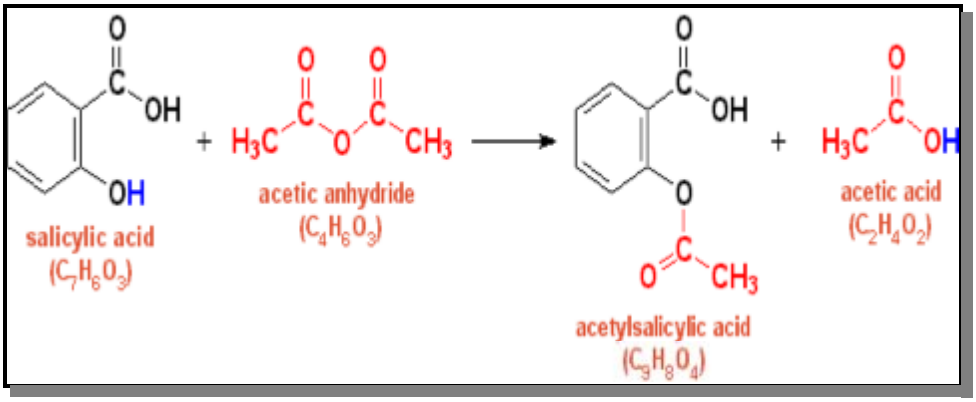
CAN YOU STOMACH IT?

ASA works by blocking enzymes. It blocks cyclooxgenase- 2 (COX-2) which promotes inflammation, pain, and fever. COX-2 produces prostaglandins which causes people to become sensitive to pain. By inhibiting production of prostaglandins, aspirin diminishes the body's response to a chain of chemical processes that eventually lead to pain. The ingestion of aspirin also inhibits the COX-1 enzyme which maintains the thickness of the stomach lining.

Purpose: To compare the percentage ASA and the effective buffering capacity of various of pain relievers that contain ASA.

Hypothesis: If the percentage ASA increases in a pain reliever, then the buffering capacity of the pain reliever will also increase.

Method: Several titrations were completed with a standardized base. Tablets containing 80mg, 325mg, 500mg, 500mg + caffeine and crude product ASA were each titrated with $NaOH_{(aq)}$. The pH changes were noted during each titration and were used to create titration curves. The buffering region in these curves occurred where there was minimal change in pH. The buffering region of the tablets increased as amount of ASA in the tablets increased.



The Synthesis of Aspirin- An esterfication reaction.

Observations:

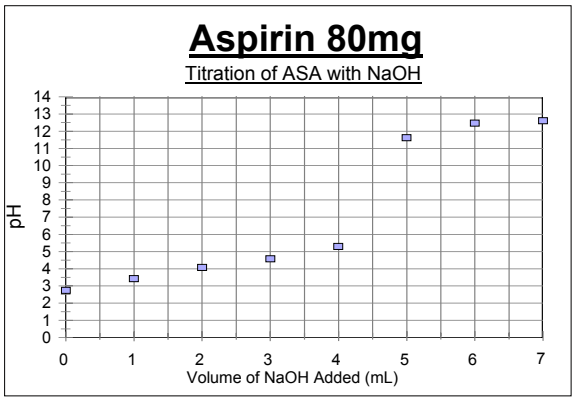


Figure 1- Determining the buffering region of 80mg ASA by titrating tablet with

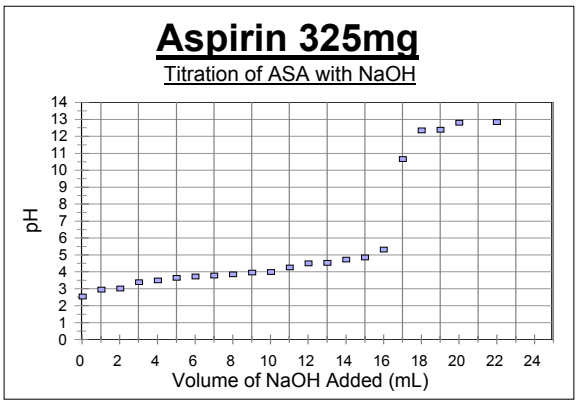


Figure 2- Determining the buffering region of 325mg ASA by titrating tablet with

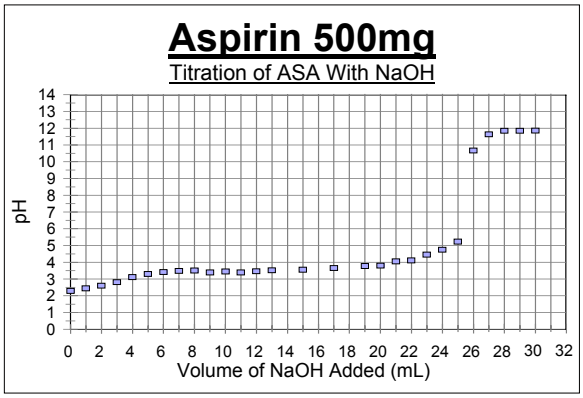


Figure 3 -Determining the buffering region of 500mg ASA by titrating tablet with

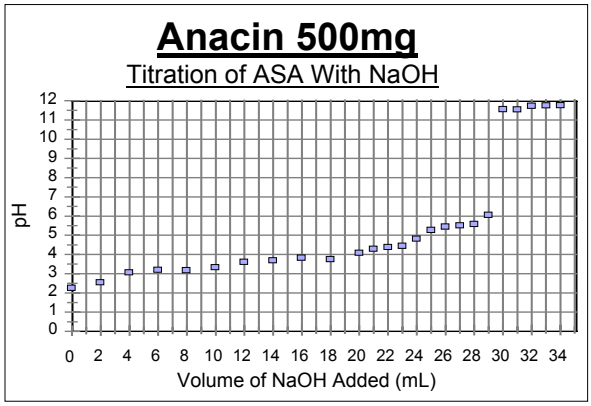


Figure 4- Determining the buffering region of 500mg ASA in Anacin by titrating tablet

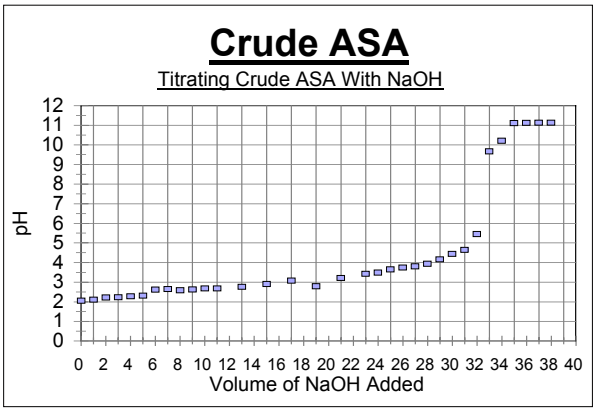


Figure 5- Determining the buffering region of crude ASA.

Discussion:

The aspirin buffer works because the concentration of the weak acid and its salt are large compared to the amount hydroxide ions added. When hydroxide ions are added to the solution, protons are dissociated from some of the weak-acid molecules of the buffer, converting them to the base of the buffer.[1] The tablet with the greatest buffering capacity was the tablet with the highest quantity of ASA. One possible explanation for this is that if there is a greater amount of ASA, more will have to be converted to sodium acetylsalicylate (aspirin's conjugate base). Therefore, a greater amount of $NaOH_{(aq)}$ will be needed to consume all of the ASA in the tablet.

When aspirin is titrated with $NaOH_{(aq)}$, it forms salt (sodium 2-ethanoyloxybenzenecarboxylate) and water:

$$C_8H_7O_2COOH_{(aq)} + NaOH_{(aq)} \text{ ----> } NaC_8H_7O_2COO_{(aq)} + H_2O_{(l)}$$

(weak acid) (strong base) (salt) (water)

Buffering capacity (greatest to lowest):

1. Crude Product
2. Aspirin 500mg & Anacin 500mg
3. Aspirin 325mg
4. Aspirin 80mg

As aspirin moves from the stomach to the small intestine, the pH of the system rises to 5.5-6.4. At this pH, the aspirin is 'activated' and the aspirin de-protonates. The aspirin is now in it's ionizable form and becomes very soluble.[16] Aspirin in it's ionizable form:

$$HC_8H_7O_2CO_{2(aq)} \rightleftharpoons H^+_{(aq)} + C_8H_7O_2CO^-_{2(aq)}$$

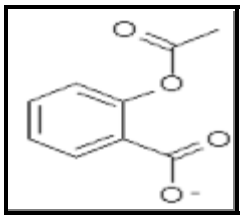
The neutral aspirin that still remains in the small intestine passively moves through the membrane and can be absorbed by the blood. The charged form of aspirin still cannot readily pass through the membrane. Le Chatelier's principle explains that the movement across the membrane removes

neutral aspirin from the intestine. Therefore, the chemical equilibrium between the neutral and ionized form of aspirin is changed and some of the ionized form will bind a proton to re-establish the equilibrium. This occurs repeatedly until all of the aspirin is dissolved.

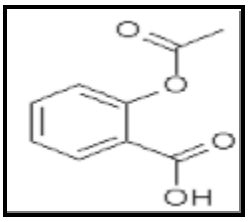
Conclusion:

If aspirin has a high buffering capacity when it enters the stomach it is more difficult for it to become ionized. Therefore, the more neutral form of aspirin is found in small intestine and absorbed more readily through the membrane. This aspirin will work more quickly in the body because more neutral forms of it are available to pass through the membrane. Even though pain relief will occur more quickly than in lower dose aspirin, negative effects on the stomach lining will also occur more quickly. As aspirin quickly enters the bloodstream, it inhibits the enzyme COX-1. Therefore, the stomach lining becomes thin allowing the digestive juice inside to irritate it.

On the other hand, aspirin that has a low buffering capacity will be present mostly in the ionizable form, therefore, the equilibrium will have to shift before it begins to be absorbed by the membrane in the intestine. Even low-dose aspirin is known to cause stomach irritation because *any* inhibition of prostaglandin synthesis in the stomach will lead to damage.



acetylsalicylic acid in neutral and basic solution (water soluble)



acetylsalicylic acid in acid solution (fat soluble)

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