Evolution of Resistance to Antibiotics in Bacteria Lab Report

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1 Evolution of Resistance to Antibiotics in Bacteria Lab Report

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1.1 Experiment 1

1.1.1 Hypothesis

1. Applying antibiotics in multiple short treatments leaves more antibiotic resistant bacteria to survive than if applying a single full treatment.

1.1.2 Predicted Results

1. The group with short treatments of antibiotics will result in significantly more surviving resistant bacteria than the group with a single, sustained, full treatment of antibiotics.

1.1.3 Results

1. In this experiment we found that bacteria "d. (beads)" was the most resistant.
2. The final percent of resistant bacteria was higher when antibiotics were applied in four short treatments as opposed to one full treatment where the final percent was 0 percent.
3. Recorded results tables are in the Appendix

1.2 Experiment 2

1.2.1 Description

Hypothesis

1. The presence of other infectious bacteria in the environment negatively impacts the effects of antibiotics when targeting an infection.

Predicted Results

1. The group with short treatments of antibiotics will result in significantly more surviving resistant bacteria than the group with a single, sustained, full treatment of antibiotics.

1.2.2 Results

1. In this experiment we found that bacteria "d. (beads)" was the most resistant.
2. The final percent of resistant bacteria was higher when antibiotics were applied in four short treatments as opposed to one full treatment where the final percent was 0 percent.
3. Recorded results are in **Appendix A**

1.2.3 Methods

Independant variable

1. The independant variable was the presence of interfering bacteria in the group.

Dependant variable

1. The dependant variable was the amount of remaining target bacteria after treatment.

Manipulation of independant variable

1. We defined 2 types of bacteria
    1. The target bacteria
        1. This is the bacteria which we are trying to eliminate with the antibiotic.
    2. The interfering bacteria
        1. This is the different bacteria caused by another disease.
2. We defined 2 groups.
    1. Group A had only the target present at 100%
    2. Group B had 50% target bacteria and 50% interfering bacteria.
3. In Group A we added 50 instances of target bacteria and 0 instances of interfering
4. In Group B we added 50 instances of target bacteria and 50 instances of interfering.

Measurement of the dependent variable

1. For each group we first measured the starting count of target bacteria then we measured the count of surviving target bacteria and turned it into a percentage of the starting count of target bacteria.

Predicted Results

1. We predicted that there would be significantly more surviving target bacteria measured in Group B than in Group A.

1.2.4 Results

1. We found that in Group A there was 18% surviving target bacteria while in Group B there was 42% surviving target bacteria.
2. Results table is in **Appendix B**

1.2.5 Discussion

Your answer should be 2-3 pages long. Explain the hypothesis and why the hypothesis is important to medicine. Compare the predicted to the observed results. Evaluate the hypothesis. Use the observed results of the experiment to convince your reader that the hypothesis either is or is not supported by the results. This evaluation is the conclusion of your lab report. Compare your conclusion to information from at least 2 reference sources. The information from these references must be directly related to the hypothesis or conclusion of your experiment. A selection of articles that may be relevant to your experiment are available on the BIOL 1120L lab Canvas course. You will find them in the "Evolution of Resistance to Antibiotics in Bacteria" module.

Hypothesis and Importance to Medicine Our hypothesis is that the presence of other infectious bacteria in the environment negatively impacts the effects of antibiotics when targeting an infection. This hypothesis is important to medicine because it can help us understand how to better treat infections in the presence of other diseases. This helps us analyze the counfouding factors that may be present in a patient's body when they are infected with a disease.

Predicted vs Observed Results The predicted results were that there would be significantly more surviving target bacteria measured in Group B than in Group A. The observed results were that in Group A there was 18% surviving target bacteria while in Group B there was 42% surviving target bacteria. The observed results strongly reflect the predicted results with the observed results showing more than double the amount of surviving target bacteria in Group B than in Group A.

Conclusion The hypothesis is supported by the results of the experiment. The observed results show that there was significantly more surviving target bacteria in Group B than in Group A. This is consistent with the hypothesis that the presence of other infectious bacteria in the environment negatively impacts the effects of antibiotics when targeting an infection.

Comparison to Other studies

1. Unfortunatly, I was unable to find any studies that directly relate to the hypothesis of this experiment.
2. Instead I will critique the methodology of the experiment.
    1. While the experiment does ideally replicate the conditions of a patient with multiple diseases, it does not control the total amount of bacteria in each group. This could lead to a confounding factor in the results because in Group B there is a higher total amount of bacteria rather than replacing the target bacteria with interfering bacteria.
    2. The experiment could be improved by controlling the total amount of bacteria in each group to ensure that the results are not confounded by the total amount of bacteria present.
    3. While the simulation provides some insight into the effects of multiple diseases on the effectiveness of antibiotics, it does not fully replicate the conditions of a patient with multiple diseases. This is because the simulation only considers the effects of the interfering bacteria on the target bacteria and does not consider the effects of the interfering bacteria on the patient's immune system. This could be improved by incorporating the effects of the interfering bacteria on the patient's immune system into the simulation.

1.3 Appendices and Raw Data

1.3.1 Raw Calculations

[ ]:
```python
# Survival Rates for Two Groups

def calculate_percent(surviving_count, starting_count):
        return round((surviving_count / starting_count) * 100, 2)

group_A = {
        "beginning_count": 50,
        "surviving_count": 9,
}

group_B = {
        "beginning_count": 50,
        "surviving_count": 21,
}

group_A["percent_surviving"] = calculate_percent(
        group_A["surviving_count"],
        group_A["beginning_count"]
)

group_B["percent_surviving"] = calculate_percent(
group_B["surviving_count"],
        group_B["beginning_count"]
)

print("Group A: ", group_A)
print("Group B: ", group_B)
```

```
Group A:  {'beginning_count': 50, 'surviving_count': 9, 'percent_surviving':
18.0}
Group B:  {'beginning_count': 50, 'surviving_count': 21, 'percent_surviving':
42.0}
```

Appendix A:
LEGEND: a: hearts, b: bells, c: sealife, d: beads

Table 7.1 Results of short treatment simulation

15 sec Treatments	Beginning numbers of each type of bacteria				Number of surviving bacteria					Percent (%)of surviving bacteria				Numbers added during reproduction			
	a.	b.	c.	d.	a.	b.	c.	d.	Total	a.	b.	c.	d.	a.	b.	c.	d.
One	25	25	25	25	15	14	16	21	66	23	21	24	32	8	7	8	11
Two	23	21	24	32	11	7	14	17	49	22	14	29	35	11	7	15	18
Three	22	14	29	35	9	8	14	23	54	17	15	25	43	8	7	11	20
Four	17	15	25	43	13	8	15	20	56	23	14	27	36				

Table 7.2 Results of full treatment simulation

60 sec Treatment	Beginning numbers of each type of bacteria				Number of surviving bacteria					Percent (%)of surviving bacteria			
	a.	b.	c.	d.	a.	b.	c.	d.	Total	a.	b.	c.	d.
One	25	25	25	25	0	0	0	0	0	0	0	0	0

AppendixB

March 26, 2024

0.0.1 Appendix B

	Starting Count Target Bacteria	Surviving Count Target Bacteria After Treatment	Surviving Percentage Surviving Count/Starting Count * 100
Group A	50	9	18%
Group B	50	21	42%