Inactivation of feline calicivirus using copper compound nanoparticles

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Our research group has proposed copper iodide (CuI) nanoparticles-doped polymers toward the development of antimicrobial polymer textile. The CuI nanoparticles in the textile contribute to higher antimicrobial activity against an adhesive bacterium, *Vibrio alginolyticus*, and long-term prevention of biofouling in marine environments. However, the toxic effects of CuI nanoparticles to microorganisms are still unknown. In this study, the antiviral properties of CuI nanoparticles were investigated using non-enveloped virus, feline calicivirus (FCV), which was used as a surrogate for human norovirus. The effect of CuI nanoparticles and copper ions on FCV infectivity to Crandell-Rees feline kidney (CRFK) cells was elucidated to better understand the mechanism of antiviral activity of the copper compounds.

The effect of copper compounds on the FCV infectivity to CRFK cells is shown in Figure. The infectivity of FCV to CRFK cells was significantly reduced when FCV was subjected to more than 100 μg/ml of CuI nanoparticles for 1 h. FCV infectivity titer was reduced by seven orders of magnitude from approximately 1.3 x 10⁸ plaque forming units (pfu)/ml when 1000 μg/ml of CuI nanoparticles was exposed. On the other hand, 5.25 mM of CuCl₂ solution (equimolar amount of 1000 μg/ml of Cu nanoparticles) reduced FCV infectivity about four orders of magnitude. Unexpectedly, an obvious decrease of FCV infectivity, approximately four orders of magnitude, was confirmed by using the supernatant after removing CuI nanoparticles. Inductively coupled plasma (ICP) emission analysis revealed the release of copper ions from Cu nanoparticles in aqueous solutions. These results suggest that released copper ions may contribute to higher antiviral activity against FCV.

Fig. Inactivation of FCV after exposure for 60 min with various concentrations of CuI nanoparticles suspension and CuCl₂ solution. The concentration of CuCl₂ solution was prepared to fit Cu concentration of CuI nanoparticles suspension (52.5 nM – 5.25 mM).