

Limit of Detection of the Odinwell Optical Sensor in Clinically Relevant Wound Bacteria

Background

Early detection of bacterial activity in wounds is essential for preventing infection-related complications, yet conventional diagnostic methods typically identify infection only after bacterial loads become clinically significant [1]. Odinwell's optical sensor is designed to capture bacterial autofluorescence signals directly within wound-like environments, potentially enabling earlier identification of bacterial proliferation than current clinical benchmarks. The objective of this study was to determine the sensor's limit of detection for porphyrin-producing bacteria typically found in chronic wounds, thereby assessing its sensitivity and evaluating its potential role in advancing early infection monitoring.

Materials & Methods

Bacterial colonies of *E. coli* and *S. aureus* were inoculated into Lysogeny broth and Tryptose Phosphate broth respectively, and both were supplemented with 1 mM 5-aminolevulinic acid and incubated at 37°C for 24 hours under shaking conditions. Serial dilutions of each culture were prepared in Phosphate Buffered Saline, and aliquots were applied onto 4 cm² filter papers in triplicates. Fluorescence measurements were obtained using the Odinwell sensor. For each dilution series, colony-forming unit (CFU) counts were determined by plating on LB agar. CFU/cm² values were calculated based on the quantified colonies and the corresponding filter paper area. Each dilution was compared with the bacteria-free negative control using a one-tailed Mann-Whitney U test, starting from the highest concentration and proceeding stepwise to lower concentrations. The smallest dilution showing a statistically significant increase in fluorescence was identified, and p-values were Bonferroni-corrected for multiple comparisons.

Results

For both *S. aureus* and *E. coli*, fluorescence was detectable down to approximately 10³ CFU/cm², which therefore represents the lower limit of detection for the sensor across the tested species. As shown in Figure 1, the sensor response increased in intensity with increasing bacterial surface concentration. The lowest detectable concentration significantly higher than the bacteria-free negative control was 1400 CFU/cm² ($P_{\text{Bonf}} < 0.0001$).

Discussion

The Odinwell sensor successfully detected porphyrin in tested bacterial species, achieving a detection limit of approximately 10³ CFU/cm².

As the measurements in this experiment were obtained through surface-level detection, it is appropriate to compare them to the Levine technique, which has a diagnostic infection cutoff of 10⁵ CFU/cm² [2-3]. Swab-based method remains the most clinically used technique for quantifying bacterial burden in wounds, due to its cost-effectiveness compared to tissue biopsy [4]; however, they still require skilled personnel, financial and logistical resources, and results are obtained only after 24-72 hours. In contrast, the Odinwell sensor provides instantaneous results without swabbing or sample handling required.

Conclusion

These results indicate that the Odinwell sensor can detect bacterial loads even earlier than the established clinical infection threshold, offering a sensitive, instantaneous, and non-invasive approach for early surface-level detection. This capability suggests strong potential for the sensor to complement existing diagnostic methods and support earlier clinical decision-making in wound management.

References

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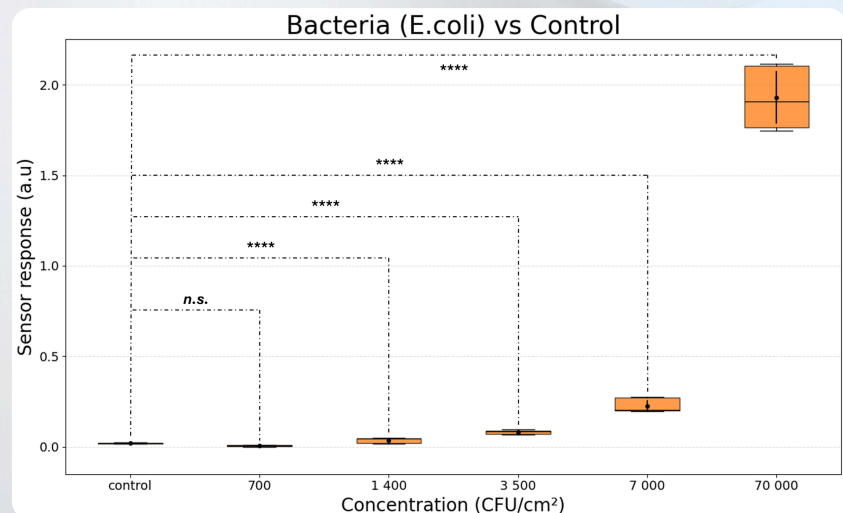


Figure 1. A representative graph of sensor response versus bacterial surface concentration in CFU/cm² for *E. Coli*.