Corona – Must We Fear Transmission from Livestock to Humans?

SARS-CoV-2 is causing one of the worst global challenges in the 21st century right now. The virus is a member of the family of coronaviridae and belongs to the RNA-viruses. It is assumed that the virus was transmitted by wild animals on a wet market in China. If the virus came from wild animals, is it possible that it can also be transmitted to our farm animals and vice versa? There is considerable confusion in the market. In India, e.g., sales of poultry meat broke down by 80% since January, due to rumors that one could catch the virus from eating chicken.

Corona – nothing new in agriculture!

For people working in the agricultural sector, coronaviruses are not unknown. Cattle producers often fight against diarrhea in newborn calves and against winter dysentery in young adult cattle. Pig farmers know Porcine Epidemic Diarrhoea (PED) and Transmissible Gastroenteritis (TGE) very well. Poultry farmers vaccinate their animals against infectious bronchitis (IB). Are these diseases all caused by the same viruses? No! Different members of the coronavirus family are responsible.

Most of the coronaviruses are species – and tissue – specific

To infect animals or humans, the spike-proteins forming the crown – the "corona" – of the coronavirus must bind to receptor molecules on the target cells of the host's tissues. The binding is highly specific, just like a lock and its specific key go together, or how an antibody binds to a particular pathogen. SARS-CoV-2, for example, needs a particular cell membrane protein (angiotensin-converting enzyme 2 – ACE2) to enter human cells; TGE viruses, on the other hand, depend on the porcine aminopeptidase N (ANPEP). The cells of pigs have other receptor molecules than the cells of poultry. The cells of the gastrointestinal tract are different from the cells of the respiratory tract (Russ, 2020).

Table: examples for the different coronaviruses in livestock and humans (adapted from Ackermann, 2016)

Virus	Disease	Species	Genus*
TGEV PEDV FCoV-I	Transmissible gastroenteritis Porcine epidemic diarrhea Feline infectious peritonitis (FIP)	Pigs Pigs Cats	α
BCoV HEV MERS-CoV SARS-CoV SARS-CoV-2	Diarrhea in newborn calves; winter dysentery Vomiting and wasting disease Middle East respiratory syndrome Severe acute respiratory syndrome COVID-19	Cattle Pigs Humans Humans Humans	β
IBV TCV	Infectious bronchitis Blue comb disease	Poultry Poultry	γ
PDCoV	Porcine delta coronavirus	Pigs	δ

*for the allocation to the genus, one crucial factor is the viral protein nsp 1.

Corona in Pigs

For pigs, five coronaviruses are relevant. The porcine epizootic diarrhea virus (PEDV) and the transmissible gastroenteritis virus (TGEV) belong to the α genus. They show a high affinity to the epithelial cells of the gastrointestinal tract. The porcine respiratory coronavirus (PRCV) is also a representative of the α genus, but does not show any affinity to the gastrointestinal epithelial cells. It causes respiratory diseases. The other viruses are the hemagglutinating encephalomyelitis virus responsible for the vomiting and wasting disease and belonging to the β-genus, and the porcine delta coronavirus (PDCoV), causing diarrhea (Stiebnitz, 2017).

Corona in Poultry

Infectious bronchitis caused by a coronavirus belonging to the γ genus is one of the major economically critical respiratory diseases in poultry. As it also affects the kidney and the reproductive tract, the consequences are kidney damage, decreased egg production, and bad egg quality. A further significant problem of IB in poultry is the rapid spread. Within 48 hours, a whole flock can be infected and remains a virus reservoir, even after recovery. Usually, the infection is horizontal, from hen to hen, not from hen to the chick. However, infection via contaminated eggs shell in the hatcheries is also possible (MacLachlan and Dubovi, 2016).

Corona in cattle

The symptoms associated with bovine coronaviruses are calf diarrhea, winter dysentery (hemorrhagic diarrhea) in adult cattle, and respiratory infections in animals of various ages (MacLachlan and Dubovi, 2016). The bovine coronavirus belongs to the ß genus. The bovine coronavirus is not as host-specific as

many other coronaviruses. It can infect dogs, turkeys, and other wild ruminants such as waterbucks, giraffes, or white-tailed deers.

Can SARS-CoV-2 also be exchanged between humans and livestock?

SARS-CoV-2, like the MERS-CoV (Middle East Respiratory Syndrome) and the SARS-CoV (2002/03), belongs to the ß genus of coronaviruses. All three can infect animals and humans, which can be seen from the way they spread: SARS-CoV originated from bats, MERS-CoV was transmitted by camels, and for SARS-CoV-2, bats (Zhou et al., 2020) but also pangolins (Zhang, 2020) are assumed to be the source. But not livestock animals.

There is one known case of a SARS-CoV infected pig, which was discovered in China in the context of research on the SARS epidemy in 2002 (Chen, 2005). Scientists from the Chinese Academy of Sciences in Beijing examined six animal species living in close contact with humans and found this one pig infected by SARS-CoV of human origin. As the only person having contact with the pig was tested negative for the coronavirus several times, it was concluded that the infection likely came from virus-contaminated feed. The pigs in rural areas in China are often fed the leftovers from restaurants.

For now: keep calm

Today, there is no scientific indication that livestock can contract SARS-CoV-2 from humans or vice versa. In Germany, the Friedrich Löffler Institute (2020), a leading research institute on epizootic diseases, is conducting extensive studies at the moment to better understand the sensitivity of animals towards SARS-CoV-2. Reliable results are expected earliest at the end of April. Until then, let's keep calm, and behave responsibly to weather these unsettling times.

By Inge Heinzl, Editor EW Nutrition

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