



**CALIFORNIA SCIENCE & ENGINEERING FAIR  
2019 PROJECT SUMMARY**

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| <b>Name(s)</b><br><b>Kelly Gan</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Project Number</b><br><b>J1604</b> |
| <b>Project Title</b><br><b>Natural Antibiotic Effects of Honey, Garlic, Lemon, and Ginger against Escherichia coli</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       |
| <b>Abstract</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                       |
| <b>Objectives</b><br>Antibiotic resistance is a serious issue with the overuse of synthetic antibiotics, which kill good bacteria and kill with one method, allowing bacteria to evolve and mutate, unlike natural antibiotics. The purpose of my project was to find out which natural antibiotics- Manuka Honey, Garlic, Lemon, and Ginger, is the most effective against inhibiting Escherichia Coli (E.Coli) growth. My hypothesis was that Garlic is best with biggest zone of inhibition, due to its multiple active compounds.                                                               |                                       |
| <b>Methods</b><br>20 Luria Broth Agar plates were swabbed with K-12 strain E.Coli bacteria and split into six parts each, consisting of: Negative control with nothing, Positive control with Ampicillin, and 4 different concentrations of natural antibiotic on a disk (4000mg/ml, 2000mg/ml, 1000mg/ml, 500mg/ml), using a serial dilution with water. 5 samples per antibiotic (Honey, Garlic, Lemon and Ginger) were prepared, and the 20 plates were incubated for 24 hours at 37 degC. The zone of inhibition's diameter in millimeters for each disk was measured. 3 trials were performed. |                                       |
| <b>Results</b><br>Based on the average zone of inhibition for 15 samples in 3 trials, Garlic exhibited the largest zone at all concentrations (23.9mm at 4000mg/ml) and was better than Ampicillin. Manuka Honey (12.8mm at 4000mg/ml) and Lemon (11.4mm at 4000mg/ml) inhibited E.Coli but were not very effective. Ginger results are poor (8.6mm at 4000mg/ml), and dropped rapidly at lower concentrations.                                                                                                                                                                                     |                                       |
| <b>Conclusions</b><br>My hypothesis was correct, Garlic inhibits E.Coli best even at lowest concentrations of 500mg/ml (10.7mm). Garlic is effective due to its 100+ active compounds from Allicin, and targets enzymes that are needed for the production of energy for the bacteria. These results encourage people to take natural antibiotics instead of synthetic antibiotics, so that antibiotics resistance doesn't proliferate. Moving forward, I want to try different types of bacteria for these 4 and other natural antibiotics, since they may be effective for different bacteria.    |                                       |
| <b>Summary Statement</b><br>I investigated the effectiveness of 4 natural antibiotics (Honey, Garlic, Lemon, Ginger) against inhibiting Escherichia Coli growth by measuring zone of inhibition, and found that Garlic far exceeded others due to its many active compounds.                                                                                                                                                                                                                                                                                                                        |                                       |
| <b>Help Received</b><br>Dr. Eisen helped with E.coli purchase and experiment advice. My mom helped with purchasing of materials.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                       |