Determination Of the Effectiveness and Acid Neutralization Capacities (ANC) Of Some Commercial Antacid Tablets

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Abstract- ***This study involves the evaluation of the effectiveness and acid neutralizing capacities (ANC) of five different commercial brands of antacid tablets. Antacids are substances commonly used by patients to obtain fast symptomatic relief from unpleasant feeling such as pain or burning sensation in the stomach or chest that is caused by difficulty in digesting food (dyspepsia or acid-indigestion). They are weak bases which neutralizes excess stomach acid and consequently raises the pH of the gastric contents and thus relief pains and alleviate symptoms of heartburn. The ultimate goal of antacid therapy is to reduce the concentration of acid in gastric juice to a pH of 4-5. The potency of the antacids depends mainly on their acid neutralization capacity (ANC) and this can vary from one brand to another. Five different but widely used commercial antacid tablets were selected for the purpose of this study. Each of the sample tablet was purchased, crushed, weighed and kept at room temperature before being analyzed using titrimetric method (back titration). The volume of the excess acid neutralized by NaOH for each of the antacid solution were Gelusil (Danacid) (9.50 ml), Gestid (16.80 ml), Omeprazole (Krishat) (15.30 ml), Emtrisil (13.00 ml), Gascol (12.50 ml) and Cimetidine (18.00 ml). The order of the acid neutralization capacity (ANC) of the antacid tablets from highest to lowest potency are Gelusil (Danacid) (40.5mEq), Gascol (37.5mEq), Emtrisil (37.0mEq), Omeprazole (34.7mEq), Gestid (33.2mEq), and Cimetidine (32.0mEq). Gelusil was the most active antacid with the highest value for antacid neutralizing capacity (40.5), hence, consumed the lowest volume of NaOH for the back titration process (9.50ml). Comparatively, cimetidine was the least active antacid with the lowest ANC valuen (32.0), hence, consumed the highest volume of NaOH (18.0ml).***

Indexed Terms- ***Antacids, Gastric juice, Acid neutralization capacity, Back titration.***

I. INTRODUCTION

An acid is a chemical specie (a molecule or ion) that donates protons or hydrogen ions and/or accepts electrons. Most acids contain hydrogen atom (s) that can be released (dissociate) to yield a cation and anion in water. An aqueous solution of an acid has a pH less than 7. Chemicals or substances having the property of an acid are said to be acidic (Bergström et al., 2014). The higher the concentration of hydrogen ions produced by an acid, the higher its acidity and the lower the pH of the solution (Peterson et al,. 1977). Common aqueous acids include hydrochloric acid (a solution of hydrogen chloride which is found in gastric acid in the stomach and activates digestive enzymes), acetic acid (vinegar is a dilute aqueous solution of this liquid), sulfuric acid (used in car batteries), and citric acid (found in citrus fruits). Acids can be solutions or pure substances, and can be derived from acids that are solids, liquids, or gases. Strong acids and some concentrated weak acids are corrosive, but dilute and other weak acids are not (Farzaei et al., 2013).

Antacids are group of medicines or drugs which help to neutralize the acid content of the stomach. Antacids are weak bases which on ingestion lower the acidity of the gastric contents. A base is any substance that can neutralize an acid.

Buffers usually consist of a weak acid and its conjugate base; this enables them to readily absorb excess H+ or OH–, keeping the system's pH within a narrow range. Some antacids contain a buffer that maintains the pH of the stomach. Biological buffers can be found in blood and many cells to maintain a stable pH to allow for proper function of proteins and

enzymes. Buffers create a resistance to a change in the pH of a solution.

Maintaining a constant blood pH is critical to a person's well-being. The buffer that maintains the pH of human blood involves carbonic acid (H2CO3), bicarbonate ion (HCO3–), and carbon dioxide (CO2). Bicarbonate ions combine with free hydrogen ions to produce carbonic acid, thereby removing hydrogen ions from the system hence, moderating pH changes. Similarly, excess carbonic acid can be converted into carbon dioxide gas and exhaled through the lungs; this prevents too many free hydrogen ions from building up in the blood and dangerously reducing its pH; likewise, if too much OH– is introduced into the system, carbonic acid will combine with it to create bicarbonate, lowering the pH. Without this buffer system, the body's pH would fluctuate enough to jeopardize survival.

Antacids, which combat excess stomach acid, are another example of buffers capable of absorbing hydrogen and moderating pH, bringing relief to those that suffer "heartburn" from stomach acid and other hyperacidity related problems.

Gastric acid also known as gastric juice, or stomach acid, is a digestive fluid formed within the stomach lining. Composed of hydrochloric acid (0.2 to 0.4 percent), potassium chloride, sodium chloride, and several digestive enzymes (as pepsin). Gastric acid plays a key role in digestion of proteins by activating digestive enzymes, which together break down the long chains of amino acids of proteins. Gastric acid is regulated in feedback systems to increase production when needed, such as after a meal. Other cells in the stomach produce bicarbonate, a base, to buffer the fluid, ensuring a regulated pH. These cells also produce mucus a viscous barrier to prevent gastric acid from damaging the stomach (Johnson et al., 2017), the pancreas further produces large amounts of bicarbonate and secretes bicarbonate through the pancreatic duct to the duodenum to neutralize gastric acid passing into the digestive tract. The normal volume of the stomach fluid is 20 to 100 mL and the pH is acidic (1.5 to 3.5), a level maintained by the proton pump H+/K+ ATPase.

Digestion of food in the stomach results from the action of this gastric juice which also helps to protect against microbes. The acidic nature of the stomach makes it possible for the conversion of the inactive forms of digestive enzymes into active forms, this also helps to dissolve minerals and kill bacteria that may enter the stomach along with food. However, hyperacidity which may be due to acid indigestion, otherwise known as dyspepsia or uncontrollable increase in the secretion of hydrochloric acid within the stomach, results in the unpleasant symptoms of heartburn caused by acid reflux and may contribute to inflammation and ulcer formation in the stomach lining. To protect the tissues of the body from this acid, the stomach also secretes a thick layer of mucus. If the mucus layer is worn away and stops functioning effectively, the acid can damage the stomach tissue, causing an ulcer (Shannon Johnson, 2018). Ulceration is an imbalance between the rate of secretion of gastric juice and the degree of protection afforded by the gastro duodenal mucosal barrier as well as the neutralization of the gastric acid by duodenal juice.

Ulcer is defined as erosion in the lining of the stomach or duodenum and is caused by the disruption of the gastric mucosal defense systems. Ulcer in the stomach is called gastric ulcer and in the duodenum is called duodenal ulcer and together it is named as peptic ulcer (Gopinathan and Naveenraj, 2013). Ulcer incidence varies with the type of ulcer, gender and age. Peptic ulcer is initiated as open craters or sores in the inner lining (mucosa) of the stomach or the duodenum. A coating of mucus and other biochemicals normally shield the stomach and duodenum from digesting themselves. When these protective mechanisms are disturbed, powerful digestive acids can erode into the lining of these organs and cause ulcers. Stomach ulcers, which are also known as gastric ulcers, are painful sores in the stomach lining. Stomach ulcers are a type of peptic ulcer disease. Peptic ulcers are any ulcers that affect both the stomach and small intestines (duodenum). Some common causes might be an infection by the bacteria pathogen called Helicobacter pylori, or long-term and frequent use of non-steroidal anti-inflammatory drugs (NSAIDs) such as aspirin and ibuprofen, and high acid secretion. Other causes of peptic ulcer are smoking, alcohol consumption, psychological stress and irregularity in diet and other factors that make heartburn worse such as stress and

spicy foods. The classic symptom of a stomach ulcer is indigestion, also called dyspepsia. Indigestion causes pain or discomfort in the stomach area. This symptom can be mistaken for heartburn, which can occur at the same time.

Stomach ulcer symptoms tend to be more distinct than heartburn, but symptoms can still be vagus. An ulcer tends to produce a burning or dull pain in the stomach area. This pain is sometimes described as a "biting" or "gnawing" pain. Some people may describe a hungry sensation. Other symptoms include: Weight loss, Nausea and vomiting, Not eating because of pain, Burping, Bloating. Dietary changes can help prevent stomach ulcers from developing. People at risk of stomach ulcers should include more of the following nutrients in their diet: Fruits and Vegetables, Fiber, Probiotics, Vitamin C, Zinc, Selenium.

Reduction of gastric acid production using proton pump inhibitors (PPI) that block acid producing cells, H2-receptor antagonists, which prevent the stomach from producing excess acid as well as re-enforcement of gastric mucosal production has been the major approaches to cure peptic ulcer. As a result, numerous drugs have been introduced from time to time, offering newer options for treatment of peptic ulcer.

One of the quickest and easiest ways to control hyperacidity, neutralize the excess acid and stop the painful burning sensation in the stomach is to consume an antacid tablet. Antacids being one of the oldest and most effective remedies for indigestion and other stomach acid-related issues, are most commonly weak bases which interacts and counter the effects of the excess stomach acid, through the chemical process of neutralization (Johnson et al., 2017). Antacids are the substances most commonly used by the patients to obtain fast symptomatic relief from dyspepsia. They are the week base which neutralize the gastric acid and raise the pH of the gastric contents (Jagadeshi 2015). The symptomatic relief of pain produced is mainly by reducing the acidity and partly by consequent relief of the muscle spasm. Reduction in the acidity also inhibits the activity of pepsin . Antacids also increases the tone of the lower esophageal sphincter and hence reduces the reflux of the acid and gastric contents into the esophagus (Sathoskar et al., 2009). Antacids are the mainstay of gastric ulcer therapy. Several controlled studies have established their efficacy in ameliorating peptic and duodenal ulceration. Drugs that are more effective than antacids in healing ulcers and relieving the symptoms of gastro-oesophageal reflux are available, but many people still use over-the-counter antacids to treat dyspepsia and heartburn. Despite competition from new H2-receptor blockers, antacids are still prescribed in large quantities. (Tripathi, 2008)

Several antacid tablets are available over the counter and sold under various commercial names such as Maalox, Mylanta, Rolaids, Tums, Gaviscon, Alka-Seltzer, and Rennie, among others. However, while it is assumed that the antacid as a whole actively contributes to the counter action of the acid, the active ingredient performs the main role of neutralization.

The most common active ingredients come in the form of carbonates, bicarbonates, trisilicates and hydroxides. For instance, the majority of companies use sodium bicarbonate ($NaHCO3$), magnesium hydroxide ($Mg(OH)2$), aluminum hydroxide ($Al(OH)3$), or calcium carbonate ($CaCO3$) as the weak base (active ingredients) which counteracts the stomach acid (International Foundation for Functional Gastrointestinal Disorders, 2015).

Through the characteristics of its quick dissolution and rapid buffering effects, in addition to its rapid gastric acid neutralization qualities and high acid neutralization capacity, magnesium hydroxide ($Mg(OH)2$), otherwise known as milk of magnesia, is one of the most effective and widely used active ingredients for antacids (Zajac et al., 2013). Due to its low solubility in water, magnesium hydroxide is considered an ideal compound because rather than dissolving wholly at once, it slowly dissolves as it neutralizes (Massachusetts Institute of Technology, 2010).

The potency of the antacids depends upon their acid neutralizing capacity (ANC).

The antacid neutralizing capacity varies from one another depending upon their formulations. (Jagadeshi 2015). The therapeutic efficacy and the adverse effects depend upon the metallic ion with which the base is combined. The common metallic ions combined with

the base are aluminium, magnesium or sodium (Bennett and Brown, 2008). Antacids can be classified as systemic antacids or non systemic antacids. Systemic antacid undergoes complete systemic absorption following oral ingestion, like sodium bicarbonate. The non systemic antacids are those that does not undergo systemic absorption following oral ingestion. The most commonly used non systemic antacids are aluminium hydroxide, aluminium phosphate, magnesium trisilicate, magnesium hydroxide, magnesium carbonate and calcium carbonate. (Smith and Arson, 2017)

The systemic antacid most commonly used is sodium bicarbonate. It is white in colour, water soluble and completely absorbable antacid. It reacts with the gastric acid to form sodium chloride, water and carbon dioxide. It is an effective and rapidly acting antacid. The carbon dioxide liberated during the process of acid neutralization often gives a sense of relief from the abdominal discomfort. One the adverse effect of sodium bicarbonate as a result of its systemic absorption is the problem of "alkalosis". The sodium chloride formed may result in the retention of fluid and the carbon dioxide liberated may cause nausea, belching, flatulence, cramps, fullness and rupture of the already formed and swollen peptic ulcer (Dandan et al., 2014).

Among the non systemic antacids, aluminium hydroxide reacts with the gastric acid to form aluminum chloride. The advantages of aluminium hydroxide are that it has astringent and demulcent property by which it forms a protective coating over the ulcer crater. It may also absorb toxins, bacteria and gases with constipation being its major adverse effect. The other adverse effects are prevention of the absorption of the phosphate from the intestine causing osteomalacia, in patients with high chronic renal failure, high aluminium concentration in the serum may cause encephalopathy and the deposition of aluminium in the bones may cause osteo-dystrophy (Pavlovic et al., 2007).

Another most commonly used non systemic antacid is Magnesium hydroxide. It is available as milk of magnesia containing 7 to 8.5% of the magnesium hydroxide. It is more palatable than the other preparation of the magnesium (Neuvonen, 1991). The major adverse effect of the magnesium hydroxide is diarrhea. Clacium carbonate occurring as a white powder with chalky taste is also used as non systemic antacid. It reacts with the gastric acid to form the calcium chloride. The major side effect of calcium carbonate is that it increases the gastric and basal gastric acid secretion level above the basal level (Bhardwaj and Sharma, 2011). There is non systemic absorption of the bases (active ingredients) among non systemic antacids, because the salt formed with combination of the gastric acid combines with the bicarbonate in the intestine to form the original base which is excreted in faeces (Moayyedi et al., 2003)
Alginic acid may be combined with the antacid to encourage the adherence of the antacid to the mucosa and it also acts like a protective to the gastric mucosa. Simethicone or disemethicone are included in the antacid as a foaming agent to reduce flatulence by lowering the surface tension and allowing the small bubbles of froth to coalesce into large bubbles that can easily be passed from the stomach down the colon thereby reducing the pains associated with ulcer and other hyperacidity related problems (Houshia et al., 2012).

The effectiveness of an antacids depends upon its acid neutralizing capacity. Acid neutralizing capacity of an antacid is defined as the number of mEq of 1N HCl that are brought to the pH of 3.5 in 15 minutes by a unit dose of the antacid preparation. Ways of Determining the Effectiveness of antacids are the use of pH Meter and Back Titration Methods.

Presently, there are different antacid tablets available in different formulations in the market. Hence, the purpose of this study was to

i. Determine the acid neutralizing capacity of different commercial antacid tablets and how they compare.
ii. Know which of these antacid tablets could neutralize stomach acid the more.
iii. Compare theoretical and experimental results.

II. MATERIALS AND METHODS

Antacid Samples: The antacid samples, major composition, and recommended dosage used in this study are shown in table 1 below

S/N	Sample Name/Brand	Major Ingredients (Composition)	Recommended Dosage
	Gelusil (Danacid)	Magnesium Trisilicate ($Mg2O8Si_3$) B. P. 250mg Dried aluminum hydroxide ($Al(OH)_2$) B. P. 120mg	2 tablets
	Gestid	Dried aluminum hydroxide ($Al(OH)_2$) B. P. 300mg Magnesium Trisilicate ($Mg2O8Si_3$) B. P. 50mg Magnesium hydroxide ($Mg(OH)_2$) USP 25mg Simethicone ($C_6H_{18}O_4S_{i3}$) USP 10mg	2 tablets
	Omeprazole (Krishat)	Omeprazole ($C_{17}H_{19}N_3O_3S$) USP 20mg	1 tablet
	Emtrisil	Magnesium Trisilicate ($Mg2O8Si_3$) B. P. 50mg Dried aluminum hydroxide ($Al(OH)_2$) B. P. 300mg Magnesium hydroxide ($Mg(OH)_2$) USP 25mg Simethicone ($C_6H_{18}O_4S_{i3}$) USP 20mg	2 tablets
	Gascol	Magaldrate containing magnesium hydroxide ($Mg(OH)_2$) Aluminate complex AL_2O_3 Simethicone ($C_6H_{18}O_4S_{i3}$)	2 tablets
	Cimetidine	Magnesium stearate, corn starch, sodium starch glycolate	2 tablets

- Reagents: Wash Bottles, distilled water, phenolphthalein, Standardized 0.01M NaOH, Standardized 0.01M HCl.

- Apparatus: Weighing balance, Bunsen burner, conical flasks, Stirring Rod, Burette, and titration apparatus (burette, pipette e.t.c).

Methods

- Sample collection: The antacid tablets were purchased and collected from pharmacy shops in Auchi, Edo State, Nigeria. The tablets were certified by a professional pharmacist as appropriate.
- Sample Preparation

Each of the antacid tablet was weighed and the mass recorded. The antacid tablets (per dose) were also weighed and recorded. Each of the weighed tablet was transferred into clean mortal and crushed into fine powder using the pestle. The crushed antacid tablets were transferred into a 250ml beaker each and labelled with their corresponding names.

- Determination of the Acid Neutralization Capacity of the Different Antacid Tablets

Fifty (50)ml of 0.01M HCl was measured into the flasks containing each the crushed antacid tablets. The mixtures were stirred and heated for about 15 seconds to ensure complete dissolution, cooled and three (3) drops of phenolphthalein indicator were added to each of the mixture. The amount of unreacted HCl (Excess HCl) remaining in the solution was determined by back titration of the solution with a standard solution of NaOH (0.01M). The performance of the antacids are intended to reflect their in-vivo efficacy.

The following procedural steps were used to determine the amount of acid neutralized by the different antacid tablets.

1. Each of the crushed antacid tablet (per dose) was transferred into a beaker (250 ml) and labelled with the corresponding name.
2. Using the graduated measuring cylinder, 25 ml of 0.1M HCL was measured and carefully poured into the beaker containing the ground or crushed antacid powder.
3. The beaker was swirled to help dissolve the antacid and a stirring rod was gently dropped into the beaker.
4. The solution was heated and stirred for three minutes to drive off any CO_2 still dissolved in the solution as a result of reaction of carbonate in the solution with HCl.
5. The beaker was removed from the heating mantle and allowed to cool.

6. Three to four drops of phenolphthalein indicator was added to the antacid solution in the beaker.
7. The burette was clean and using a funnel, it was filled to the 0.00 mark with standardized 0.01M solution of NaOH and titrated (back titration) into the HCl solution of the antacid to the phenolphthalein endpoint.
8. The volume of NaOH used for the titration was recorded.
9. The procedure was repeated with the other antacid tablets samples.

CALCULATIONS

The amount of acid that reacted with NaOH is the neutralizing capacity of the antacid tablet (ANC). The Acid Neutralizing Capacity (ANC) of the different antacid tablets were expressed in terms of milliequivalents (MEq) of acid consumed per dose of the antacid tablets as follows;

Volume of Acid Neutralized by NaOH= V_{HCl} X C_{HCl} = V_{NaOH} X C_{NaOH}

Where

V_{HCl} = Volume of HCl used (ml)

C_{HCl} = Concentration of HCl (ml)

V_{NaOH} = Volume of NaOH used (ml)

C_{NaOH} = Concentration of NaOH (ml)

Also, the amount of acid neutralized by the antacid tablets equals to the amount of acid initially present in the flask minus the amount of acid neutralized by NaOH.

Therefore,

Amount neutralized by antacid = N_{acid}initially in the beaker – N_{acid} neutralized by NaOH

i.e. $HCl_{neutralized} = HCl_{initial} - HCl_{titrated}$

RESULTS AND DISCUSSION

Table 2: Characteristic Properties of the Different Antacid Tablets

S/N	Sample Name/Brand	Weight/Tablet (g)	Weight/Dose (g)	Colour of Antacid	Colour After Dissolving Antacid in HCL	Colour After Adding Indicator to the Mixture	Colour at End Point	Litmus Paper + Solution Before End Point	Litmus Paper + Solution after End Point
	Danacid(Gelusil)	1.1	2.2	White	White	White	Pink	Turns blue litmus Red	Neutral to both red and blue litmus
	Gestid	1.2	2.4	Milkish	Milkish	Milky	Pink	Turns blue litmus Red	Neutral to both red and blue litmus
	Omeprazole (Krishat)	1.2	0.2	White	Yellow	Yellow	Pink	Turns blue litmus Red	Neutral to both red and blue litmus
	Emtrisil	1.1	2.2	Light green	Light green	Light green	Pink	Turns blue litmus Red	Neutral to both red and blue litmus

	Gascol	1.1	2.2	White	White	White	Pink	Turns blue litmus Red	Neutral to both red and blue litmus
	Cimetidine	1.2	2.4	White	White	White	Pink	Turns blue litmus Red	Neutral to litmus

Table 3: Results of the Determination of the Effectiveness of the Different Antacid Tablets

Volume of HCl solution added =25ml

Indicator used =3 drops of phenolphthalein

Solution in burette = $NaOH_{(aq)}$

Solution in beaker =solution of antacid table with HCl

S/N	Antacid Name/Brand of Sample	Initial Burette Reading (ML)	Final Burette Readings (ML)	Volume of NaOH used (ML)	Volume of Acid Neutralized by NaOH (ML)	Antacid Neutralizing Capacity (ANC) (MEq)
1.	Danacid (Gelusil)	0.00	9.5	50	9.50	40.5
2.	Gestid	0.00	16.8	50	16.80	33.2
3.	Omeprazole (Krishat)	0.00	15.3	50	15.30	34.7
4.	Emtrisil	0.00	13.0	50	13.00	37.0
5.	Gascol	0.00	12.5	50	12.50	37.5
6.	Cimetidine	0.00	18.0	50	18.00	32.0

DISCUSSION

Many products are available to relieve acid indigestion and stomach upset caused by excess stomach acid, and all of them claim to be effective. However, some must be more effective than others. One product may claim to absorb some number times it weight in acid and another may claim to have some percentage or per dose more neutralizing power than others.

To determine the amount of base in an antacid tablet (i.e the acid neutralizing power) ideally you will dissolve it in water and titrate with acid which is the case in most titration processes. But this is not an option here because the carbonates e.g. $CaCO_3$ (from mental hydroxide and metal carbonate salts) which are common ingredients in antacid are quite insoluble in water. By the time the tablet completely dissolves, you would have added too much acid. To overcome this problem, the antacid tablet is dissolved in a known

amount of excess acid, the excess acid is then neutralized with a standardized base. The excess HCl is titrated with a base such as NaOH to completely react with the excess acid. So part of the added acid is neutralized by the antacid tablet while the remaining acid is neutralized by the base added (NaOH). This is called back titration.

The equivalent point is when the number of moles of NaOH added equals the number of moles of HCl remaining after the reaction with the antacid tablet. At the end point of the titration, the excess acid has been neutralized by the bases (the antacid plus NaOH).

Therefore, the acid neutralizing capacity of an antacid tablet is the amount of hydrochloric acid that it can neutralized.

One dose of each antacid tablet was used for the determination of the acid neutralizing capacity i.e per dose of each tablet. 0.1M concentrations of HCl and NaOH were used for the analysis which is slightly higher than the average pH of 2.0 of gastric juice. The concentration of a solution with a pH of 2.0 is about 0.01M, 0.1M concentrations of HCl and NaOH were used rather than 0.01M in other for the ANCs of the tablets to be easily determined and the reaction and endpoint or equivalence point, easily noticed when it changes to pink colouration with phenolphthalein. Also, it is assumed that a 0.1M concentration of HCl represents a situation of high acidity (hyperacidity) of the gastric juice. The antacid tablet is considered ineffective at a pH of 3.

The weight of the different antacid samples per tablets were Gelusil (Danacid) (1.1 g), Gestid (1.2 g), Omeprazole (0.2g), Emtrisil (1.1g), Gascol (1.1g), Cimetidine (1.2 g). The weight per dose were Gelusil (Danacid) (2.2g), Gestid (2.4g), Omeprazole (0.2 g), Emtrisil (2.2g), Gascol (2.2g), Cimetidine (2.4g).

Table one (1) shows the brand/names of the antacid tablets used for this analysis, their major ingredients and recommended dose.

Table 2 shows the characteristic properties of the different antacid tablets.

Table 3 shows the results of the determination of the effectiveness and acid neutralization capacities (ANC) of the different antacid tablets in milli equivalent i.e milli moles of hydrogen ions (mmol H^+) consumed.

The study clearly shows that there is considerably variation in the *in vitro* ANCs of the different antacid tablet. The order of ANC values from the highest to lowest potency of the tested tablets are Gelusil (Danacid) (40.5mEq), Gascol (37.5mEq), Emtisil (37.0mEq), Omeprazole (34.7mEq), Gestid (33.2mEq) and Cimetidine (32.0mEq). Cimetidine was the least active antacid and has the lowest value for the ANC, hence consumed the highest volume of NaOH for the back titration (18.00 ml). Gelusil (Danacid) was the most active antacid and gave the highest value for ANC, hence consumed the lowest volume of the NaOH used for the back titration (9.50 ml), followed by Gascol with ANC value of 37.5mEq. Probably, the effectiveness of these drugs may be due to the present of magnesium, aluminum, and calcium salts combination in this samples. Mostly, carbonate salts are considered as very potent antacid with prolong time of action. Drake and Hollander (2012) demonstrated a tenfold difference in the ANC between the lowest and the highest effective antacid formulations. Another study established by Kibwaye *et al.,* (2010) showed that the ANC per tablet antacid varies three times among seventeen commercial products. Later on, Ebenezer *et al.,* (2015) found that the ANC of the most potent antacid formulation thirteen times potent than the least one. Because of this wide variation in the neutralization capacity, the product as well as its ANC must be known when antacid tablet is being recommended.

Furthermore, the results of this analysis showed that all the antacid tablet were active against the acid but to different levels or degree. Also, it seems that the effectiveness will follow a dose dependent pattern and depends on the concentration of the acid (stomach acid). Therefore these antacid drugs are good candidates for the management of acid ingestion, acid burns, gastritis etc.

CONCLUSION

According to Leontiadis *et al*,. (2005), one of the most important requirement of an antacid is that it

should be palatable. Naturally, it is impossible to suit every ones test with a single flavoring agent, and for this reason some preparations are marketed in various flavors or without any flavor. It is probably that such preparations as gastric mucin and amino acids might enjoy wider use of patience could stand the taste for a long enough time to achieve the necessary results. Most people who take antacid do not have any side-effects. However, side-effects occur in a small Number of users. The most common are diarrhea, constipation and belching. Magnesium-containing antacids tend to be laxative whereas aluminium-containing antacid tend to be constipating. Antacid containing both magnesium and aluminium may balance out these effects and so minimize any possible side-effect of diarrhea or constipation.

From the results of this analysis, it is clear that the antacid tablet Gelusil was more active and is more potent because it neutralized higher amount of acid while the Cimetidine tablet was the least active and less potent.

RECOMMENDATIONS

It is recommended that further work should be carried out on other antacid drugs particularly on their cytotoxicity and tissue absorption to fully ascertain their neutralizing capacity and their ability to alleviate pains associated with dyspepsia, ulcer and other hyperac idity problems.

Antacids with higher ANC should be used to obtain faster symptomatic relief from dyspepsia and other acid related problems. It is recommended that the ANC values be included in the leaflets of the antacid products to enhance proper prescriptions.

When taking antacids, they should not be taken at the same time with other medications.This is because antacids can affect how well our medication is absorbed.

Finally, in vivo and other in vitro studies should be carried out with the use of gastric juice or at least artificial gastric juice to further ascertain the ANCs of these tablets.

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