Effectiveness of Household Spices in Reducing Airborne Bacteria

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Abstract:

Airborne bacteria have been the cause of millions of deaths over the past few years. While finding ways to prevent this causation, the idea of implementing spices that are effective against other types of bacteria was presented. This led to the question: if effective, what spice will be the most effective in killing airborne bacteria: cinnamon, clove, or garlic? Passive air sampling was used to collect the bacteria in the air. This method exposes the nutrient agar to the airborne bacteria by letting the lids of the Petri dishes open for at least one hour. Spice-covered disks are then put on the Petri dishes and into the incubator. The effectiveness of the bacteria will be shown by the zone of inhibition surrounding the disk. The larger the diameter is, the more effective it is against the bacteria. The results showed that the diameter of the zone for all three spices and control was zero. In closing, all of the tested spices were proven to be ineffective as there was no visible zone of inhibition surrounding the disks. There is a growing need for accessible antimicrobial products; this study shows that household spices do not pertain to successfully fighting against airborne bacteria.

Acknowledgments:

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Introduction:

The bacteria that roams around the air affect all human beings. Most times, breathing in these microbes does not have a severe effect. However, many widely-appearing diseases originate from airborne bacteria. This includes the common cold, chickenpox, and measles, among others. Airborne bacteria have been the topic of conservation because the coronavirus also pertains to this category.

A study done by a professor from the University of Kansas was the basis of this project. The study had proved "the antimicrobial effects of various spices on E. coli O157:H7 in raw ground beef and sausage and found that cinnamon, clove, and garlic were the most powerful." (Institute of Food Technologists, 1999). The preventive and curative traits attributed to these spices could be effective against other foodborne bacteria. This study investigates if the spices are effective against airborne bacteria rather than foodborne. The reason for the use of garlic, cinnamon, and clove was because they are known and easily accessible, found in almost every household. I hypothesized that garlic would be the most effective because of its antimicrobial properties that can be implemented into other bacteria.

Question:

What spice will be the most effective in killing airborne bacteria: cinnamon, clove, or garlic?

Hypothesis:

If airborne bacteria are exposed to cinnamon, cloves, and garlic, then garlic would be the most effective in killing the bacteria because of its antimicrobial effects that can also be implemented in other types of bacteria.

Variables:

Dependent Variable: the size of the zone of inhibition around the disk

Independent Variable: the spice that the bacteria is exposed to

Control Variable: a Petri dish without bacteria, a disk without spice

Constant: the day and location the bacteria were collected, the amount of spice in each disk, the area and temperature the Petri dishes are in

Materials:

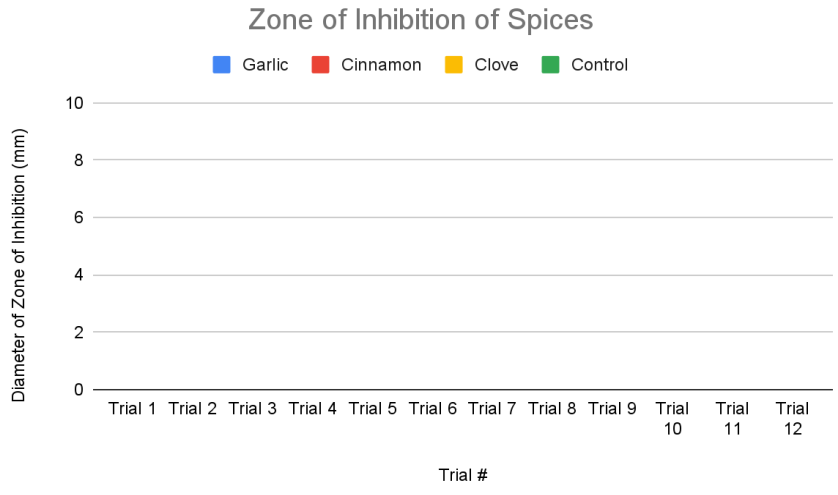
- Minced garlic
- Cinnamon stick
- Clove
- 3 containers
- Nutrient agar petri dish
- Blank sterile disks
- Marker
- Single-channel pipette
- Tweezers
- Bunsen burner

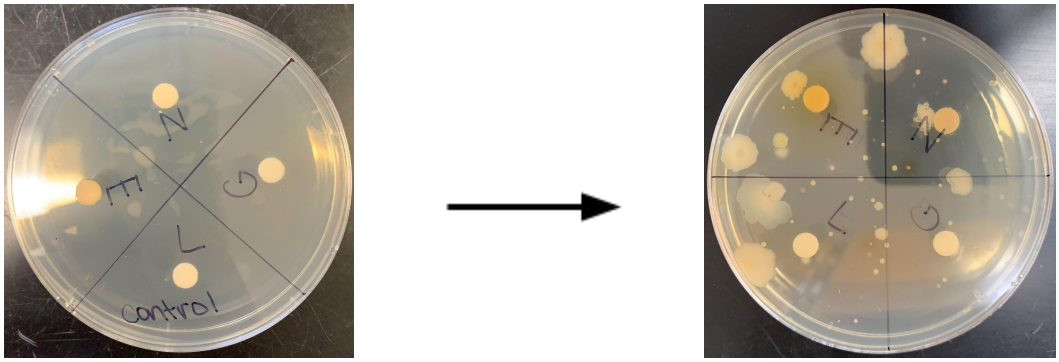
Methods:

1. Put garlic (minced), cinnamon (in stick form), and clove, each in a different container.
2. For every gram of any spice, put in ⅛ cup of hot water to make the liquid substance (leave this mixture to sit overnight)
3. With a marker, divide your agar plates into four and label each section g, n, e, and l for garlic, cinnamon, clove, and control, respectively.
4. Add the same number of disks as the agar dishes in four separate empty Petri dishes, one for each of the spices and control.
5. Add 20 uL of each solution on each 6 mm disk with your single-channel pipette.
6. Let the disks dry for at least 3 hours.
7. For your nutrient agar plates, place them with the lids open in the area you want to collect your data for around 1 hour.
8. Sterilize your tweezers with a bunsen burner by holding them in the flame until it turns red
9. Let it cool for about 10 seconds.
10. Place the respective disks in the center of each section with your tweezers (there should be four disks in each dish)
11. Make sure to sterilize the tweezers each time you use them
12. Incubate your agar plates upside down at approximately 32 degrees Celcius
13. Collect data on the diameter (zone of inhibition) around the disks to see the susceptibility/resistance of the spices

Results:

	Garlic	Cinnamon	Clove	Control
Trial 1	0	0	0	0
Trial 2	0	0	0	0
Trial 3	0	0	0	0
Trial 4	0	0	0	0
Trial 5	0	0	0	0
Trial 6	0	0	0	0
Trial 7	0	0	0	0
Trial 8	0	0	0	0
Trial 9	0	0	0	0
Trial 10	0	0	0	0
Trial 11 (control)	0	0	0	0
Trial 12 (control)	0	0	0	0





Discussion:

The findings of this study suggest that garlic, cinnamon, and clove do not have any effect against airborne bacteria. Currently, there are no previous research studies that can be considered. However, various variables can be regarded when looking at the unexpected results. First, these spices may only be effective against foodborne bacteria instead of airborne, which was being tested. Second, the structure and composition of these bacteria contrast as airborne bacteria are "suspended as individual cells or found as an agglomerate of many bacterial cells." (Romano et al., 2020). Third, another distinctive difference is their relation to the human body. Airborne pathogens are from a source of infection or biological waste products that accumulate in garbage cans, caves, and dry arid containers (Ather et al., 2021). On the other hand, foodborne pathogens are directly transmitted from animals to humans, or through vectors" (Stein & Chirilã, 2017). The area of the body it affects is also different. As airborne bacteria is inhaled, it goes through the respiratory tract, and foodborne is consumed, so it goes through the digestive tract. Fourth is the sterilization of the materials used. As the project was completed in a high school setting where other projects were also being carried out, it could have influenced the results.

Conclusion:

My hypothesis of garlic being the most effective spice against airborne bacteria was proven false in this experiment. All three spices had shown no zone of inhibition surrounding the disks in any of the trials. There were even cases where the bacteria grew directly on the disks. These results indicate that these spices are not effective against these spices. Some limitations include the type of bacteria the study was directed at and the sterilization of the research area. Although the results may seem insignificant, it provides us with valuable information that these spices cannot be used for the purpose of fighting airborne bacteria. This is an important topic to discuss because it involves millions of people, especially due to the ongoing pandemic of COVID-19. An interesting future study may be testing if different spices or substances are effective. For example, the bacteria could be exposed to properties found in disinfectants. This approach could also test if the spices were what was ineffective.

Resources:

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