Greater San Diego Science and Engineering Fair
2015 PROJECT SUMMARY

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Project Title: Can Liquid Crystal be Used As An Innovative System to Detect Bacteria

Abstract

Objectives/Goals

Liquid crystals are used in television screens, computers screens, monitors, watches, and many other daily appliances. However, the unique properties of liquid crystals can also be utilized to detect harmful bacteria, which in turn could help detect diseases. Upon the discovery and detection of the bacteria, doctors will be able to provide treatments to patients earlier before the diseases fully develop. Such early detection of the disease can save both lives and money. The objective of this project is to demonstrate if an innovative system such as liquid crystals can be used for the detection of bacteria such as *Staphylococcus epidermidis*.

Hypothesis

Utilizing the unique property of liquid crystals, the experimenter can conclude that liquid crystals will be very helpful to detect bacteria during its early stages when it is reproducing. By viewing the patterns existed in the liquid crystal, it is possible to determine if bacteria are beginning to develop. Based on the liquid crystal properties, the hypothesis for this experiment is that 1) liquid crystal can be used to detect the presence of bacteria; 2) the concentration with 65% cholesteryl oleyl carbonate, 25% cholesteryl pelargonate, and 10% cholesteryl benzoate will provide the most promising results at room temperature as the optimal operating temperature of stabilizing phase in such liquid crystal is between 17 to 23 degree Celsius.

Methods/Materials

The materials needed to create liquid crystals are cholesteryl oleyl carbonate, cholesteryl pelargonate, and cholesteryl benzoate. Bacteria used in this experiment are *Staphylococcus epidermidis* bacteria. Analytical balances and weighing boats will be used to weigh the chemicals. All these systems prepared will be observed and examined under the polarizing microscope. After creating several different systems, *Staphylococcus epidermidis* bacteria will be placed in the prepared liquid crystal systems accordingly and the impact of bacteria were observed. All the data is collected and analyzed at various concentrations with and without bacteria using a Kinetic ELISA Microplate Reader.

Results

The results showed that the first liquid crystal system (65% cholesteryl oleyl carbonate, 25% cholesteryl pelargonate, and 10% cholesteryl benzoate) created was the most effective in detecting bacteria at ambient temperature. The optimal detection wavelength was at 650 nm and the liquid crystal system is very sensitive to detect the presence of bacteria at approximately 0.67% of *Staphylococcus epidermidis* bacteria.

Conclusions/Discussion

At room temperature, liquid crystal system with 65% cholesteryl oleyl carbonate, 25% cholesteryl pelargonate, and 10% cholesteryl benzoate was very effective in detecting *Staphylococcus epidermidis* bacteria than the other three liquid crystal systems, because the experiment was performed at room temperature, where it had an optimal liquid crystal temperature range near ambient temperature. It was also noted that wavelength 650 nm was more effective in measuring the impact of bacteria because it was farther away from the bacteria inhibition wavelength at 405 nm and 470 nm. The experiments confirmed the hypotheses and future experimental designs were discussed.

Summary Statement

Liquid crystal system can be used as an innovative system to detect the presence of bacteria. Optimal wavelength for the detection of *Staphylococcus epidermidis* bacteria was found and the sensitivity of the detection was determined. Such technique may be further employed in other infectious diseases system.

Help Received

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