German Federal Institute for Risk Assessment

FAQ

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Anthrax: can the pathogen *Bacillus anthracis* be transmitted through food?

→ Changes compared to the version from 22 October 2014: individual answers have been supplemented with additional information

Anthrax is an infection caused by the pathogen *Bacillus (B.) anthracis*. It is a zoonotic illness, meaning that the pathogen can be transmitted between humans and animals. *B. anthracis* occurs in soil and primarily leads to illness in grazing animals. The bacterium is endemic (meaning the bacterium is present in animal populations) in Latin America, Asia and Africa, especially in warm regions. *B. anthracis* is also widespread in European countries, although it is detected less frequently than on other continents. In Germany, anthrax infections are occasionally found in ruminant animals.

The German Federal Institute for Risk Assessment (BfR) has compiled questions and answers regarding the potential health risk posed by foods derived from ruminant animals infected with *B. anthracis*.

What is *Bacillus (B.) anthracis*?

B. anthracis belongs to the genus Bacillus. It is a gram-positive and spore-forming rod-shaped bacterium that can grow aerobically (in the presence of oxygen) or anaerobically (in the absence of oxygen). *B. anthracis* occurs in soil and causes illness predominantly in grazing animals. Outside of human or animal tissue the vegetative forms of *B. anthracis* (i.e. live, replication-competent bacteria) lose their virulence (their ability to cause illness) and have low chances of survival. However, when infected animals die, persistent variants of the bacterium, so-called anthrax spores, are formed.

What is anthrax?

The disease resulting from infection with *B. anthracis* is called anthrax. However, infections with other bacteria – like *Bacillus cereus* strains which form anthrax toxins – can also lead to illnesses with comparable symptoms. Such unusual *Bacillus cereus* strains have been found in different animal samples from African countries, one animal sample from China, and very rarely in human samples from the US. *B. anthracis* occurs world-wide as a zoonotic

pathogen, which means that direct transmission of the pathogen from infected animals to humans is possible.

Where is *B. anthracis* found?

B. anthracis is a globally occurring zoonotic pathogen endemic (this means that the bacterium is found in animal populations) in Latin America, Asia and Africa, especially in warm areas. The bacteria also occur in European countries, although they are not as prevalent in Europe as on other continents. Herbivorous farm and wild animals are believed to be the main reservoir of vegetative (reproducing) cells. Anthrax spores (long-lasting, dormant forms of the bacteria) are resistant to environmental stresses and can survive in soil for decades.

What animals are affected?

Herbivorous animals, particularly domestic and wild ruminants, are highly susceptible to illness caused by the anthrax pathogen. Usually, the intake of the pathogen occurs via feed which is contaminated with anthrax spores from soil. In the last three decades, sporadic outbreaks of anthrax have occurred in Germany too, mainly affecting cattle. Carnivorous animals, such as canines and felines, can also become infected by eating (meat from) infected animals.

How do humans become infected with *B. anthracis*?

There are three different types of anthrax in humans. Cutaneous (skin) anthrax is caused by direct contact of the skin with animal materials containing the pathogen, for example skins, organs, coats, wool, bones or bone meal. The pulmonary form (pulmonary anthrax) develops when spores are inhaled in the form of dust or aerosols. Intestinal anthrax has been observed following consumption of highly contaminated meat, offal, or water. Injection anthrax can be caused by the injection of a substance contaminated with anthrax spores. Cases of injection anthrax have in the past been linked to intravenous use of contaminated heroin.

How long is the incubation period in humans?

The incubation period, i.e. the time from the infection to the first symptoms of illness, depends on the way the disease was contracted and on the number of pathogens that entered the body. It usually varies between several hours to several days but may be even longer.

What are the symptoms of an infection with *B. anthracis*?

In all its forms, anthrax can cause severe general symptoms, high fever, drowsiness, and cardiovascular disorders including shock. Cutaneous anthrax can manifest in the form of papules with redness and swelling, followed by fluid-filled blisters which then become scabby necrotic ulcers (“anthrax carbuncles”). The very rare pulmonary type (pulmonary anthrax) is characterised by an unspecific initial stage with fever, headache and pain in the limbs. Within 1 to 3 days, patients then develop severe symptoms which may include sepsis as well as pulmonary and cardiovascular failure.

For intestinal anthrax, there are two distinct disease patterns. The oropharyngeal type (affecting the mouth and throat) starts with a sore throat, difficulty swallowing, and ulcer formation in the mouth or the oesophagus. This is followed by severe disease of lymph

nodes, oedemas and sepsis. The abdominal form is characterised by fever, fatigue and indisposition, later with severe abdominal pain, bloody diarrhoea, and peritonitis in some cases leading to sepsis and cardiovascular failure.

Injection anthrax typically leads to the development of extensive redness, swelling, and massive oedema formation on the skin and soft tissue. In the region of the injection site, affected skin areas can die off (necrotic fasciitis).

Anthrax meningitis can develop from all forms of anthrax. It presents as a rapid worsening of the patient's general state and is accompanied by sudden-onset headache, high fever, muscle pain, shaking, and disorientation.

Can food be contaminated with *B. anthracis*?

When animals from infected herds are slaughtered, *B. anthracis* cells and spores can be transferred to the meat and meat products. Slaugthering of clinically healthy animals transfers only very low quantities of the pathogen. Massive pathogen quantities are only released in the bacteraemic stage, i.e. when the bacteria are spreading through the circulatory system of infected animals. This occurs during the acute or hyperacute stage of the illness (these terms denote a very quick and severe progression and symptoms). In addition, the various steps of meat processing into products can lead to a reduction in the number of pathogens present, for example through heating or acidification. Moreover, based on the current state of knowledge, the quantity of *B. anthracis* required for transmission to humans through food is very high.

In Germany, there have been only occasional reports of anthrax in humans in the last two decades. Reports about anthrax outbreaks among ruminants are also rare. For these reasons, the BfR currently regards the probability of becoming ill with anthrax following consumption of food produced in Germany as very low.

How can *B. anthracis* be killed?

Vegetative forms of *B. anthracis* are easily killed during cooking and by common disinfection methods. Anthrax spores, on the other hand, are highly resistant to heat, dryness, deep freezing and common drinking water chlorination. Additionally, they are extremely resistant to disinfectants. The spores are inactivated only when heated to 100°C for 15 minutes. Strong sunlight over long periods of time can reduce the spore count. Only sporicidal disinfectants are suitable for disinfection. Further information on suitable disinfectants and inactivation methods for anthrax spores can be found in sources including the "Guidelines on means and methods for performing disinfection for certain animal diseases" (*Richtlinie über Mittel und Verfahren für die Durchführung der Desinfektion bei bestimmten Tierseuchen* – in German) of the German Federal Ministry of Agriculture, Food and Regional Identity and the Friedrich Loeffler Institute, the Australian Veterinary Emergency Plan (AUSVETPLAN), the "Technical Factsheets" from Iowa State University, the "Terrestrial Animal Health Code" of the World Organisation for Animal Health, as well as on the website of the Robert Koch Institute.

Under which conditions can *B. anthracis* multiply?

In a nutrient-rich environment such as the blood or lymph fluid of an infected grazing animal, the spores can germinate at 8-45 °C and in a pH range of 5-9. The vegetative form of the bacterium can multiply between 22 and 42°C. Under certain conditions (optimal

temperature,pH levels and minimal accompanying microflora), multiplication in food is also possible.

Which groups of persons are at risk of becoming ill with anthrax?

Persons working in slaughterhouses, who come into contact with animals from herds infected with *B. anthracis,* have an increased risk compared to other persons. However, cases of anthrax infection in humans are very rare in most industrialised nations. Infection via the skin though contact with animals for slaughter or with the coat, meat, blood, bones or other by-products of such animals is conceivable. This form of infection could also occur in persons involved in the processing of meat, since these activities are associated with a higher risk of injury and hence with skin lesions (injured skin). Infections via the respiratory system, for example during processing of contaminated wool or coats in closed rooms, occur even more rarely.

Further information on the BfR website

Foodborne infections – general information
https://www.bfr.bund.de/en/food-safety/assessment-of-microbial-risks-in-foods/food-hygiene/foodborne-infections/

About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the Federal Ministry of Agriculture, Food and Regional Identity (BMLEH) 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.

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