THE EFFECT OF BAKING SODA AND ANTACIDS ON ACIDS

by

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Honors Science

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This is an example from a previous year of a good literature review.

For the literature review assignment, you only fill in the essay under literature review & the references page at the end.
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STATEMENT OF THE PROBLEM

What is the effect of baking soda vs. over the counter antacids on neutralizing the acids?
HYPOTHESIS

If baking soda is added to acids, then it will work just as well as an OTC antacid to neutralize the acid and remedy heartburn.
LITERATURE REVIEW

Millions of people worldwide are affected by heartburn. Most of these people turn to over-the-counter antacids to get adequate relief for this burning sensation below their breastbone (Lutz, 2000). Although they do their job, these antacids can get expensive if people keep using them to get relief for their daily heartburn. There could possibly be a cheaper alternative. People who suffer from heartburn who have financial problems would benefit greatly from a solution to this common ailment.

Heartburn, or gastroesophageal reflux (GER), is inappropriately named because it actually has nothing to do with the heart. Gastroesophageal reflux occurs when stomach contents flow into the esophagus (Tighe, Afzal, Bevan, Beattie, 2009). Seven to ten percent of the world experiences heartburn every single day (Berardi, 2004). Fortunately, GER cannot kill its victims. Most people experience heartburn when they lie down after a large meal. There are many symptoms for heartburn, including a sour taste in the mouth, trouble breathing while sleeping, sore throat, choking when lying down, trouble swallowing, and the most common symptom, burning sensation behind the breastbone (Edison, 2001). Asthma symptoms are increased with heartburn, and overweight people are more likely to experience heartburn.

There are certain things that can trigger heartburn, including rich or spicy foods, heavy meals, eating too fast, chocolate, garlic, onions, peppermints, tomatoes, citrus fruits, smoking, lying down after eating, drinking alcohol or coffee, wearing tight clothing, swallowing too much air, and pregnancy (Powell, 2006). Infants can also experience GER, mostly because of their not yet fully developed digestive system (O’Mara, 2008). As of yet, there are no cures for GER, but there are ways to prevent this uncomfortable sensation. One way is to wear clothing that is loose
around the abdomen (Powell, 2006). Gastroesophageal reflux disease (GERD) is when people experience heartburn two or three times a week, or when GER is long-lasting. “Individuals who suffer from frequent heartburn indicate that it limits their food choice, disrupts work, sleep, and social events, and reduces their overall well-being,” (Berardi 2004).

Many people who experience GER or GERD turn to over the counter (OTC) antacids to subside the pain. “Antacids are weak bases used to neutralize the acid (HCl) that causes heartburn,” (Kim, 2008). The problem with this is these medicines can get expensive over time. Professionals do not recommend using these antacids because “their duration of action is limited and multiple doses are required…OTC antacids neutralize gastric acid in order to work,” (Berardi, 2004). Also, using antacids is proven to increase pneumonia risk by four point five percent (Seppa, 2004). There may be an alternative substance to relieve the pain of heartburn. Baking soda and milk is an old remedy for heartburn (Lutz, 2000).

Everything about heartburn is due to the chemical reaction of acids and bases. “The Latin word for acid, acidus, means sharp or sour…An acid’s acidity is due to hydrogen ions it releases in water. An acid’s strength depends on how many hydrogen ions it forms in water,” (Gardner, 2009). An acid is a substance that can neutralize a base. A base is a substance that can neutralize an acid. “Bases are also called alkalis, a word that means ashes,” (Gardner, 2009). An acid has a sour taste, while a base has a bitter taste. “An alkali is any compound having highly basic properties, strong acrid taste, and ability to neutralize acids. Their pH is above 7 and turns litmus paper to blue,” (Othmer, 2007). Litmus paper is a strip of special paper that has the ability to change color when an acid or base is applied to it. The paper turns blue in bases, and turns red in acids. Litmus paper is useful to determine if a substance is an acid or a base, but
there is another method that can be used to determine how acidic or basic a substance is. They are called pH test strips.

pH stands for “potential of hydrogen. This term shows the concentration of hydrogen ions in a solution,” (Kim, 2008). pH test strips are useful when determining how acidic or basic a substance is. They come with a color-coded scale. Each color represents a different number for how acidic a substance is. If the number is less than 7, then it is an acid, higher than 7 is a base, and if the number is 7, then it is a neutral. However useful these strips are, there is a problem with using this method. Sometimes, it can be difficult to determine exactly what color the strip turns.

There have been many tests to determine how acidic or basic a substance is. Included in these, there have been many tests to determine the effect of antacids on acids. The producers of the OTC antacids were required to test the effect of these antacids to see if they work or not. These test results had to have been returned successful in order to sell these products. One specific experiment found that Tums worked more efficiently than Maalox or Alka Seltzer. The ending pH of the Tums was higher, which means less acidic, than the other two variables. (Coker-Kerr, 2010). No one has tested if baking soda, a common household antacid, works better than or just as well as OTC antacids.

This new, improved experiment will be comparing these two variables. The purpose is to provide a cheaper alternative to OTC antacids when experiencing heartburn. Baking soda will be added to vinegar and the pH will be recorded using pH test strips. Two OTC antacids will be added to vinegar and the pH of both will be taken and recorded separately. These are the independent variables. The results, the dependant variables, will be compared to the original pH of the vinegar, which is the control group. The hypothesis is that baking soda will work just as
well as the OTC antacids in neutralizing the vinegar. The most important constant is the acidity of the starting vinegar. The same vinegar will be used in each test in order to maintain the same pH of the starting vinegar. This experiment differs from other experiments because it not only compares OTC antacids to other OTC antacids, but it compares it to baking soda as well.

A cheaper alternative to remedy heartburn is needed by many who have financial troubles. This experiment will attempt to find one. Baking soda will be used as an antacid to neutralize vinegar and is hypothesized to work just as well as OTC antacids to remedy heartburn.
MATERIALS

Four small Tupperware containers
1.8 L of distilled white vinegar
60 pH test strips
7.5 teaspoons of baking soda
30 TUMS tablets
30 teaspoons of Maalox
PROCEDURES

1. Pour 120 ml of distilled white vinegar into 4 small Tupperware containers.
2. Take the pH of the vinegar in the first container. This is the control group.
3. Record the pH of the control group on a chart.
4. Each antacid added to the vinegar will be the independent variable.
5. Add 1/2 teaspoon of baking soda to a different container.
6. Take the pH of the container with the baking soda using a pH test strip after the substance has dissolved.
7. Record the pH of the container with the baking soda on a chart.
8. Add two TUMS tablets to another container.
9. Take the pH of the container with the TUMS after the substance has dissolved.
10. Record the pH of the container with the TUMS on a chart.
11. Add two teaspoons of Maalox to the remaining container.
12. Take the pH of the container with Maalox after the substance has dissolved.
13. Record the pH of the container with Maalox on a chart.
14. The pH of all the containers with the antacids is the dependant variable
15. Repeat the process until there has been 15 trials. The containers and the testing environment will stay the same. These are the constants.
16. Compare the data and the come to the conclusion, based on the pH levels of the acids with the baking soda compared to the OTC antacids.
RESULTS

Heartburn affects millions of people worldwide. This experiment was conducted in order to find an alternative remedy for heartburn, other than over-the-counter antacids. The independent variable in this experiment was the type of antacid used to neutralize the acid, which, in this case, was vinegar. In this experiment, the antacids used were Maalox, TUMS, and Arm & Hammer Baking Soda. The dependent variable was the pH of the containers of vinegar after the antacid was added to them. The untreated vinegar was the control group and did not change throughout the experiment.

The mean in pH for the vinegar, the control group, was 2, for Maalox was 2, for TUMS was 4, and for the baking soda was 5, as shown by Table 1. All fifteen trials had the same results for each variable, so the results are well supported and accurate. Maalox always had a pH of 2, so it seems as if it did not work at all in neutralizing the vinegar, which also had a pH of 2, keeping in mind that the higher the number, the less acidic and more basic it is. None of the antacids fully neutralized the vinegar, but that was not expected. In order for the vinegar to be fully neutralized, the antacids would have had to have a pH of at least 7. The highest in this experiment was the baking soda with a pH of 5, which is still considered an acid.

The null hypothesis is if baking soda is added to an acid, it will not work as well as an over-the-counter antacid to neutralize the acid and remedy heartburn. The alternative hypothesis is if baking soda is added to acids, then it will work just as well as an OTC antacid to neutralize the acid and remedy heartburn. The baking soda actually worked the best out of the other given antacids. Knowing this, the null hypothesis was rejected and the alternative hypothesis was supported, as shown by Figure 1 and Table 1.
TABLE 1: COMPARING THE EFFECTIVENESS OF ANTACIDS IN pH

<table>
<thead>
<tr>
<th>Type of antacid</th>
<th>Vinegar</th>
<th>Tums</th>
<th>Baking Soda</th>
<th>Maalox</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH of antacid</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>2</td>
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FIGURE 1: COMPARING THE EFFECTIVENESS OF ANTACIDS IN pH
CONCLUSIONS

This experiment was conducted in order to find an alternate remedy to heartburn, which affects millions of people worldwide. The experimental hypothesis, if baking soda is added to acids, then it will work just as well as an OTC antacid to neutralize the acid and remedy heartburn, was supported. As seen from Figure 1 and Table 1, baking soda had an ending pH of 5, making it the most effective antacid tested in this experiment. The runner-up antacid was TUMS, with a pH of 4, and Maalox with a pH of 2. Maalox was completely ineffective in neutralizing the vinegar with a pH of 2. This experiment suggested that there is a cheaper, effective alternative to TUMS or Maalox in order to remedy heartburn.

As explained in the literature review, heartburn is caused by the acids in a person’s stomach flowing up the esophagus. This process is also known as acid reflux. That is where the antacids come in to play. The antacids neutralize the stomach acid, reducing the burning sensation. So, if someone is experiencing heartburn, they can just ingest baking soda, a common household antacid. It is cheaper, and even more effective than some over-the-counter (OTC) antacids.

However, there are some uncertainties and errors. It is possible that the pH test strips were not always accurate. The colors shown could easily be misread, causing the wrong pH number. The numbers on the pH test strip ranged from 1 to 14 with an incline of 1.0, causing the readings to be slightly vague. Also, the antacids might not have been left in the vinegar long enough to have fully finished neutralizing the acid. There are also some limitations on the availability of pH test strips. Appropriate test strips must be ordered online, as most of the ones found in stores are meant to be used for soil or pool testing.
Based on these errors, there are some improvements that could be made regarding the pH test strips. The strips used could incline by decimal points, which would help to make the results more exact. Also, the antacids could be left in the vinegar longer than what it takes to fully dissolve the substance, about five minutes. The results can be generalized to most humans. The only people who could not use this information are the people who do not experience heartburn once in a while. Many people would benefit from these findings. If this experiment was continued, it could test how long the effects of the antacids last. For example the pH could be tested after 1 minute, 2 minutes, 5 minutes, and so on. Now that baking soda is shown to reduce the acidity of vinegar, it could be tested to see how long these effects last. This could be a possible direction this experiment will take if it is continued.
REFERENCES - THIS SHOULD BE CENTERED


