

To Tell the Tooth...
Miriam Drysdale & Karly Walker

Question

Which toothpaste works most efficiently and effectively and can we make our own that works just as well but for a better value?

Hypothesis

We predict that our homemade toothpaste will work just as well as three leading brands: Crest Complete, Colgate Total and Arm and Hammer All-In-One. We believe this because our toothpaste is made from household ingredients such as salt and baking soda, which have proven cleaning properties.

Conducting the Experiment

Step 1: Making Nutrient Agar

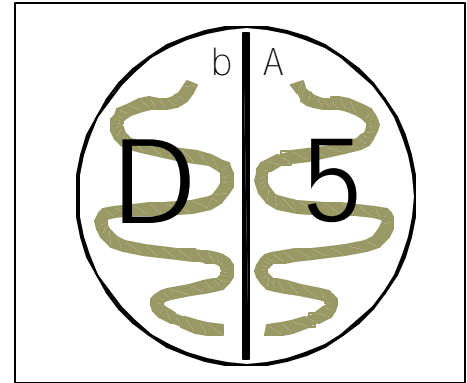
Nutrient agar is used to grow bacteria/cells. It acts like food and provides nutrients that are needed in order for the cells to grow. Nutrient agar contains beef extract, peptone and agar. Nutrient agar was made as follows: Combine 11.5 grams of powdered nutrient agar and 500 milliliters of distilled water in a large fleaker, place on a Hot Plate Stirrer and heat until boiling. Place the nutrient agar in an autoclave for 15 minutes at 121°C and 15 pounds per square inch to sterilize. After sterilization, pour 1/2 of a centimeter of the nutrient agar in the bottom of sterile petri dishes and let set.

Step 2: Making Homemade Toothpaste “Baron-paste”

Our recipe was a result of internet searches of existing toothpaste recipe ingredients as well as ingredients we felt it should have. The ingredients included salt, baking soda, water, glycerin and mint flavoring and proportions were determined from a trial and error process.

Step 3: Testing

First, lines were drawn to divide the petri dishes in half (B | A - Before and After). The code of each person was also drawn on the petri dishes – eg. “D5”. (See illustration)



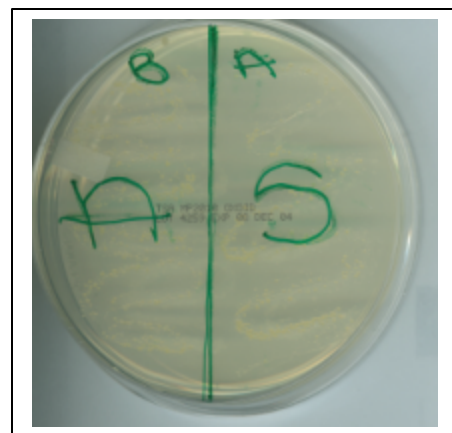
The subject’s mouth was then swabbed using sterile swabs and the bacterium was placed on the nutrient agar in the petri dish in a zigzag pattern as illustrated . Each subject was swabbed in the same manner running the swab gently along all gum lines. The subject then brushed their teeth thoroughly for 2 minutes (duration recommended by the Canadian Dental Association) with ¼ teaspoon of toothpaste. The subject followed a prescribed brushing pattern. After brushing, the subject rinsed their mouth with 3 tablespoons of water. The subject’s mouth was then swabbed again, but with a different sterile swab. The bacterium was then put on the “ After” side of the nutrient agar in the petri dish in a similar zigzag pattern. The finished sample was then placed upside down so that the condensation would rise onto the bacteria to keep it humid and moist. This process was repeated for all of the subjects with each type of toothpaste. A total of 12 subjects were tested – 6 males and 6 females all approximately 14 years old.

Step 4: Growing the Bacteria

- The samples were placed in an incubator for 36 hours at 37°C.

Step 5: Observing the Results

- Pictures and digital scans of some samples were taken. Each cluster/colony of bacteria were counted and recorded. This photograph shows a sample with a high concentration of colonies.



Step 6: Making Slides

The glass slides were cleaned with ethanol to make them clean and free of grease. Six slides were marked according to the sample put on it. An inoculating loop was flamed, dipped in the saline water (salt water) and put it on the slide. The inoculating loop was flamed again then a small sample of bacterium was spread out in the saline water. These steps were repeated for the before and after of a male sample, a female sample and someone who had braces. The smears were then heat-fixed by passing the slides rapidly through the Bunsen flame three times so that the smears will not wash off. The slides were then placed on a staining rack and flooded with methylene blue so that the bacterium could be identified.

Observing and Recording Data

We examined all the slides with microscopes. We noticed that the bacteria was grouped together in clusters making it staphylococci, and because the bacteria are epithelial cells, the bacteria we have found growing in people's mouths are called staphylococcus epidermis. Staphylococcus epidermis is a normal flora, which means that it is not harmful, and it is supposed to be there. Even though this bacteria is not dangerous, the harmful bacteria that cause tooth decay leech off the staphylococcus epidermis, making large amounts of this bacteria in peoples mouths not a good thing. The only way to really tell if the toothpaste worked is if after the subject brushed, there is less staphylococcus epidermis then before. This means that it cleansed the mouth of the bacteria. Arm & Hammer All-In-One toothpaste however shredded the mouth, thus producing more staphylococcus epidermis after brushing than before as is evident in our findings. This same concept is seen when a salty substance is eaten.

Organizing and Analyzing Results

To accurately measure the amount of staphylococcus epidermis, we divided the petri dish in half horizontally then counted each individual colony. We then calculated a percent increase or decrease from the before and after counts. We then calculated an overall percentage increase or decrease for each toothpaste from all results.

The averages of all four tests were as follows: Baron-Paste Entire had a 43% decrease in bacteria, Crest Complete had a 42% decrease in bacteria, Colgate Total had a 34% decrease in bacteria and Arm & Hammer All-In-One had a 12% increase in bacteria.

We were concluded that Arm & Hammer had an increase in bacteria because it shredded the mouth, instead of cleansing it. To prove this information either correct or incorrect, one of us brushed our teeth for 2 minutes with ¼ tsp of Colgate Total, swabbed our mouth then repeated this process 10 times to see if constant brushing would shred the mouth. We determined that the brushing did shred the mouth, because after counting the bacteria, we noticed that the amount of bacteria increased almost every time.

We also wanted to discover how long after brushing, the bacteria would grow back. To investigate, we brushed our teeth, swabbed, waited 2 minutes, swabbed and repeated the swabbing and waiting process 10 times. We noticed that the amount of bacteria increased almost every time, leading us to the conclusion that bacteria starts growing back right away.

We noticed that girls had more staphylococci epidermis in their mouths than boys, even though they brushed for the same amount of time, with the same toothpaste, with the same amount of toothpaste and with the same brand of toothbrush. We theorized that this could be so because

girls could have more sensitive gums. We later confirmed our theory by talking to periodontist, Dr. Thibault. He told us that female gums become more sensitive during hormonal periods. Such as, pregnancies (this is known as pregnancy gingivitis), menstruations and in pre-pubescent and pubescent female teenagers.

7. Conclusions

In our experiment we wanted to find the most efficient working toothpaste for the lesser cost. We also wanted to see if we could create toothpaste that works just as efficiently and for the same, or a better price. Fortunately and unexpectedly, our toothpaste endeavor was a complete success. Because some of the toothpastes contain much salt, the mouth is shredded, causing there to be more staphylococcus epidermis. The reason for this being a bad thing is that it means the toothpaste did not cleanse the mouth, also the staphylococcus epidermis is what tooth decay causing bacteria feed off of. Out of the brand name toothpastes, we found that Crest Complete cleanses the mouth the best. Our information is extremely relevant to everyday life because the majority of people brush their teeth at least twice everyday. Our toothpaste however, cleanses the best and is the most cost effective - our philosophy is very similar to the cough syrup "Buckley's", it tastes awful, but it works!

8. Acknowledgments

We would like to thank Mrs. Carole Larocque from Cambrian College for her technical help as well as the use of the Chemistry lab and equipment. We would also like to thank Mr. Jeff Walker for his help with the video production. The most thanks however, has to go to the student volunteers from R.L. Beattie Public School who endured our toothpaste and after many teeth brushings perhaps have the cleanest teeth in all of Canada.

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