Biomimicry: A Counter Response to the Red Queen

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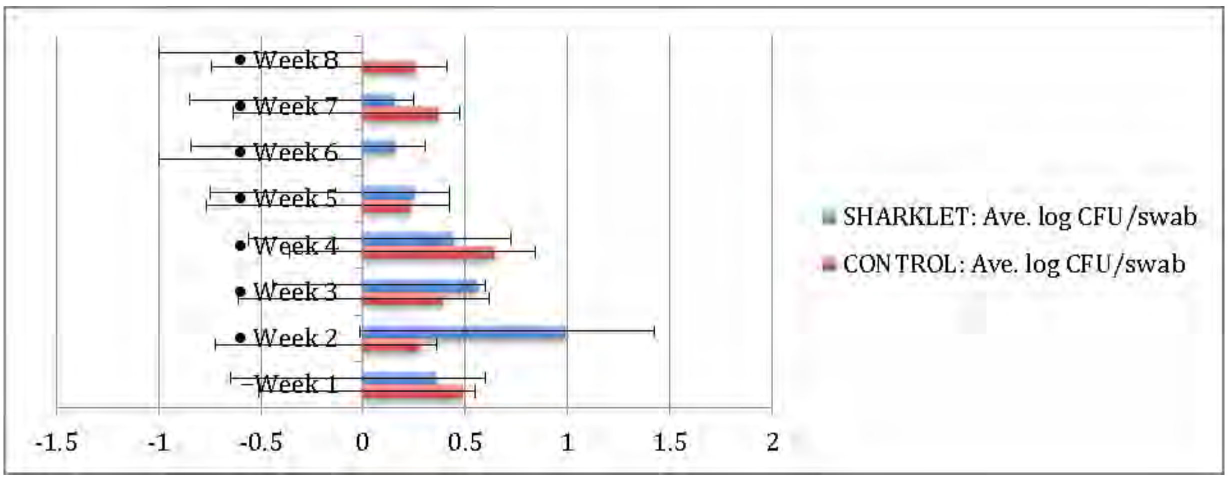
Multidisciplinary fields are incorporating biomimicry by creating technologies and ways of thinking that imitate the natural world. Specifically, material sciences are employing biomimicry to outsmart a biological challenge, the antibacterial battle. The majority of modern day antibacterial products boast a 98% kill rate when it comes to germs. Through the use of catchy slogans and user-friendly imagery, the masses generally feel safe from germ infestation after using these antibacterial products. The overuse of these home products create the same concern as killing off good and weak bacteria that leave a breeding ground for the strong, resistant bacteria (Kaplan, 2000). By virtue of the fact that they were able to survive, the remaining germs have shown their adaptability, and when given room to grow, will transform into resistant bacteria that can potentially cause more harm than the original bacteria. Microbes congregate in large numbers, multiply quickly and mutate easily to adapt to their environment, thus producing infection. Due to this, a resistant bacterium is not a matter of "if" but of "when" (Walsh, 2000). The Red Queen Hypothesis seeks to explain the co-evolutionary constant level of adaption between two biological systems in competition. With each round of evolution between disease-causing bacteria and the antibacterial and antibiotics that we engineer to fight them, an individual maximizes the utility of all available information (Robson, 2003).

The purpose of this study was to employ biomimicry to find an alternative way for inhibiting bacteria in an effort to avert resistant bacteria by mimicking nature as a model, measure and mentor (Benyus, 2002). All organisms have advanced functions and mechanisms that can be a guide to our human problems, including the problems presented by bacteria. The growth resistance of microorganisms on a shark's skin inspires Sharklet™ —a no-kill biofilm inhibiting the spread of infection. The surface topography of this non-toxic material has been modified resulting in the first no-kill technology for inhibiting the growth of microorganism and hence infection. There is a lack of research on the effectiveness of no-kill technology; thus, this study should add to the literature in this area. Given the possibilities presented by Sharklet™, applications could be incorporated to enhance textiles. Sharklet™ could be applied to the soles of shoes that can track bacteria back into our homes or infant textiles as parents seek to avoid chemically enhanced goods that promise to inhibit bacteria.

A campus daycare for children was the environment used for an experiment using Sharklet's no-kill biofilm, which has the primary duty of inhibiting the spread of infection. The daycare setting is a prime location for person-to-person transmission of organisms given the abundant treatment with antibiotics of viral illness that persons in that environment receive (Locke, 2005). The environmental study was performed by comparing Sharklet's™ pattern on a non-toxic biofilm to a smooth control sample, both supplied by Sharklet™. Sharklet's pattern and the smooth control biofilm were exposed to identical conditions where alike bacterial exposure exists. This was achieved by placing both films in an alternating checkerboard grid formation on a child's toy. Over the course of the study, captured images of the cultured bacteria served as a visual observation of the growing bacteria's culture forming units (CFU) per a swab. These plates were kept in room temperature and photographed at day three, day six and to conclude, at day nine. The number of colony forming units (CFU) per a swab was subsequently recorded. A LOG equation, (=LOG10(CFU/swab)), was used to keep the data consistent. This method was chosen because cell replication of bacterial growth, that is growth of the culture, can be documented at a steady rate. From this data, an overall total of the average LOG CFU/swab compared both films. See Table 1.

Table 1. Total Average LOG CFU/swab Comparing Sharklet™ to the Smooth Control



Overall averages from both Sharklet™ and the smooth control showed no significant difference of one film over the other for inhibiting bacteria. Limited observance with multiple contributing variables make environmental (field) studies difficult to interpret and usually require hundreds of data points, if not more, to show a difference. Given more time, providing a wider range of data, Sharklet™ is still hypothesized to inhibit microbes more effectively than a smooth surface. It is recommended that similar studies be conducted over a longer time period.

References

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