Antimicrobial copper as an effective and practical deterrent to surface transmission of SARS-CoV-2

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Abstract.

The aerosols are critical for SARS-CoV-2 transmission, however in areas with high confluence of people the contaminated surfaces take an important role that we could attack using antimicrobial surfaces including copper. In this study, we wanted to challenge infectious SARS-CoV-2 with two samples of copper surfaces and one plastic surface as control at different direct times contact. To evaluate and quantify virucidal activity of copper against SARS-CoV-2, two methods of experimental infection were performed, $TCID_{50}$ and plaque assays on VeroE6 cells, showing significant inactivation of high titer of SARS-CoV-2 within minutes reaching 99.9 % of inactivation of infectivity on both copper surfaces. Daily high demand surfaces contamination is an issue that we have to worry about not only during the actual pandemic time but also for future, where copper or its alloys will have a pivotal role.

Keywords: SARS-CoV-2, Copper, virucidal activity

Importance: Quantitative data obtained of TCID50 and plaque assay with infectious SARS-CoV-2 virus showed that after direct contact with copper or copper alloys, viruses were inactivated within minutes. Notably, the SARS-CoV-2 virus used in these assays was in high titer (106 PFU/mL) showing strong copper inactivation of the infectious SARS-CoV-2.

Introduction. The world has been ravaged by Covid-19, with devastating impact on life and economy[1,2]. Significant progress in knowledge and treatment have been made at a break-neck pace, but much work remains to be done in containment and prevention of current and future pandemics. One area of need is the lack of an effective and long-term method for reducing surface transmission of diseases. Antimicrobial detergents effectively kill bacteria and virus quickly, but lack longevity. Industrial nanoparticle coating is expensive and requires disassembly and reassembly of existing fixtures[3]. Spray-on nanoparticle solutions require drying time and though nominally longer-lasting than Lysol, is still not permanent[4].

Antimicrobial copper has received resurgent attention as a potential solution[5,6]. It received approval by EPA as antimicrobial in 2008[7], and anti-Covid in February of 2021[8]. With copper being a safe, natural, and ubiquitous compound, it would seem the perfect panacea, however the time to killing of coronavirus is a potential concern. The National Institute of Allergy and Infectious Diseases (NIAID) published data of copper's superiority in killing coronavirus to plastic and stainless steel surfaces, which essentially had no impact in April of 2020[9]. However, the reported 4 hours required for complete eradication by copper is at odds with other studies on human coronavirus and bacteria, which report significant inactivation on the order of minutes[10-13]. Copper's mechanism of killing involves electron and oxygen free radicals[7] causing breakdown of membranes and disintegration of genetic material, thus theoretically work better against simple organisms like virus. If plenty of published reports support copper's killing time of numerous bacteria in minutes[14-16], it stands to reason that it would work at least as quickly against viruses. At least one article published subsequent to NIAID study has validated copper's ability to deactivate SARS-CoV-2 within minutes.[17] This article by Dr. Keevil also explained the difference in methodology that led to the much longer kill time in the previous paper by NIAID.

The present study seeks to quantify copper's speed of action against SARS-CoV-2 and shed some light on the practical use of copper as a means to reduce surface transmission. An antiviral activity study comparing 2 different samples of 99.9% copper against plastic surfaces, based on ISO 21702-2019 standard of "Measurement of Antiviral Activity on Plastics and Other Non-porous Surfaces" was performed.