German Federal Institute for Risk Assessment

FAQ

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# No adverse health effects to be expected from cookware with PTFE non-stick coating

→ Changes to the version from 18 December 2018: full revision of the questions and answers, new reference to the 2023 proposal of the European Chemicals Agency (ECHA) for a broad ban on PFAS, new information regarding PTFE-coated utensils over gas or charcoal grills, additional BfR publications on this topic.

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Cookware with a non-stick coating has many advantages: nothing gets baked on, it is easy to clean, and it allows for low-fat cooking. The polymer polytetrafluoroethylene (PTFE) is often used as the coating material.

PTFE non-stick coating on cookware, ovenware, and frying pans only poses a health risk when it is strongly heated while unfilled, as the coating can overheat and, if the temperature rises to 360 °C, develop gases hazardous to health.

During use of the cookware, (fluorinated) substances from the PTFE coating can be transferred to food. However, when used properly as intended, the potentially released amounts of these substances are so small that no adverse health effects are to be expected.

In the following, the BfR has compiled the most common questions and answers about cookware, ovenware, and frying pans with PTFE non-stick coating.

**What is PTFE?**

PTFE stands for polytetrafluoroethylene. It is a polymeric molecule, i.e. it consists of many interconnected tetrafluoroethylene groups, and belongs to the chemical group of per- and polyfluoroalkyl substances (PFAS). The synthetic polymer is resistant to cold, heat, and chemicals and is often used for non-stick coatings for cookware, frying pans, and ovenware. The defining characteristic of pans, baking forms, and other cookware coated with PTFE is a slightly waxy surface. Its water- and fat-resistant properties prevent foods from sticking when they are heated. PTFE is the substance most commonly used for this kind of coating for food contact materials, but other, similar compounds such as ethylene tetrafluoroethylene copolymer (ETFE), perfluoro alkoxy polymers (PFA), or hexafluoropropylene tetrafluoroethylene copolymer (FEP) can be used alternatively.

**How are PTFE coatings manufactured?**

Manufacturing non-stick coatings involves PTFE as well as various auxiliary substances, such as emulsifiers, colourants, or fillers. These emulsifiers also include other, non-polymeric PFAS. At the end of the manufacturing process, the cookware and ovenware is sintered. This means that the substances are partially melted under heat and pressure so that they bake together and solidify as they cool down. During sintering most of the remaining starting and auxiliary substances from the PTFE manufacture are removed or tightly bound into the coating. This means they are released into the environment only under harsh conditions.

**Where else is PTFE used?**

Due to its resilience against chemicals, PTFE is preferably used in contexts involving aggressive chemicals. PTFE is used to coat hoses, seals and technical plastic components. It is also used in textiles, the aviation and aerospace industry, and medical implants, as well as in the manufacture of dental floss and in piercing jewellery. Irons or hair straighteners may also have PTFE-coated surfaces.

**What should be observed when cooking, baking, and frying with PTFE-coated utensils?**

Cookware coated with PTFE should not be overheated, as this can lead to the decomposition of the polymer at around 360 °C and above. Substances which are hazardous to health are released into the ambient air without visible smoke formation. PTFE-coated cookware should therefore never be heated when unfilled. Particular care should be taken with induction and gas stoves, as they allow for very fast heating.

Overheating is very unlikely when the cookware is filled with food. As long as water or aqueous foods are present in the cookware, ovenware, or frying pan, the temperature cannot rise far above 100 °C, the boiling point of water. Depending on whether it is of vegetable or animal origin and whether it has been hardened, oil begins to evaporate at temperatures between 110 and 270 °C. The smoke from evaporating oil or the smell of burning warn consumers about potential overheating. In conventional baking ovens/stoves, the maximum temperature is around 250 °C and thus far below the values which might cause substances from the coating to be released.

From the BfR´s perspective, PTFE coated utensils should not be used at temperatures around 360 °C or above, as may occur directly over burning flames, e.g. from gas or charcoal grills.

Most articles coated with PTFE should be cleaned thoroughly before the first use. The BfR recommends treatment of the utensils prior to the first use according to the manufacturer’s instructions.

**Are chemicals released from cookware, ovenware, and frying pans that are coated with PTFE?**

Fluorinated substances are used in the manufacture of PTFE. The fluorinated starting substances and production aids as well as the PTFE itself belong to the group of so-called PFAS (per- and polyfluoroalkyl substances). Some PFAS are associated with various health effects. During use, particularly at higher temperatures, cookware coated with PTFE may release very small amounts of substances remaining in the coating from the manufacturing process. The BfR does not have any data from its own experimental studies regarding the

transfer of such substances from PTFE-coated cookware into food. According to the current state of scientific knowledge, the amounts of potentially released fluorinated substances are so small that adverse health effects are not to be expected, as long as the cookware is used as intended. Overheating the coating should be avoided.

**What health risk are consumers exposed to through the use of cookware, ovenware, and frying pans with a PTFE non-stick coating?**

When non-stick coated cookware is used as intended, health impairments to consumers are not to be expected. However, overheating to temperatures higher than 360 °C can lead to the formation and release of invisible gases which may be hazardous to health. According to the current state of knowledge, it is possible that these gaseous substances may transfer into food. To date, however, cases of illness have only been reported from the industrial manufacture of PTFE and not from private households.

The BfR advises against overheating of coated cookware, ovenware, and frying pans when unfilled. The BfR is not aware of any data indicating that commercially available cookware, ovenware, and frying pans with PTFE coating transfer fluorinated chemicals to foods in amounts which could impair human health as long as being used properly (no overheating).

The detachment of tiny particles from a scratched coating and accidental ingestion while eating is not expected to cause any negative impact on consumer health. This is because PTFE is inert (slow to react) and particles are not digested, but excreted unchanged.

**How are consumers protected from health hazards posed by cookware, ovenware, and frying pans?**

According to EU law, food contact materials including cookware must be manufactured in such a way that, under normal foreseeable conditions of use, they do not release chemicals into food in quantities which may be hazardous to human health.

On 7 February 2023, the European Chemicals Agency (ECHA) published its proposal for a ban on the manufacture, use, and distribution (including import) of the broad group of PFAS. This is meant to prevent further entry of these substances into the environment and could result in a ban of PTFE used for coatings on cookware, ovenware, and frying pans for use in private households as well as restaurants.

Since the late 1950s, the BfR and its predecessor institutions have published recommendations for food contact materials. These include lists of substances which can be used for the manufacture of safe food contact materials under the indicated conditions.

**Further information on PTFE non-stick coatings:**

BfR FAQ "**Here to stay: per- and polyfluoroalkyl substances (PFAS) in food and in the environment**"

https://www.bfr.bund.de/en/service/frequently-asked-questions/topic/here-to-stay-per-and-polyfluoroalkyl-substances-pfas-in-food-and-in-the-environment/

BfR recommendation "**LI. Temperature Resistant Polymer Coating Systems for Frying, Cooking and Baking Utensils**"
https://empfehlungen.bfr.bund.de/recommendations/510/pdf?locale=en

**About the BfR**

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the Federal Ministry of Food and Agriculture (BMEL) in Germany. The BfR advises the Federal Government and the States ('Laender') on questions of food, chemicals and product safety. The BfR conducts independent research on topics that are closely linked to its assessment tasks.

*This text version is a translation of the original German text, which is the only legally binding version.*

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