Thesis Project Portfolio

Development of a Microplate Accessory for Improved Bacterial Growth

How the Creation of Vitamins Have Normalized Self-Medicating and Redefined How Americans Perceive Health

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Spring, 2023

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Executive Summary

A microbe is classified as a bacteria or fungi that produces either harmful or helpful effects to the human body on the microscale. Rather it be through foods, such as yeast and cheese, or in vaccines, like the common flu shot, science has shown that microbes are an essential aspect of human existence. In 2021, the international market for microbial products was estimated at roughly 190 billion dollars. The growth of this field is largely attributed to advances in microscopy and cell culture that have allowed scientists to better understand how to mimic conditions found inside of the human body to grow bacteria outside of the body. Manipulating these bacteria has become extremely adventitious to society, as researchers can now genetically modify and grow microorganisms by request. This increase in the ability to test and replicate bacteria has allowed scientists to create more effective vaccines and new classes of drugs. Similarly to how bacteria have allowed for the creation of new drugs, in-vivo laboratory studies on vitamins inside the body have allowed for the curing of diseases and nutrition deficiencies due to microbiology technologies.

The 96-well plate is an 8 by 12 grid of cylindrical wells with microscale working volumes and is the most common way to grow bacteria. However, this plate does not exactly mimic the temperature, oxygen transfer, fluid evaporation, and light interference of the human body to maximize bacterial growth. Spectrophotometric readings shown that uneven bacterial growth occurs across these plates, so technical portion of this project sought to develop a microplate accessory for increased bacterial growth. A baffled lid was constructed using eight unique baffle designs. Experiments tested light interference off the baffles using a spectrophotometer, dispersion of microbeads in solution with microscopy, and durability of the baffles with finite element analysis completed (FEA). A baffle diameter of more than 3.75 centimeters showed no light inference. FEA showed the baffles could withstand 41.2 megapascals of forces and confirmed durability against laboratory forces and drops. Microscopy of microbeads with the baffled lid showed an increase in dispersion than with no lid ($p < 0.0001$). Tests using bacteria can later confirm increased bacterial growth due to disruption of media from baffles.

Since the mid 1950s, vitamins have encroached upon the general American public. A majority of American adults use at least one type of vitamin regularly. Vitamin companies encourage a culture of self-medicating due to the easy purchase and use of their products. I sought to answer how the creation of vitamins has altered consumption and overall perception of health. Frequency of vitamin consumption, how their intended use has changed, FDA policy on the advertising of vitamins, populations vitamin companies target, and medical provider vitamin recommendation rate were all vital factors to explore how vitamin companies have gained a large footing in the U.S. government. Through a policy search on laws and regulations from the FDA, it was determined that under-regulation of vitamin allows for a direct-to-consumer advertising that disproportionality targets women and those without college degrees. The low classification for vitamins allow them to escape clinical trials proving efficiency and further revealed that vitamin policy has not been changed for decades. Lobbying of the government by larger companies that have economic power over food and drug regulators. Fast food and processed food markets have used millions upon millions of dollars to prevent regulation of their products; vitamin companies were shown to be no different.

For the technical project, our capstone team achieved our first and second objectives: demonstrating how different baffle hole diameters significantly altered optical density measurements in relation to an unbaffled well and proving an increase in dispersion of microbeads when compared to an unbaffled lid. FEA testing confirmed the lid's durability against drops and everyday physical forces, but ABS-like resin proved to be cytotoxic to bacterial cultures. Future tests should incorporate bacteria, a different material, and later determine which of the eight baffles was the most successful at mixing. For the STS research project, I was content with the availability of public vitamin policy online. I might recommend that future works further delves into more on the opinion of medical professions on vitamins through interviews and population studies.

This project was made in collaboration with Charlottesville-based biotechnology company Cerillo LLC. Special thanks to our advisors at Cerillo, Daniel Carrier and Sydney DeCleene, UVA capstone

professors, Timothy Allen and Shannon Barker, and graduate teaching assistants Natasha Claxton, Zehra Demir, and Noah Perry for your guidance and mentorship throughout the Capstone process.