Reusable trays made of stainless steel, for example, are preferable for grilling.

What must be taken into account for infants and toddlers?
Breastfed infants take up significantly lower amounts of aluminium salts than those who are not, as infant formula and follow-on formula contain on average significantly higher amounts of aluminium than breast milk. The aluminium content of specially adapted baby foods, such as soy-based, lactose-free or hypoallergenic baby food, can be even higher. The BfR advis-
es women to exclusively breastfeed infants up to the age of six months, if possible, and then to successively feed them normal food.

Vaccines are another source of aluminium uptake for infants and toddlers. However, vaccinations have a high health benefit, both for the individual and the entire population. In addition, clinical and epidemiological studies show that exposure to aluminium from vaccines can be considered safe from a health point of view. The BfR refers to the German Federal Institute for Drugs and Medical Devices (BfArM), the Paul Ehrlich Institute (PEI) and the Robert Koch Institute (RKI) regarding the effects and side effects of vaccines.

**What should young women take into account?**
Young women can take up large quantities of aluminium via cosmetic products. As aluminium can be stored in the body for a very long time and is able to reach the placenta, unborn children could also be exposed to an increased concentration of aluminium during pregnancy. From the BfR's perspective, any aluminium uptake from an avoidable source of exposure over a longer period of time should therefore be critically evaluated by young women.

**Which foods contribute the most to the aluminium intake of adults in Germany?**
The food groups with the highest individual contributions are instant tea drinks (accounting for 11% of total food intake), mixed raw vegetable salads (8%), tea drinks (7%), cocoa and chocolate products (6%) and multigrain bread (4%). However, the food groups mentioned only account for 36% of the total intake. The remaining 64% is ingested through a wide variety of foods.

**What is the function of aluminium compounds as food additives?**
Food additives are intended to be added to foods in order to influence their texture or to achieve certain properties or effects.

For example, elemental aluminium is allowed in food solely for coating confectionery and for decorating cakes and fine pastries. No more aluminium may be used for this purpose than is absolutely necessary to achieve the desired effect ("Quantum satis"). In addition, certain food colourants can also be used as aluminium lakes in the manufacture of certain foods.

Additionally, various food additives containing aluminium are permitted for certain technological functions for certain foods.

Through Regulation (EU) No. 380/2012 dated 3 May 2012 from the Commission amending Annex II to Regulation (EC) No. 1333/2008 from the European Parliament and Council of Europe with regard to the conditions of the use and quantities applicable to food additives containing aluminium, the use of food additives containing aluminium has been restricted.

**Why can aluminium be transferred to food from packaging or tableware?**
Aluminium is soluble under the influence of acids or salt. For this reason, packaging and containers used for food such as beverage cans, yoghurt cup lids and aluminium containers for fruit juice are coated on the inside to prevent transfer of aluminium ions to the food or drink.

Aluminium from foil can be transferred to foods containing acid and salt. For this reason, the BfR recommends that acidic and salty foods are not heated, kept warm or stored in coated aluminium trays. Aluminium foils are not suitable or intended for storing, heating or keeping warm acidic or salty foods.
Is there an aluminium limit value for tableware and cooking pots etc. that come into contact with food?
What matters, is not the mere presence of aluminium in products intended for consumers but rather how much aluminium is transferred from the respective product into the food and can thus be absorbed by the body. For objects made of metal or alloys, there is a resolution by the Council of Europe that suggests a specific release limit of 5 mg aluminium per kilogram food. Resolutions are only recommendations and do not contain legally binding limit values. There is also no specific EU limit value for the release of aluminium from ceramic objects. However, for any material, Regulation (EC) No. 1935/2004 stipulates that food contact materials may not transfer their constituents to food in quantities which could endanger human health. In the absence of specific limit values, a toxicological individual assessment has to be carried out.

Is it possible that aluminium will transfer to food when heating food in aluminium menu trays?
The transfer of aluminium from the tray to the food is possible if it is an uncoated aluminium tray. However, the amount depends on many factors, such as the salt or acid content of the food and the temperature and duration of storage in the aluminium menu tray. In a research project, the BfR has investigated whether aluminium ions from uncoated aluminium menu trays can transfer to food if the cook & chill process, which is often used in external catering, is applied. The investigations show that, especially during warm keeping, high quantities of aluminium ions are released from these menu trays and transferred to the food. Find out more information about the project in the BfR Opinion No. 007/2017 of 29 May 2017 at https://www.bfr.bund.de/cm/349/uncoated-aluminium-menu-trays-first-research-results-show-high-release-of-aluminium-ions.pdf.

The transfer of aluminium to food can be avoided, for example, by using coated aluminium menu trays when applying the cook & chill method or by using trays made of other materials. From the BfR’s perspective, this is particularly recommended for sensitive consumer groups, such as children or the elderly, who may consume warm meals from aluminium menu trays every day as part of communal or external catering.

What should catering providers and their customers take into account when using aluminium menu trays?
Caterers may generally only use packaging that is suitable and appropriate for the intended use. General requirements for the safety of food contact materials are laid down in Regulation (EC) No. 1935/2004. The Regulation stipulates, among other things, that these materials and objects must be labelled, if necessary, with special instructions for safe and proper use.

The BfR recommends:

- Catering companies should follow the instructions for use on the menu trays.
- Catering companies should select menu trays from suitable materials for their meals. There are alternatives for contact with acidic and salty foods, such as coated aluminium menu trays or menu trays made from other materials.

Why are high aluminium concentrations regularly detected in lye biscuits, and do they pose a health risk?
In 2002, the BfR recommended that the transfer of aluminium to lye biscuits should be reduced to the absolute technically feasible minimum. To achieve this goal, the technical processes leading to an increased transfer of aluminium to the baked goods, such as dipping
the dough pieces into the lye before they are baked on aluminium baking trays, should be avoided. However, official control laboratories keep detecting aluminium concentrations in baked lye products of more than 10 mg per kilogramme of food. This means that under certain circumstances, consumers can take up considerable quantities of aluminium via lye biscuits. This is a source of exposure that can be eliminated by changing the technological processes.

Reports from the official food control laboratories show that the BfR’s recommendation of reducing the transfer of aluminium to baked lye goods to the absolute technologically achievable minimum has unfortunately not yet been completely implemented.

Which cosmetic products can contain aluminium?
Aluminium salts such as aluminium chlorohydrate are predominantly used in antiperspirants due to their anti-perspiration effect. However, they are also used as a coating for nanoparticles in sun creams, as colour pigments in lipsticks and in the form of aluminium fluoride in toothpaste. High amounts of aluminium can also be found in whitening effect toothpaste.

What are antiperspirants?
“Antiperspirants” are cosmetic products with an anti-perspiration effect and are available as roll-ons, sticks, creams or aerosols (sprays). In contrast, deodorants do not contain any aluminium and therefore have no anti-perspiration effect. They work by killing off sweat-decomposing bacteria, which are responsible for the unpleasant smell. Most antiperspirants also contain active ingredients with a deodorising effect.

Why is aluminium used in antiperspirants?
Aluminium compounds are used in antiperspirants due to their anti-perspiration effect. This anti-perspiration effect is achieved by the narrowing of the pores of the skin as a result of the contact with aluminium salts. In addition, a jellylike aluminium protein complex is formed that temporarily blocks the ends of the sweat ducts.

In what quantities is aluminium contained in cosmetic products?
According to information from the industry, concentrations of up to approx. 30% aluminium chlorohydrate are usually used in antiperspirants, depending on the product. This corresponds to a maximum aluminium concentration of about 7.5%. Data from scientific literature shows average and maximum aluminium concentrations of approx. 2.8% and 5.8% respectively. Data on other cosmetic products are available from scientific literature. According to this, lipsticks can contain up to about 3%, whitening (abrasive) toothpaste up to 4.5% and sun creams up to 0.8% aluminium.

How much aluminium do consumers take up through the use of antiperspirants?
Assuming a mean aluminium content in antiperspirants of 2.8% (equivalent to about 11.2% aluminium chlorohydrate), the aluminium uptake into the body, estimated on the basis of currently available data, approximates the amount that would be absorbed, if one would take up orally, for example via food, about 6 mg of aluminium per day. For an adult weighing 60 kg, this would correspond to an oral intake of approximately 0.7 mg per kg body weight per week. For adolescents, who generally have a lower body weight than adults, or for users of antiperspirants with higher aluminium concentrations (see above), absorption may correspond to an oral intake of up to 2 mg per kg body weight per week. This means that the tolerable weekly intake (TWI) of 1 milligram of aluminium per kilogram of body weight could already be exhausted or even significantly exceeded by using aluminium containing antiperspirants on healthy skin. Users who regularly use aluminium containing antiperspirants should take into consideration additional aluminium uptake from food, other cosmetic prod-
ucts as well as aluminium containing food contact materials, such as cooking utensils and aluminium foil.

The tolerable weekly intake (TWI) for aluminium denotes the quantity of aluminium than can be ingested weekly throughout a person’s entire lifetime without adverse effects on their health. From a toxicological point of view, the total weekly intake of aluminium should not regularly exceed the TWI value. To achieve this, total exposure to aluminium should be further reduced. This, according to current information, includes reducing notable contributors to exposure like aluminium containing antiperspirants and cosmetic products. Risk management measures in the areas of food contact materials and cosmetic products could also contribute to this.

**Is there information on cosmetic products that they contain aluminium compounds?**
Aluminium compounds must be listed as ingredients on the packaging of the cosmetic products.

**Is there a connection between aluminium uptake and Alzheimer’s disease?**
Various studies attempted to establish a connection between aluminium absorption and Alzheimer’s disease but found no clear evidence. According to current information, a connection is unlikely. However, a final assessment is not yet possible due to the inconsistent data situation.

**Is there a connection between the use of aluminium containing antiperspirants and breast cancer?**
So far, it has not been possible to provide scientific evidence of a causal relationship between aluminium absorption from antiperspirants and the development of breast cancer.

In studies with mice, no tumours were observed even when high doses of aluminium were used.

However, studies in breast cancer patients whose breast gland tissue and secretion had higher aluminium concentrations than healthy tissue or secretion from healthy women showed indications of a possible connection. However, it is unclear whether the increased aluminium concentration is the cause or consequence of the cancer. Concentrations of other metals such as iron, chromium and nickel were also increased.

An epidemiological study also found a correlation between the use of antiperspirants containing aluminium and breast cancer incidence. However, two other epidemiological studies did not find any such correlation.

Here, too, the existing data is inconsistent and in some cases contradictory. There is a need for further research, but current evidence suggests that the use of antiperspirants containing aluminium is unlikely to be a risk factor for developing breast cancer.

**Is it better to grill food with or without an aluminium tray/foil?**
Transfer of aluminium compounds to the food is also to be expected when grilling food on an aluminium tray. On the other hand, aluminium trays are used to avoid fat dripping into the embers and therefore to prevent the development of carcinogenic polycyclic aromatic hydrocarbons (PAHs). Viewed in this light, the use of aluminium trays/foil for grilling meat is justifiable. However, the grilled meat should only be salted and seasoned once it is cooked. Alternatives are grill trays made of other materials, such as stainless steel or ceramics.
Can I continue to use aluminium cooking pots/pressure cookers?
Provided that they are coated, yes. If they are not, no salty or acidic foods such as apple purée, tomato purée, rhubarb or salted herring should be prepared or stored in these kinds of pots.

Should I avoid espresso makers, espresso capsules and thermal flasks made of aluminium?
When espresso makers made of aluminium are used for the first time, a protective layer is formed which largely reduces the transfer of aluminium. This is confirmed by studies conducted by the BfR. However, when espresso makers are cleaned in the dish washer, this protective layer may be removed, which leads to an increase in aluminium release during subsequent use. But even then, the aluminium release is below the release limit value laid down by the Council of Europe resolution on metals and alloys (5 mg/kg). During further use, a new protective layer is formed, which reduces the transfer of aluminium. The use of aluminium espresso makers only contributes to a small extent to the overall exposure to aluminium. In the view of the BfR, there is consequently no reason to advise against their use. It is recommended, however, that consumers refrain from cleaning these espresso makers in the dishwasher.

Espresso capsules made of aluminium and/or with an aluminium cover are coated on the inside. This means that no transfer of aluminium into the beverage is to be expected.

As far as the BfR is aware, parts of thermal flasks, which come into contact with the liquid, are not made of aluminium.

What scientific uncertainties exist currently in the health assessment of the use of aluminium in different products?
There is still a need for research to assess the health risks of regular uptake of aluminium over a very long period of time. The data on occurrence in food are from a pilot total diet study. Although the results are essentially in accordance with comparable European and international studies, there are some uncertainties due to the character of the pilot study. In addition, further data is lacking on aluminium concentrations in the body (internal exposure) and on actual absorption of aluminium via the skin through the regular use of antiperspirants. This kind of data would significantly increase the accuracy of the risk assessment and the comparative assessment of the different sources of exposure.

To enable a better assessment of the actual aluminium absorption via the skin, the cosmetics industry has, according to its own statements, conducted a study investigating the absorption of aluminium from antiperspirants under realistic conditions of use. The results of the study were submitted to the EU Scientific Committee for Consumer Safety (SCCS) for assessment. In this context, on 7 March 2017, the EU Commission asked the SCCS to update its opinion published in March 2014 (SCCS/1525/14) on the “Safety of aluminium in cosmetic products”, thereby taking into account the new data (https://ec.europa.eu/health/sites/health/files/scientific_committees/consumer_safety/docs/scs2016_q_009.pdf). The original deadline for completing the updated opinion (October 2017) was postponed by the European Commission to October 2019 (see link above) as the cosmetics industry had announced the submission of another study running until November 2018. (https://ec.europa.eu/health/sites/health/files/scientific_committees/consumer_safety/docs/scs2016_miwg_031.pdf). The result of the SCCS assessment is not yet available.