

SARS-CoV-2 infection in farmed fur animals

Dear Editor,

We have some comments prompted by the recently published paper in *Transboundary and Emerging Diseases* titled "SARS-CoV-2 infection in cats and dogs in infected mink farms" by van Aart et al. (2021).

SARS-CoV-2 has brought unprecedented challenges to public health. Besides humans, other mammals including cats, dogs, lions, tigers and mink have been reported to be susceptible hosts for SARS-CoV-2 (Li, 2020). Among these species, massive outbreaks with apparent clinical signs and high mortality were reported in mink in the Netherlands, Denmark, Italy, Spain, Sweden, the United States, Greece, France, Canada, Lithuania and Poland (Pomorska-Mol et al., 2021). This raises a huge public concern about the transmission of mink-derived SARS-CoV-2 variants to humans and other animals. Most recently, a research group reported evidence of transmission of SARS-CoV-2 on mink farms between humans and mink and back to humans (Oude Munnink et al., 2021). The same research group provided evidence of mink-to-cat transmission without involvement of humans (van Aart et al., 2021). Besides farmed mink, two cases of wild mink infected with SARS-CoV-2 without any clinical signs were reported in Spain and the United States (Aguilo-Gisbert et al., 2021). Therefore, mink may act as an important SARS-CoV-2 animal reservoir for transmission to humans and other susceptible animals.

Transmission of SARS-CoV-2 from infected farmed mink to humans has been confirmed by different research groups. Bas B. Oude Munnink reported that the viral sequence of a SARS-CoV-2 from an infected mink farm worker clustered within mink-derived SARS-CoV-2 sequences with only a seven-nucleotide difference (Oude Munnink et al., 2021). Qiang Wang analyzed 761 mink-derived SARS-CoV-2 genomes and identified that 18 patients were infected with mink-derived SARS-CoV-2 variants with some typical mutations (Wang et al., 2021). Although the mink-derived SARS-CoV-2 adapted to mink are less lethal and infective compared to those in humans (Konishi, 2021), it is imperative to monitor closely this mink-derived SARS-CoV-2 in the event of potential large-scale transmission in human populations.

Some European countries – including Denmark, the Netherlands and Poland – are large mink producers. Since the first report of confirmed cases of SARS-CoV-2 in mink in the United States, hundreds of mink farms in European countries have been infected with SARS-CoV-2 (Pomorska-Mol et al., 2021). To prevent the spread of SARS-CoV-2 among the mink population and between mink and humans, several European countries (including Denmark, Ireland and Spain) have culled all mink to prevent human infection. Other countries such as Greece, France and Lithuania have culled all infected mink in SARS-CoV-2-positive mink farms. In Asia, China is the main mink fur producer with

TABLE 1 Numbers of fur animals for SARS-CoV-2 serological survey

Province	City	Mink	Fox	Raccoon dog
Shandong	Weihai	286	27	200
	Yantai	–	296	–
Hebei	Qinhuangdao	4	112	215
Henan	Luoyang	273	65	182

annual production more than 20 million mink in around 8000 farms (Fenollar et al., 2021). Most mink farms are located in Northern coastal provinces such as Shandong, Hebei and Henan. We previously performed a serological survey on 91 mink during the SARS-CoV-2 pandemic from November 2019 to March 2020 and found negative results (Deng et al., 2020). To further explore if the mink and other fur animals in above main fur animal-producing provinces were infected with SARS-CoV-2, 1660 serum samples from 563 mink (collected between June 2018 and July 2020), and 500 foxes and 597 racoon dogs (collected between December 2020 and January 2021) were examined (Table 1). The results showed that no SARS-CoV-2-specific antibodies were detected in these serum samples.

As mentioned above, several cases of transmission from humans to cats, dogs and mink have been reported. The reverse-transmission from animals to humans have been only reported and confirmed for mink. The highly efficient transmission from mink to humans and other animals could be explained by the high density of SARS-CoV-2-infected mink with high viral load, which does not happen in the case of domestic species such as cats and dogs.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data are available from the corresponding authors upon reasonable request.

Junhua Deng^{1, #}

Ningning Huo^{2, #}

Yalei Chen²
 Hongchao Wu²
 Jingjing Bai¹
 Xiangdong Li³ 
 Yuxiu Liu²
 Kegong Tian² 

¹ Luoyang Putai Biotechnology Co., Ltd, Luoyang, China

² National Research Center for Veterinary Medicine, Luoyang, China

³ Jiangsu Co-innovation Center for Prevention and Control of Important Animal Infectious Diseases and Zoonoses, College of Veterinary Medicine, Yangzhou University, Yangzhou, China

Correspondence

Kegong Tian and Yuxiu Liu, National Research Center for Veterinary Medicine, Luoyang, China.

Email: tiankg@263.net; qingqingyuxiu1@163.com

Xiangdong Li, Jiangsu Co-innovation Center for Prevention and Control of Important Animal Infectious Diseases and Zoonoses, College of Veterinary Medicine, Yangzhou University, Yangzhou, China.

Email: xiaonanzhong@163.com

Junhua Deng and Ningning Huo contributed equally to this work.

ORCID

Xiangdong Li  <https://orcid.org/0000-0002-4635-1602>

Kegong Tian  <https://orcid.org/0000-0001-5362-1415>

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