Efficacy of Commercially Available Antimicrobial Copper Surfaces Against Common Nosocomial Pathogens

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Background

The demand for novel approaches for prevention of hospital-associated infections (HAIs) has recently focused on intrinsically antimicrobial surfaces such as copper. We assessed the bactericidal activity for common nosocomial pathogens of various copper surfaces over time in comparison to stainless steel.

Methods

Methicillin-susceptible *Staphylococcus aureus* (MSSA, ATCC 29213) and clinical isolates of vancomycin-resistant *Enterococcus faecium* (VRE) and *Acinetobacter baumannii* were evaluated.

Products tested included:

Products by CuVerro -
- 80% copper (Cu)/20% nickel (Ni) alloy
- 90% Cu/10% Ni alloy

Antimicrobial copper products from LuminOre Inc. –
- Cu Pebbled and Smooth texture (55% Cu/45% Inactive Resin)
- Ni Pebbled and Smooth texture (64% Cu/11% Ni/25% other ingredients)

EOS protective surface from Cupron -
- 16% cuprous oxide/84% other ingredients

Additional products tested -
- 100% Cu
- Polystyrene plus colloidal copper
- Steel plus colloidal copper
- Stainless steel was the negative control

Organisms grown on sheep blood agar (BAP) were suspended in saline and standardized to a density approximating 1.5 x 10^8 CFU/mL. A 10 µL aliquot was applied to 4 separate cleaned and sterilized coupons (sample pieces of each product, measuring 1 cm^2), which were incubated at room temperature for either 0, 30, 60 or 120 minutes. After incubation, the coupon was placed in 1 mL D/E buffer containing glass beads and vortexed. An aliquot was removed, serially diluted and plated onto BAPs in duplicate to determine surviving CFU per coupon. At least 4 replicates of each coupon were tested.

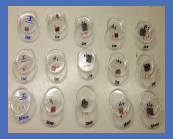


Fig. 1

Fig. 2

Figures 1 and 2. Various copper surfaces inoculated and incubated at room temperature. I) Stainless steel sample (negative control); H) LuminOre Copper Touch pebbled texture sample; N) EOS Cupron sample. 10 µL aliquot applied to 4 separate cleaned and sterilized coupons (one for 0, 30, 60, and 120 minute incubation).

Fig. 3

Fig. 4

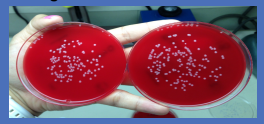


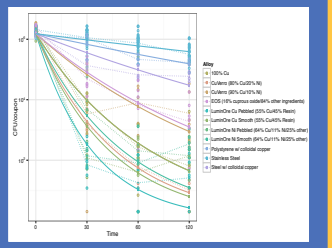
Fig. 5

Figures 3-5. Coupon placed in 1 mL D/E buffer containing 5 glass beads and vortexed. 100 µL aliquot plated to BAP. Lastly, colony forming units are counted after overnight incubation.

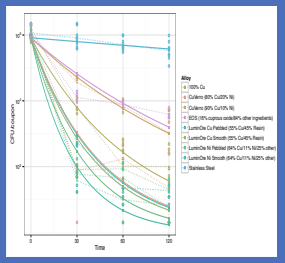
Discussion

Ranking of products was performed by fitting exponential decay models to the CFU/coupon and ranking kill rates. Statistical differences between kill rates were determined by two-tailed z-tests on kill rates.

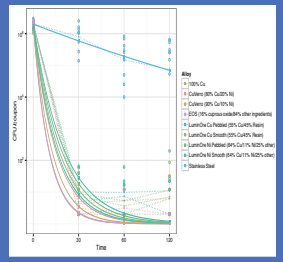
MSSA CFUs/Coupon vs. Time



VRE CFUs/Coupon vs. Time



Acinetobacter CFUs/Coupon vs. Time



Results

For all three organisms, all copper surfaces demonstrated statistically significant enhanced killing compared with stainless steel, although there were differences between organisms and surfaces.

For MSSA, LuminOre copper-colored pebbled surface killed best (p=0.035 compared with next highest ranked sample); for VRE, LuminOre Nickel-colored smooth (p=0.01).

For *Acinetobacter*, all copper materials were comparable (p=0.006 compared with stainless steel).

An increased copper concentration did not seem to impact the kill curves.

Conclusion

All copper products demonstrated significantly enhanced killing compared with stainless steel, with two LuminOre products showing greatest efficacy for MSSA and VRE. While all the tested commercially available copper surfaces had antimicrobial activity, there was substantial variation between organisms and surface types. These findings have fundamental implications for the design of studies of antimicrobial surfaces.

Acknowledgements

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