Harnessing the Power of Aloe Vera to Combat Antimicrobial Resistance

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Background

According to the World Health Organization, antibiotic resistance has increased over the past several decades with the rate of production of novel antibiotics being in decline.[1] Modern antibiotics were innovated only about 100 years ago, but many have lost their abilities due to overprescription, human and agricultural misuse, and inevitably evolution.[5] The decrease in production and efficacy has medical consequences, with diseases caused by antibiotic-resistant pathogens becoming more difficult to treat. In fact, the cost of healthcare and productivity loss due to antimicrobial resistance is 55 billion dollars. Meanwhile, the number of antimicrobial resistance-related deaths per year projected for 2050 is 10 million lives.[2] Researchers may never be able to outrun evolution, but they must nevertheless continue to explore novel solutions. Team AloeSporin searches for solutions by looking at the medicinal properties of a species with historical and cultural significance. For centuries, *Aloe vera* has been used to heal skin exposed to ultraviolet radiation. Studies have shown that *Aloe vera* extract has antimicrobial properties, for instance it is able to block biofilm formation of MRSA strains.[4] Given the promise that the Aloe species shows towards combating multi-drug resistant infections, Team AloeSporin aims to study its properties more in-depth.

Research Question

The questions that our team seeks to answer is if there is an optimal concentration of *A. Vera* that can promote skin cell regeneration while inhibiting the growth of the antibiotic resistant bacteria *Staphylococcus Aureus* when applied topically?

Hypothesis

Based on a preliminary literature review, we predict that *A. vera* will cause a significant change in the rate of skin cell regeneration in higher concentrations. Similarly, it is hypothesized that *S. aureus* cultured with increasing concentrations of *A. vera* will increasingly inhibit bacterial growth. Finally, we predict that a prototype topical cream containing *A. vera* as the primary active ingredient will perform as well as the pure extract of the plant.

Research Design

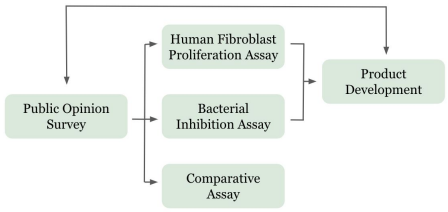

Figure 1: Diagram of Research Design

- The public opinions survey is to verify that our research addresses a community concern.
- The assays function to validate our preliminary research and build a basis for future direction.
- The final goal of the project is to work towards a marketable alternative to healing antibiotic ointments or creams.

Methodology

Public Opinion Survey: Supplement our research by collecting information regarding the sustainability and use of antibiotics.

- Available for UMD students and faculty.
- Anonymous
- Participants will be able to enter a raffle for the chance to win either a $25, $15, or $10 gift card.

Cell Proliferation (CP) Assay: Culture BJ fibroblast cells with different concentrations of *A. vera* to determine an optimal concentration to promote skin cell regeneration.

- Test *A. vera* against a positive control (methylene blue) and a negative control (Neosporin)
- Measure the rate of cell proliferation by counting cells and gauge period of recovery

Bacterial Minimum Inhibitory Concentration (MIC) Assay: Standardized cultures of *S. aureus* and *S. epidermidis* with different concentrations of *A. vera* to determine an optimal concentration to inhibit bacterial growth.

- 100 uL of Aloe solution or Bacitracin will be added to column 1 to start serial dilution of 100 uL until column 10. Columns 1-10 should all have 100 uL of 1 x concentration
- 10 uL of bacteria will be added to columns 1-11.
- Columns 11-12 are controls

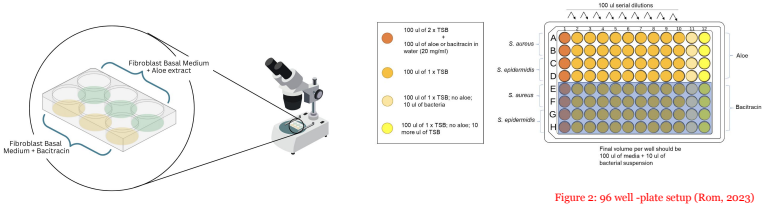

Figure 2: 96 well -plate setup (Rom, 2023)

Cream Emulsion Prototype: Uses the *A. vera* extract with the lowest bacterial MIC and an optimal skin cell regeneration concentration to produce a topical cream antibiotic prototype.

- Reagents: stearic acid, petroleum jelly, TEA, methylparaben, and propylparaben.
- Treatment: heat reagents in a water bath at 70℃ to their melt points, then combining the oil and water phases into a singular emulsion before cooling.[3]

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