The effects of black tea on the growth

Science, Biology

The effects of black tea on the growth of E. coli bacteria cultures Kierstin Barker, Melissa Bischak, Jackie Tyszkiewicz, Errin Enany September 25, 2012 Abstract: This study was carried out in order to investigate whether black tea has antimicrobial properties as stated in Steven Johnson's The Ghost Map. If tea does have antimicrobial properties, then it could aid in warding off waterborne diseases. We believed that if black tea is steeped in boiled water, then the amount of bacteria exposed to this solution would decrease. We expected to see no difference in the amount of bacteria exposed to the black tea solution.

Tannic acid, black tea, boiled water, and a tetracycline antibiotic were tested for their zones of inhibition in order to determine antimicrobial properties. Our results stated that tea does not contain tannic acid but does contain tannin and therefore does not have antimicrobial properties that contain tannic acid based on the results of this experiment. Introduction: In the novel: The Ghost Map, written by Steven Johnson, Johnson refers to the idea that tea has antimicrobial properties and that it could possibly have influenced people's risk of contracting infectious diseases such as cholera (Johnson, 2006).

Traditionally, people drank tea to improve blood flow, eliminate toxins, and to improve resistance to diseases (Dufresne and Farnworth, 2000). Tea has been shown to have a wide range of physiological and pharmacological effects such as having antimicrobial properties, inhibiting malignant cells, and simply leaving the drinker feeling refreshed (Hamilton-Miller, 1995). Black tea contains amounts of tannic acid.

Tannic acid is a commercial type of tannin, which is a bitter plant polyphenolic compound that binds to and precipitates proteins and various other organic compounds including amino acids and alkaloids and has antimicrobial properties which could possibly aid in warding off waterborne diseases (Yildirim, 2000). Could some people in the city of London actually have been saved from the fatal cholera disease due to their preferred drink of tea? If tea actually does have antimicrobial properties, then it could possibly provide some explanation as to why some people were not affected by this waterborne disease as seriously as others.

So, our primary question is, “ Does black tea decrease the amount of live bacteria in a solution? ” In order to test this question, we have devised hypotheses and experiments to see if black tea actually does stunt bacterial growth and whether tannic acid helps aid in this process. While making observations, developing questions, designing an experiment to test hypotheses, and analyzing data, we also want to demonstrate our proficiency in using the scientific method throughout this study. We believe that if black tea is steeped in boiled water, then the amount of bacteria exposed to this solution will decrease.

We expect to see no difference in the amount of bacteria exposed to the black tea solution. If we are able to accept our alternative hypothesis, then the claims that Steven Johnson makes in The Ghost Map could be plausible and tea with tannic acid could have possibly helped ward off waterborne diseases during this particular outbreak in London. By testing antibiotic, tannic acid, and black tea solutions on prepared agar plates covered in E.

coli bacteria, we predict to observe the different effects that each solution emits based on the zone of inhibition for each type of solution.

Materials and Methods: This experiment was carried out on September 11, 2012. In order to carry out such an experiment, many different materials were used. Two 200 mL beakers were each filled with 200 mL of deionized water. Using a Bunsen burner, both beakers of water were heated until boiling at 100? C. Three agar plates were prepared with 100 microliters of E. coli bacteria. This amount was measured using a micropipette. The bacteria were then spread around the entire surface area of each plate. Each agar plate was then labeled accordingly (figure 1).

Plate #1: Plate #2: Plate #3: Antibiotic (Tetracycline- 30 micrograms/disc) Antibiotic (Tetracycline- 30 micrograms/disc) Boiled water Boiled water Tea Tea 0. 5% tannic acid 0. 5% tannic acid 2% tannic acid 2% tannic acid Figure 1: Labeling of agar plates. The arrows represent the side in which the solution was placed. Each half of the plate contained 3 discs doused with the appropriate solution. After the water was boiled, a black tea bag was then placed into one of the beakers and steeped for 4 minutes. This time was monitored using a stopwatch.

After the tea had been steeped, 6 discs were dipped into the tea solution and then placed in the appropriate agar plate (plate #3). The discs were fairly equal distances apart. The same procedure was done with the other beaker of boiled water, the antibiotic, and the different percentages of tannic acid. A total of 6 discs were placed on each plate (ex: 3 dipped in boiled water, 3 in antibiotic in plate #1). These agar plates with added discs were then placed

in an incubator set to 37? C for 48 hours and then placed in a refrigerator at 4? C.

After the allotted time, the agar plates were taken out of storage and the bacterial reactions to the different solutions were observed and the zone of inhibition on each disc was measured in centimeters using a caliper measuring tool. Results: Table 1. Average diameter in centimeters of the zone of inhibition of the discs soaked each solution. Diameter of Zone of Inhibition| Solution| Average (cm)| Boiled Water| 0. 0| Black Tea| 0. 0| Tannic Acid (0. 5%)| 0. 27| Tannic Acid (2%)| 0. 63| Antibiotic| 1. 0| Table 1. Average diameter in centimeters of the zone of inhibition of the discs soaked each solution.

Diameter of Zone of Inhibition| Solution| Average (cm)| Boiled Water| 0. 0| Black Tea| 0. 0| Tannic Acid (0. 5%)| 0. 27| Tannic Acid (2%)| 0. 63| Antibiotic| 1. 0| After measuring the zone of inhibition for each type of solution, we were able to conclude which solution had the most antimicrobial properties based on its zone of inhibition. The solution that had the most antimicrobial properties (stunted the growth of the bacteria the most) would have the greatest average zone of inhibition. According to our data, the solution with the greatest zone of inhibition was the antibiotic (table 1).

This concentration was then compared to the rest of the solutions activity towards the bacteria. The higher tannic acid concentration had a greater zone of Figure 2. Average zone of inhibition in centimeters of each solution tested. For tannic acid solutions, the percentage in the parentheses is the concentration of the tannic acid. Figure 2. Average zone of inhibition in centimeters of each solution tested. For tannic acid solutions, the percentage

in the parentheses is the concentration of the tannic acid. inhibition but a lower zone of inhibition than the antibiotic (table 1).

Therefore, the more concentrated the tannic acid is, the greater the zone of inhibition. The black tea reacted to the bacteria in the same way as our boiled water control. These both had a zone of inhibition of zero. To better reinforce the differences in zones of inhibition, a bar graph was constructed (figure 2). Through this we were able to see the varying zone of inhibition and therefore could conclude the amount of bacteria growth on the different plates based on which solution was used. Discussion: In this lab, we tested black tea in order to see if it would produce a zone of inhibition in response to E. oli bacteria. What we observed after applying discs to our agar plates was that no apparent zone of inhibition on the tea discs was reached. Our control of boiled water had the same response to the E. coli as did the tea. The tetracycline antibiotic contained the greatest zone of inhibition because it was our control and was known to have antimicrobial properties. Tetracycline is primarily bacteriostatic and exerts its antimicrobial effect by the inhibition of protein synthesis (Anderson, 2012). The tannic acid also had antimicrobial properties based on the zone of inhibition.

The greater amount of concentration, the more of an effect it had on stunting bacteria growth. Because the reaction to the bacteria in the tea and water solutions was similar and the reaction to the bacteria in the tea and the antibiotic was so different, this showed that tea does not have any antimicrobial properties based on this experiment. Because of the difference in reactions in the tannic acid versus the tea solutions, tea does not contain

tannic acid or the amount of tannic acid in tea is so little that it does not produce a significant effect on bacteria.

We expected to see no difference in the amount of bacteria exposed to the black tea solution. Therefore, we accepted our null hypothesis. We must reject our alternative hypothesis because no zone of inhibition was observed on the tea agar plate. We also did this experiment to see if tannic acid had and the black tea had a similar reaction to the bacteria. We observed that the results actually worked in reverse; the tea showed no significant signs of inhibition while the tannic acid did. With further research, we were able to conclude that tea does not contain tannic acid, but it does contain tannin (Richardson, 2012).

Tannic acid is a form of commercial tannin and has antimicrobial properties, but it is not found in tea (Post, 2009). Through further research we were able to find a similar experiment that received positive data to support that tea has antimicrobial properties. In this experiment, they attempted to describe the synergistic antimicrobial activity of tea and antibiotics against enteropathogens. Antimicrobial activity of boiled water tea extract and organic solvent extract were studied against Salmonella typhimurium to determine minimum inhibitory concentration.

Both green tea and black tea extracts effectively inhibited the growth of S. typhimurium and E. coli (Tiwari et al. , 2005). The difference in this experiment was that they added another alternative to test the tea; the tea was steeped in water at room temperature and in boiled water. According to their results, the zone of inhibition was greater in the tea at room temperature than the boiled water and the E. coli had a lower zone of

inhibition than the S. typhimurium (Tiwari et al. , 2005). Not adding these factors into our own experiment could have made a significant difference in our figures and the zones of inhibition.

Some areas of human error could have been that the tea was steeped for too short of a time to show any significant results or the forceps that handled the discs were not adequately sterile. Black tea did not have tannic acid as previously thought. Through research we were able to better our knowledge and accept our null hypothesis. Tea does have tannins which can be defensive compounds that counteract bacteria and fungi by interfering with plants' surface proteins (McGee, 2006). This could have aided in the preservation ofhealthduring cholera outbreaks, but tannic acid was not a culprit in this investigation.

Tea did not show any significant zone of inhibition and therefore does not have significant antimicrobial properties against E. coli bacteria according to this experiment. Literature Cited: Dufresne, C. and Farnworth, E. 2000. A review of latest research findings on the health promotion properties of tea. Journal of Nutritional Biochemistry 12: 404-421. Hamilton-Miller, J. M. T. 1995. Antimicrobial Agents and Chemotherapy, Vol. 39, No. 11. London: American Society for Microbiology. Johnson, S. 2006. The Ghost Map. New York: Riverhead Books. Lee Anne A. Drug Information Online, 2012. " Tetracycline Hydrochloride Capsules"

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