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**Will Pre-existing Arrangements Change the Growth Patterns in Bacterial Colonies?**

Each year in the US, 23,000 people die as a result of infection from antibiotic-resistant bacteria. These types of bacteria are able to survive in harsh environmental conditions due to their sophisticated cooperative behavior. Motile microbial colonies form complex geometric patterns as a result of the communication between individual bacteria and the entire colony. The conditions in which bacteria are cultured greatly affect the shapes of periodic patterns that will form as the bacteria propagates. Patterns aid durability, efficiency, sustainability and consequently survival. This research focuses on studying the effects of initial bacterial seeding patterns on their population growth. In nature, the environment contributes immensely to the growth patterns of species. Our experiments investigated the effect of manually placing bacteria in designated patterns to study the consequences of artificial placement in population growth. Using cell culture techniques, we inoculated E. coli at 37°C by spreading them using various patterns. We analyzed the area of the bacteria, and optical density using a photospectrometer. The results suggested that despite the difference in the area of inoculation, the bacteria adapted by varying the sizes of the colonies and consequently their population densities. As a result, the concentration of the bacteria as measured by the photospectrometer at 600nm was comparable. The specific analysis of the effects of patterns is underway. The results obtained may be utilized in bacterial culturing for research, industrial or commercial purposes. Patterns that inhibit the growth of bacteria that are resistant to antibiotics will be useful to infrastructure like hospitals to minimize the growth of superbugs and save thousands of lives.

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**INTRODUCTION**

**Facts**
- 23,000 people die as a result of infection from antibiotic-resistant bacteria
- Cooperative behavior of bacteria allow them to survive in harsh conditions.

**Key Concepts**
- Primitive, fundamental and complex bodies utilize patterns for maximizing stability and ensuring survival
- Bacteria grow in colonies and the colonies interact with one another.

**MATERIALS**
- *Escherichia coli*
- Nutrient Broth and agar
- Vernier Callipers
- Photospectrometer
- Sterile Hood

**PURPOSE**

- To investigate the effect of manual placement of bacteria in population growth
- To study patterns that will facilitate or inhibit growth of colonies.

**PATTERNS TESTED**

![Figure 1: Fibonacci series observed in a plant](image)

![Figure 2. Pattern A: Random inoculation of bacteria throughout the Petri dish.](image)

![Figure 3. Pattern B: Concentric circle with bacteria inoculated inside.](image)

![Figure 4. Pattern C: Concentric circle with bacteria inoculated outside the inner circle.](image)

![Figure 5. Pattern D: Bacteria inoculated by placing a drop in the middle.](image)
RESULTS

Figure 7. Graph demonstrating the optical density of bacterial solution with respect to different patterns.

Figure 9. Results of Pattern A (random even inoculation of bacteria.)

Figure 11. Results of Pattern C (bacteria inoculated outside the inner concentric circle.)

Figure 10. Results of Pattern B (bacteria inoculated in the inner concentric circle.)

Figure 11. Results of Pattern D (bacteria inoculated as a drop in the middle.)

Figure 6. Formation of fractal on the edge of the inoculated region

Figure 8. Formation of gaps within adjacent bacterial colonies

METHODS

**Cell culture:** Inoculation of bacteria in various patterns.

**Measurement of Optical Density:** Using a Photospectromter, the density of the bacteria was recorded at 600nm.
WILL PRE-EXISTING PATTERNS EFFECT THE POPULATION GROWTH IN BACTERIA?

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CONCLUSIONS

• Bacteria interact to adjust their colony size and number to compensate with the area of inoculation.
• Bacteria inhibited the growth of colonies forming stable structures such as hexagon.
• Bacteria propagate in fractals.
• For 200µl of bacteria, the population of pattern A was higher than all other patterns.

FURTHER RESEARCH

• Test complex placements such as hexagonal points, equilateral triangles.
• Test different amount of bacteria or area of inoculation and medium quantity by assigning constants.
• Test patterns in a different kind of bacteria.
• Use different methods for obtaining results.

REFERENCES


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