SARS-CoV-2 & others

Hunting the invisible

Professor Dr. Reimar Johne evaluates and carries out research on how viruses that cause disease spread via food. The ways in which coronaviruses can be transmitted are also being investigated.

Reimar Johne takes one of the flasks from the incubator in the laboratory and carefully sways it back and forth. The reddish liquid inside sloshes gently up and down. It is a nutrient solution. "A thin film of human cells infected with hepatitis E viruses is growing at the bottom of the flask," explains the veterinarian. "But the individual cells are invisible to the naked eye and, of course, the viruses even more so." The flask does, in fact, appear to be completely clear.

Johne's task is to make the invisible visible. He specialises in detecting viruses in food. And from those, he looks for unimaginably small pathogens that do not have their own metabolism and always require a host cell in order to replicate. "Detection is difficult because often only a few viruses are found on contaminated food," says Johne, who carries out his research at the Berlin-Marienfelde site of the BfR.

To begin with, a sample is taken from the material that will be tested; frozen strawberries, for example. This is then processed. The berries are shaken in a special buffer solution (this regulates the acidity level, among other things). In the next steps, the viruses are enriched from the liquid and their genetic material is amplified using the PCR method – a kind of quick copier for genetic information. This method makes it possible to detect even a small number of pathogens.

Coronaviruses in fruit and vegetables?

Of course, the novel coronavirus SARS-CoV-2 has had Johne and his team on tenterhooks since the beginning of the year. Many consumers were concerned that the virus could be transmitted via contaminated food, for example, through fruit from particularly affected regions. "However, this is unlikely," says Johne. "There is no scientific evidence to support this."

However, this does not mean that transmission via food is not possible. For example, an infected person could sneeze on an apple, then another person would come into contact with the viruses shortly afterwards by touching it or by eating the apple and then become infected via the mucous membrane of the mouth, nose or eyes. Theoretically possible. But not likely for several reasons.

Like other viruses related to it, SARS-CoV-2 is primarily transmitted via the respiratory tract. It is transmitted via droplets that contain the virus, which mainly pass from those infected to healthy people when they cough or sneeze. It also appears that a smear infection is possible if viruses capable of replication reach the nasal mucous membrane via hands and fingers, for instance by touching door handles, triggering an infection thereafter.

Good hygiene prevents infections

On the other hand, coronaviruses are relatively sensitive (to soap, for example) and do not survive long outside of the host. "Under laboratory conditions, it has been shown that the novel coronavirus remained 'infectious' for two to three days at most after heavy contamination of various surfaces. We assume that the virus inactivation is significantly faster under normal conditions", says Johne. "If you follow basic kitchen hygiene rules and wash fruit and vegetables thoroughly before putting them on the table, then, based on what we currently know, you have nothing to fear".

A research project should contribute to closing gaps in knowledge that still exist. In Johne's laboratory, food chemist Dr. Katja Schilling-Loeffler is investigating whether coronaviruses and other pathogens can be transmitted via drinking glasses after they have been washed by a procedure commonly used in restaurants.

If we wanted to draw up a "profile" for a typical pathogenic virus in food, in some cases it would be almost the opposite of the novel coronavirus. "A pathogen like this must be very tenacious to survive the attack from stomach acid, for example," explains Johne. "And it must be stable in the environment – at least until it has found a host in which it can replicate." Finally – the third characteristic – a few virus units should be sufficient to trigger an infection. This is because pathogens are often found only in small quantities in food.

Diarrhoea: a common consequence

If these characteristics are used as a benchmark, then few viruses remain that can be considered as typical causes of foodborne infections. "We are mainly dealing with noroviruses, rotaviruses and the pathogens that cause hepatitis A and E," says Johne. Noroviruses and rotaviruses cause gastrointestinal illnesses along with diarrhoea and vomiting, while hepatitis viruses cause inflammation of the liver ("jaundice").

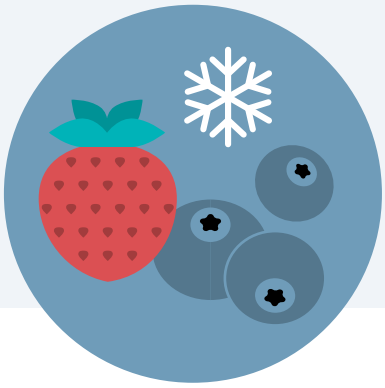
Foodborne infections caused by the tick-borne encephalitis (TBE) virus are significantly less common. It can lead to severe encephalitis and meningitis. The TBE virus is mostly transmitted by tick bites. However, if goats are infected with the pathogen via ticks, it can pass into the milk and, after consuming raw milk products, trigger the disease in humans. "The example shows that viruses that have actually developed other transmission pathways can, in some cases, also use food to spread," explains Johne.

Frozen berries are frequently the cause of disease outbreaks. A typical foodborne viral infection can start as early as the harvest. Berries are usually picked by hand and an infected person can contaminate the fruit with noroviruses or hepatitis A viruses. The pathogens then spread throughout the entire harvest when the berries are washed. Or the viruses get onto the berries as soon as the plants are irrigated if contaminated water is used.

Illness caused by few pathogens

Since few viruses are sufficient to trigger a disease, mass infections can be caused in this way. An example of this is the 2012 norovirus epidemic in Germany that resulted in almost 11,000 children and young people becoming ill. The cause were frozen strawberries from China, which had been processed by a caterer. "Almost every package in the shipment contained the virus," recalls Johne.

The most important measure against these kinds of incidents is good hygiene practice so that the fruit, vegetables or other food do not become contaminated in the first place. Consumers can also be proactive by observing kitchen hygiene rules and, for example, washing fruit

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and vegetables thoroughly. "We also recommend heating frozen berries before consumption," says Johne. "This is because cold doesn't affect viruses – but heat destroys them."

The situation is somewhat different with the hepatitis E virus. It does not contaminate food on the outside; it infects pigs and wild boars. The animals do not become ill, but they carry the virus inside them. If food is produced from these infected animals and not heated sufficiently before consumption, this can trigger disease in humans. The same applies to pork: heat it through properly!

A reference laboratory for good quality

Johne and his team's tasks have again evolved considerably since the end of 2019. The newly created "National Reference Laboratory for Foodborne Viruses" (NRL), headed by Johne, has been established at the BfR (see page 49). The NRL is the link between the equivalent EU reference laboratory in Uppsala (Sweden) and the German federal states (Laender)'s testing laboratories. It aims to make food safe from viruses and reduce infections as far as possible. Its areas of activity include quality assurance of food monitoring authorities with inter-laboratory comparisons ("ring trials"), detecting viruses in food and developing better detection methods.

This also explains the research on hepatitis E viruses in the human cell culture mentioned earlier on. Because until now, it has been very difficult or impossible to replicate this pathogen in cells. However, "virus cultivation" like this would help us to better understand the virus and maybe even make it easier to detect in food. Reimar Johne's sceptical look at the flask from the incubator reveals that he has not yet quite reached his goal. ◘

"There is no scientific evidence to support the transmission of the novel coronavirus via fruit and vegetables.

More information:

Johne, R., E. Trojnar. 2020. The establishment of a new National Reference Laboratory for Foodborne Viruses. Rundschau für Fleischhygiene und Lebensmittelüberwachung 4: 130–132. [Article in German]

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