Analysis of the Role of Iron Uptake Mechanisms and Addition of Iron-Doped Apatite Nanoparticles in Phage Infection in *Staphylococcus aureus* and *Mycobacterium smegmatis*

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**Background**
- Antibiotic-resistant bacteria have developed into a global health crisis.
- Phages, viruses that infect bacteria, could serve as an alternative to antibiotics, and have many benefits (Loc-Carrillo & Abedon, 2011).
- Iron-doped apatite nanoparticles (IDANPs), developed at MT Tech, increase phage infections (Gregory, 2017).
- The mechanism is unknown, but could involve the iron uptake mechanism of bacteria (Bonnain, Breitbart & Buck, 2016).

**Research Questions**
- Does the iron uptake mechanism of *Staphylococcus aureus* play a role in phage infection?
- Do IDANPs affect plaque size in *Staphylococcus aureus* and *Mycobacterium smegmatis*?
- What effect do iron treatments and IDANPs have on phage infection?
- How do increases in iron concentration and IDANPs affect cell growth?

**Iron treatments in *S. aureus***
- *Staphylococcus aureus* was grown in M9 minimal media, treated with various iron treatments and infected with JB phage.
- Plaque infection increased with high concentrations of iron.
- Fewer are bound to siderophores in high iron treatments, leaving them available to phages.
- IDANPs increase plaque count and plaque size.
- IDANPs increase phage infection and plaque size in these two prokaryotic biological systems.

**Plaque Size with IDANPs in *S. aureus***
- *Staphylococcus aureus* was grown in M9 minimal media, treated with IDANPs, and infected with JB phage.
- Plaque sizes were larger when cells were treated with IDANP.
- Plaque size 15% larger - 24 h in IDANPs vs. control; p < 0.001
- 5.8% larger - 48 h in IDANP; p < 0.001
- 39.0% larger - 96 h in control; p < 0.001

**Plaque Size with IDANPs in *M. smegmatis***
- *Mycobacterium smegmatis* was grown in luria broth, treated with IDANPs and infected with Yodasoda.
- Plaque sizes were larger when cells were treated with IDANPs.
- Plaque size 26% larger - 24 h in IDANPs vs. control; p < 0.0001
- 32.4% larger - 48 h in IDANP; p < 0.001
- 64% larger - 96 h in control; p < 0.001

**S. aureus Growth in Iron and IDANPs**
- *Staphylococcus aureus* was grown in M9 minimal media, treated with iron and IDANPs, and infected with JB Phage.
- Plaque counts were 65% higher in iron treatments than IDANPs alone.

**SEM of *S. aureus***
- SEM showed cellul morpohologies were different.
- IDANPs increase phage infection and plaque size in these two prokaryotic biological systems.

**Discussion and Conclusion**
- Plaque counts increase with iron concentrations.
- IDANPs increase phage infections.
- Fewer are bound to siderophores in high iron treatments, leaving them available to phages.
- IDANPs increase plaque count and plaque size.
- IDANPs increase phage infection and plaque size in these two prokaryotic biological systems.
- SEM showed cellul morphologies were different.
- IDANPs increase phage infection and plaque size in these two prokaryotic biological systems.
- The cell’s iron uptake mechanism is involved in phage infection.

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**References**