

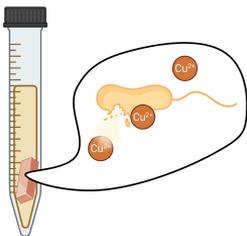
Cu Later: Balancing Copper Ion Release and Antibacterial Performance of Copper Alloys Against *Escherichia coli* K-12

Problem:

- Copper is widely used for antimicrobial surfaces, but how **alloy composition affects antibacterial efficacy** and **copper ion leaching is poorly quantified**.

Purpose:

- Excess copper leaching may pose **environmental and toxicity** concerns, creating a need to balance efficacy and safety.
- Find an **optimal antibacterial window**



Question:

- ↑ Copper % = ↑ bacterial inhibition?
- Bacterial presence **influence** Cu^{+2} over time?

Hypothesis:

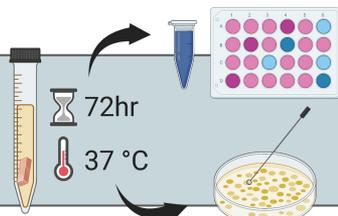
- If the copper content of a **metal alloy increases**, then **antibacterial activity against *E. coli* K-12 will increase** due to enhanced Cu^{+2} ion release. However, **brass** will achieve substantial antibacterial effects while releasing lower concentrations of copper ions than **pure copper**.

Methods:

-*E. coli* exposed to metals {Cu, brass, bronze, Zn, controls: no metal (biological), no *E. coli* (chemical)}

-Antibacterial activity measured via:

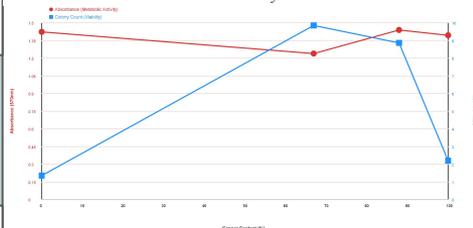
- CFU/mL** (log-scaled)
- Resazurin metabolic assay** (72 h)



-Copper ion leaching quantified (Cu^{+2} analysis)
-Triplicate trials with replicable results

Results & Analysis:

Optimal Antibacterial Window: Cu Content vs. Activity vs. Viability



- Pure copper and zinc showed the **lowest CFU counts** ($p < 0.05$)
- Brass** and **bronze** exhibited strong antibacterial activity **despite lower Cu^{+2} release**
- Antibacterial efficacy **did not scale linearly** with ion concentration

- Results suggest **optimized copper alloys (brass + bronze)** can reduce bacterial contamination while **limiting** excessive metal leaching, informing safer material design