Surveying the Relationship Between Phenotypes and Biofilm Formation in *Pseudomonas aeruginosa*

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Abstract—Bacterial biofilms can impede the effects of antibiotics in destroying a colony. The bacterial biofilm is composed of highly organized layers of cells that operate in a manner comparable to a single unit, whilst surrounded by a mucoid polymer lining. This research consisted of surveying 243 wild Pseudomonas aeruginosa isolates and their growth patterns related to biofilm formation on six different types of media. The data for each colony was cross-referenced to its strain's source to infer how the cells act in different environments. This can further corroborate a previous understanding of biofilms as well as define clear implications for future research into infection specific patterns.

I. BACKGROUND

Antimicrobial resistance is a major problem in the modern world. Despite the advent of novel drugs like penicillin, bacterial resistance rises due to these drugs' inhibitory effect on the construction of the cell wall. Instead of constantly manufacturing drugs that impose a strong selection for resistance, it is imperative to understand the fundamental bacterial mechanisms that actually inhibit the effects of antibiotics.

One of these mechanisms is the formation of biofilms. Biofilms allow bacteria to perform actions as a single unit. As a unit, bacteria are provided with a mechanical barrier from external threats such as antibiotics or macrophages [2]. Biofilms also allow a colony to transfer nutrients with ease, perpetuating a greater overall strength of the colony. High levels of organization and cell density allow bacteria to communicate and thereby adapt to their surroundings efficiently. This communication is known as quorum sensing (QS). QS is done through autoinducers, or transfer signal molecules, which range from enzymes to virulence factors. Pyocyanin, for example, can act as a QS signal which not only allows for a more coordinated colony but also extreme sickness in the host.

In this research, bacterial growth was cross-referenced to the original source to research the influence of environmental factors on biofilm formation.

II. METHODS

Bacterial growth patterns were monitored on six types of media. However, only the media that provided information on bacterial motility was analyzed in the interest of biofilms. The plate relevant to biofilms was created by mixing 42.5g of agar and 35g of LB broth into 1 L of water to create a solution known as swimming media. The media was poured into 128 x 98 mm OmniTray Single-Well plates. To plate the bacteria, 10 µL of freezer stock was mixed with 500 µL of LB broth. These colonies then grew in a shaking incubator overnight. 4 µL of the overnight culture were then transferred to 200 µL of minimal media. A pin tool replicator was used to transfer the 243 strains onto their respective media plates. The bacteria were then incubated at 37 ◎ for 4 days and photographed daily. Data regarding the extent of bacterial growth was documented using ImageJ analysis software. The software allowed for the measurement of bacteria radius which was later calculated to area.

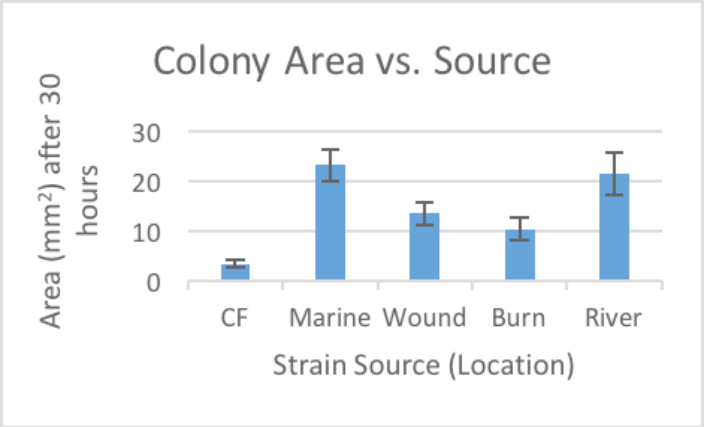

Figure 1. Bacterial growth plot. This graph plots the mean area of P. aeruginosa from varying sources with SEM error bars.

III. RESULTS

These five locations were chosen to represent the differences between environmental and clinical strain growth. Notable patterns in this data come from the comparison of these two environments. Compared to marine strains, those from cystic fibrosis isolates had 19.756 mm2 less average area. This statistic helps to prove that biofilms are formed during infection and are composed of a closely bound group cells [1]. It would thus be expected that bacteria in a biofilm would have less motility and dispersion than those from the ocean. Even more impactful is the result that burn and wound isolates do not form as thick biofilms as those from a CF patient as demonstrated by their greater motility. This result reveals that biofilms can be infection specific, and may not be a staple of all illnesses. Future research into this inference can serve as valuable tool in the efficacy of treatment as more infection specific antibiotics can be administered to patients. [1]. Overall, this research will aid in the future study of the relationship between antibiotics and biofilms, which is imperative to combatting rapidly growing resistance.

IV. ACKNOWLEDGEMENTS

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V. REFERENCES

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