German Federal Institute for Risk Assessment

FAQ

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Barbecue with confidence – how to minimise health risks

A barbecue party usually involves good weather and a wide mix of grilled food, salads, sauces and desserts. When preparing the food, a few rules should be followed to prevent unwanted health consequences. Good kitchen hygiene is important to avoid foodborne infections caused by salmonella, *campylobacter* or other pathogens – right from the preparation stage. When barbecuing, for example, it is important to ensure that the meat is cooked thoroughly. At the same time, care should be taken to ensure that the food is neither heated more intensely nor for longer than necessary, and that as little fat or oil as possible drips onto the heat source, as this can lead to the formation of harmful substances. Liquid barbecue lighters and lamp oils for torches are a particular source of health risk, especially for children. Below, the German Federal Institute for Risk Assessment (BfR) has compiled key questions and answers relating to barbecuing.

What health risks do foodborne pathogens pose when barbecuing?

Foodborne germs, such as Salmonella or *Campylobacter,* can cause nausea, diarrhoea or vomiting. Particularly during the warmer months, the risk of foodborne infection is increased because germs can multiply rapidly in food if it is not kept chilled at all times.

Particular care must be taken when handling raw food of animal origin, especially meat, fish and eggs. These may already be contaminated with pathogens at the time of purchase, which can also find their way into marinades.

Although the germs are killed off during barbecuing if sufficiently high temperatures are reached, they can be transferred to other foods beforehand via hands, cutlery and surfaces. If food is contaminated in this way and not reheated before consumption, it can result in food poisoning. Such infections can be particularly hazardous for people with impaired immune systems due to pregnancy, old age, pre-existing medical conditions, or not yet having fully developed their immune systems (young children under the age of five).

Salmonella and other pathogens can multiply in food at temperatures above 7 °C. Therefore, there is a particular risk of foodborne infection when consuming dishes that have been left unrefrigerated for a while, such as salads, barbecue sauces, desserts and other foods eaten raw.

How can foodborne infections be prevented when barbecuing?

Foodborne infections can be prevented when barbecuing by handling food hygienically – just as you would when preparing food in general. Good kitchen hygiene must be observed right from the start when preparing the food for the barbecue, such as when making salads, sauces or dips. This is particularly important when handling raw meat and other animal food products such as eggs. This includes:

- Raw animal-derived foods and other foods (e. g. salads or desserts) should be stored separately and prepared one after the other: first the foods eaten raw, such as salads or desserts, and then the raw animal food products.
- Frozen meat should be defrosted in the fridge.
- Packaging materials, defrosting water and leftover marinades should be disposed of carefully and immediately.
- Utensils and surfaces that have come into contact with raw animal food products, defrosting water or marinades must be thoroughly cleaned with warm water and washing-up liquid before further use.
- Hands must be washed thoroughly with warm water and soap between each stage of preparation.
- At least during the warmer months, it is advisable to avoid using raw eggs in homemade fresh mayonnaise and desserts (such as wine mousse or tiramisu).
- The same applies to sauces, mayonnaise and other delicate dishes (such as desserts) that do not contain raw eggs: they must always be kept well chilled and served just before eating.

When barbecuing, consumers should bear the following in mind:

- Meat should always be cooked thoroughly. With poultry, ensure that the meat is white to grey in colour, even around the bone.
- To prevent any bacteria present in raw meat or marinades from being transferred to the cooked food, separate barbecue tongs or forks should be used for each purpose.

What harmful substances can be formed during barbecuing?

When food is heated – as it is e. g. during barbecuing – various undesirable, potentially harmful substances can generally be formed. These are generally referred to as ‘heat-induced contaminants’. Well-known examples include polycyclic aromatic hydrocarbons (PAHs), heterocyclic aromatic amines (HAAs), acrylamide, furan and methylfurans, nitrosamines, hydroxymethylfurfural (HMF), acrolein, trans-fatty acids (TFA), 3-monochloropropanediol (3-MCPD) and 2-monochloropropanediol (2-MCPD) and their fatty acid esters, as well as glycidyl fatty acid esters. Some of these substances have genotoxic and carcinogenic properties; therefore, their intake should be kept as low as possible.

Which heat-induced contaminants are formed, and to what extent, in a specific case depends very much on the type and composition of the food and the particular method of preparation. This can be clearly illustrated by the following examples:

Polycyclic aromatic hydrocarbons (PAHs) can be formed in various ways during barbecuing. One well-known mechanism is the incomplete combustion of organic fuels such as charcoal. The PAHs formed in this process are carried by the smoke to the food being barbecued, where they then adhere to it. PAHs are also formed in larger quantities when animal fats or vegetable oils from the food being barbecued drip into the embers of a charcoal barbecue or onto the heating element of an electric barbecue. At high temperatures, PAHs can also be formed by pyrolysis of organic components in the food (breakdown at high temperatures).

When barbecuing protein-rich foods such as meat or fish, one should be aware that heating them to temperatures above 150 °C may result in increased formation of heterocyclic aromatic amines (HAAs). Barbecuing cured meat and sausage products may also promote the formation of nitrosamines. The reason for this lies in the added nitrite curing salt, which reacts with protein components in the meat when exposed to heat.

When carbohydrate-rich foods, which also have a high concentration of the amino acid asparagine and a low water content, are heated to high temperatures, increased levels of acrylamide are generally formed. This applies in particular to potato- or cereal-based products and dishes. Acrylamide is an undesirable by-product of the so-called Maillard reaction (also known as the browning reaction). Acrylamide begins to form at temperatures as low as approximately 120 °C and increases sharply in the temperature range of 170–180 °C.

How can the formation of harmful substances be prevented when barbecuing?

To prevent the increased formation of heat-induced contaminants in the first place, care should generally be taken to cook food gently. That is why the general rule of thumb ‘brown rather than char’ also applies when barbecuing. In other words: the food should not be heated any more intensely or for any longer than necessary.

Furthermore, there are various measures known to reduce the formation of polycyclic aromatic hydrocarbons (PAHs) when barbecuing. For example, using a gas or electric barbecue instead of a charcoal barbecue can result in lower PAHs concentrations in the food. It can also be assumed that, when barbecuing with charcoal, the PAHs concentration in the food depends on how long it is exposed to the smoke. The longer the food is exposed to the smoke, the more PAHs accumulate on it over time. Furthermore, it is advisable to wait until the initial heavy smoke has cleared after lighting the charcoal before placing the food on the grill. Another effective measure is to use drip trays to catch any liquids released from the food. This prevents fat or oil from dripping from the food onto the heat source and causing the formation of increased amounts of PAHs. This also applies to barbecues where the heat source and the food are positioned vertically to one another.

As heating cured meat and sausage products can lead to increased formation of nitrosamines, care should be taken when selecting food for the barbecue to ensure that it does not contain nitrite curing salt.

Stainless steel, ceramic, aluminum – which grill tray is best?

Trays made from various materials, such as stainless steel, ceramic or aluminum, can be used for barbecuing. All types are well suited to preventing the formation of polycyclic aromatic hydrocarbons (PAHs), which form when fat or oil drips into the embers or onto the heating element.

When food is grilled on aluminum trays, aluminum ions can be released and transferred into the food being grilled. This happens particularly when exposed to acid and salt – for example, when marinated meat or vegetables come into contact with the aluminum products. When the grilled food is consumed, the metal then enters the human body. As consumers already take up high amounts of this light metal – which is widespread in nature – through their normal diet, the German Federal Institute for Risk Assessment (BfR) believes that such additional intakes should be minimised. This is because, with frequent and regular intake, aluminum can accumulate in the body and, in an amount that is high, have adverse effects on the nervous system, bone development or fertility. For this reason, if food is being cooked on an aluminum barbecue tray, it should only be salted and seasoned after barbecuing. This helps to reduce the transfer of aluminum into the food. Given the reduced risks associated with PAHs, the occasional use of aluminum trays when barbecuing meat is acceptable. Anyone wishing to further minimise their aluminum intake and also use more sustainable, reusable products can opt for barbecue trays made from other materials such as stainless steel or ceramics.

Due to the transfer of aluminum into food, aluminum foil should ideally not be used to wrap acidic or salty foods when barbecuing. If you do not want to avoid using it altogether, you can at least place a sheet of baking paper between the food and the aluminum foil, which prevents direct contact between the food and the foil and thus leads to significantly lower levels of aluminum transfer.

Further information from the BfR on aluminum in food and consumer products can be found in our FAQs on Aluminum in food and consumer products.

Can cured meat be barbecued?

Nitrite curing salt is added when curing meat and sausage products. In the case of packaged food, this must be listed in the ingredients on the label. If cured foods are heated to high temperatures, nitrosamines – which can damage genetic material and be carcinogenic – may form. It is therefore best not to barbecue cured meat and sausage products.

What should you bear in mind when barbecuing vegetables?

Given that aluminum becomes more soluble when exposed to acid and salt, aluminum foil and aluminum barbecue trays should, in particular, not come into contact with acidic or salty foods. These include marinated meat, but also marinated vegetables. Tomatoes and other acidic fruits and vegetables (such as lemon slices), which are often barbecued alongside other vegetables for flavour, also pose a problem. Here too, a transfer of aluminum into the food is to be expected during the barbecuing process.

On the other hand, the use of aluminum trays when barbecuing is intended to prevent fat (such as butter or oil used to coat vegetables) from dripping into the embers, thereby

preventing the formation of carcinogenic polycyclic aromatic hydrocarbons (PAHs) or other substances that may be harmful to health. Taking this into account, the use of aluminum trays when barbecuing vegetables is also acceptable. However, as with meat, vegetables should only be salted and seasoned at the end of the barbecuing process.

Particular care should be taken to ensure gentle cooking of starchy vegetables such as potatoes, sweet potatoes, carrots, beetroot or parsnips. Heating carbohydrate-rich foods to high temperatures can lead to increased formation of acrylamide. Formation of acrylamide begins at temperatures as low as around 120 °C and increases strongly in the 170 – 180 °C range.

What should you bear in mind when grilling cheese?

Grilled cheese is classified as a salty food and, just like marinated meat or vegetables, should ideally not be grilled in uncoated aluminum trays, as this can cause increased leaching of aluminum ions from the unprotected surface. If the cheese is sold in coated aluminum barbecue trays, you should check with the manufacturer whether the coating is suitable for barbecuing over an open charcoal grill at very high temperatures and remains stable, or whether these trays are only suitable for use in the oven. It is preferable to use stainless steel or ceramic barbecue trays for grilled cheese.

What should be borne in mind when preparing plant-based alternatives to meat and sausages, such as tofu sausages or soya cutlets?

It must be assumed that heat-induced contaminants can also form when plant-based alternatives to meat and sausages are heated. However, which heat-induced contaminants are formed and to what extent in a specific case depends very much on the type and composition of the food and the particular method of preparation. To prevent an increased formation of heat-induced contaminants in the first place, care should generally be taken to prepare food gently. That is why the general rule of thumb ‘brown rather than char’ also applies when barbecuing plant-based alternatives to meat and sausages. In other words: the food being barbecued should, as far as possible, not be heated any more intensely or for any longer than necessary.

Why is it not allowed to barbecue indoors?

Barbecuing with charcoal indoors – including in garages – is life-threatening. The glowing charcoal releases significant amounts of carbon monoxide (CO). As the barbecue has no flue, the gases cannot escape when used indoors but instead enter the indoor air. People present will inevitably inhale CO while breathing. Within a short period of time, this can cause their tissues to suffer from a lack of oxygen, which can lead to severe brain damage or even death. The occurrence of dangerous levels of CO in the air can occur even with windows and doors wide open.

Are ‘indoor barbecues’ or ‘hot pots’ that use charcoal suitable for indoor barbecuing?

Even appliances marketed as specialised ‘indoor grills’ – despite using glowing charcoal as the heat source – as well as charcoal-fired cooking pots, known as ‘hot pots’, pose a risk to

life if used indoors, such as in living rooms or restaurants. These appliances can produce dangerous levels of carbon monoxide (CO) within a relatively short period of time.

What is the hazard posed by liquid barbecue lighters and lamp oils?

The BfR has repeatedly received reports of poisoning cases involving young children who, when left unsupervised, have sipped lamp oils or barbecue lighters containing petroleum or paraffin oil. These lamp oils and liquid barbecue lighters can very easily enter the lungs, where even very small amounts can trigger 'chemical pneumonia' – which in severe cases may be fatal.

How can children be protected from poisoning by liquid barbecue lighters and lamp oils?

As soon as a barbecue lighter is no longer needed, it should be put away immediately in a safe place. It is safer to use solid rather than liquid barbecue lighters. This virtually eliminates the risk of the harmful oils entering the lungs if swallowed.

To prevent poisoning from lamp oils, it is not enough simply to store the bottles safely. Cases of accidental poisoning have also occurred after young children sucked on the wick of a torch or oil lamp. It is therefore advisable not to use torches and oil lamps when children are present at a barbecue – not least because they also pose a burn hazard.

What should you do if an accidental poisoning incident involving liquid barbecue lighters or lamp oils occurs?

If liquid barbecue lighters or lamp oils have been swallowed despite all precautionary measures and the use of the required child-resistant caps, the following rules apply:

- Do not induce vomiting
  Vomit containing the oil can enter the lungs.
- Contact a poison centre immediately or seek medical assistance. If persistent coughing or difficulty breathing develops, call the emergency services on 112 straight away.

Even if symptoms are mild, the child must be taken to a doctor's surgery or hospital for medical assessment and observation. Where possible, keep the product involved in its original packaging and have it readily available when contacting a poison centre, or take it with you to the doctor's surgery or hospital. The more information available, the better those affected can be treated.

- Doctors' duty to report poisoning cases

To help identify risks and support appropriate preventive measures, doctors must report cases of poisoning to the BfR. Please feel free to speak to the medical staff treating your child about this reporting obligation.

Further information on barbecuing

Topic page on barbecuing (with videos)
https://www.bfr.bund.de/en/food-safety/assessment-of-microbial-risks-in-foods/food-hygiene/healthy-barbecuing/

BfR2GO, Issue 2/2018, Key Topic: Heat-induced contaminants
https://www.bfr.bund.de/en/publication/bfr2go-issue-22018-key-topic-heat-induced-contaminants/

Consumer advice: Protection against foodborne infections in private households
https://www.bfr.bund.de/en/publication/consumer-advice-protection-against-foodborne-infections-in-private-households/

About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the German Federal Ministry of Agriculture, Food and Regional Identity (BMLEH). It protects people's health preventively in the fields of public health and veterinary public health. The BfR provides advice to the Federal Government as well as the Federal States ('Laender') on questions related to food, feed, chemical and product safety. The BfR conducts its own research on topics closely related to its assessment tasks.

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