Stability of Middle East Respiratory Syndrome Coronavirus in Milk

To the Editor: Middle East respiratory syndrome coronavirus (MERS-CoV) was first diagnosed in humans in 2012. Human-to-human transmission of MERS-CoV has been limited, and the transmission route is still unclear. On the basis of epidemiologic studies, involvement of an animal host has been suggested (1). Dromedary camels have been identified as a possible intermediate host on the basis of MERS-CoV antibodies and detection of MERS-CoV viral RNA in respiratory swab samples (1–3). Furthermore, MERS-CoV genome sequences obtained from dromedary camels clustered with MERS-CoV sequences obtained from humans linked to the same farm (2). Nonetheless, most persons with MERS-CoV did not report any direct contact with dromedary camels; therefore, how MERS-CoV zoonotic transmission occurs is unclear. MERS-CoV replicates in cell lines originating from a wide variety of different hosts, which suggests the potential for a broader reservoir species range than currently recognized (4). However, unlike in dromedary camels, no serologic evidence pointing toward MERS-CoV infection has been found in goats, sheep, and cows (1).

Contamination of dairy products has been associated with transmission of bacteria and viruses. Shedding of infectious tick-borne encephalitis virus in milk was detected after experimental infection of goats, and the consumption of raw milk has been associated with tick-borne encephalitis virus clusters (5). Similarly, cattle can be infected with foot-and-mouth disease through consumption of raw contaminated milk (6).

Here, we investigate the stability of MERS-CoV in dromedary camel milk, goat milk, and cow milk at different temperatures. MERS-CoV strain Jordan-N3/2012 was diluted in unpasteurized milk or non supplemented Dulbecco modified Eagle medium (DMEM, GIBCO, Grand Island, NY, USA) to a final median 50% tissue culture infectious dose of 10^5.5/mL. We placed 1-mL aliquots in screw-cap tubes (Sarstedt, Nümbrecht, Germany) at either 4°C or 22°C and stored them at –80°C at 0, 8, 24, 48, and 72 hours post dilution (hpd) in quintuplicate. Infectious virus titers were determined by endpoint titration on Vero E6 cells in triplicate (7). When MERS-CoV was stored at 4°C, the geometric mean of infectious virus titers decreased over 72 hours; we found they decreased 37% (95% CI 0%–62%) in dromedary camel milk, 64% (95% CI 26%–82%) in goat milk, 56% (95% CI 0%–92%) in cow milk, and 80% (95% CI 70%–86%) in DMEM. At 0–72 hpd, virus titers decreased significantly only in goat milk (p = 0.0139, 1-tailed paired t test) and DMEM (p = 0.0311) but not in dromedary camel milk (p = 0.1414) or cow milk (p = 0.2895). Samples stored at 22°C showed a greater loss of infectivity than did samples stored at 4°C. Infectious virus titers decreased to <15% when samples were stored at 22°C for 48 hours (loss of 88% [95% CI 67%–96%] for dromedary camel milk, 99% [95% CI 98.6%–99.8%] for goat milk, 98% [95% CI 95%–99%] for cow milk, and 97% [95% CI 87%–99%] for DMEM). This decrease was significant by student 1-tailed paired t test analysis comparing t = 0 and t = 48 hpd (p<0.05). However, despite the reduction in virus titer, viable virus could still be recovered after 48 hours. Pasteurization of raw milk can prevent foodborne disease outbreaks caused by a variety of pathogens. We heat-treated dromedary camel, cow, goat milk, and DMEM samples for 30 min at 63°C, after which no infectious virus could be recovered (Figure).

CoV survival has been studied in phosphate-buffered saline and minimal essential media and, like MERS-CoV,
The global emergence of carbapenemase-producing organisms is a public health emergency because these enzymes confer resistance to nearly all β-lactam drugs and are often associated with multidrug or pandrug resistance (1). Alarming reports of carbapenemase-producing organisms from environmental and animal sources, including food animals, are increasing (1). Recently, clinical isolates of *Salmonella enterica* serotype Caribbean and inactivation of SARS coronavirus. J Hospital Infect. 2000;46:55–60. http://dx.doi.org/10.1053/jhin.2000.0795
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**Carbapenemase-producing Organism in Food, 2014**

To the Editor: Carbapenem antimicrobial drugs are the line of defense against multidrug-resistant gram-negative bacterial infections. The global emergence of carbapenemase-producing organisms is a public health emergency because these enzymes confer resistance to nearly all β-lactam drugs and are often associated with multidrug or pandrug resistance (1). Alarming reports of carbapenemase-producing organisms from environmental and animal sources, including food animals, are increasing (1). Recently, clinical isolates of *Salmonella enterica* serotype Kentucky that produce VIM-2 and OXA-48 were reportedly isolated from patients in China with a travel history to Africa and the Middle East, suggesting foodborne transmission of carbapenemase producers (2).