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Evaluation of the Effectiveness of Acid-Neutralizing Property of Traditional Antacids commonly used in India

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Abstract: **Gastric acidity is highly prevalent in the Indian Population. People usually take commercially available antacids to alleviate the symptoms. Unfortunately, the use of these over the counter drugs has been so common that they are vastly overused and are taken even for mild heartburn or indigestion, which makes the underlying problem worse. The present study aimed at identifying common traditional remedies used in India to treat acidity and to evaluate their acid neutralizing capacity; and compare it with their commercially available counterparts. The acid neutralizing capacities of the traditional remedies were analyzed by Back titration method. In this method the antacid is first made to react with excess hydrochloric acid (main constituent of gastric juice), which is titrated against standard sodium hydroxide and the ability of the antacid to neutralize the base is noted, which is its antacid value. *Carica papaya* and *Curcuma longa* showed good antacid property (0.15 and 0.1) compared to others. However the acid neutralizing capacity of the popular antacids like ENO (1.7) and Gelusil (1.4) were significantly higher than the traditional remedies. However, taking into account the dangers of the overuse of these medications; one can think of traditional remedies as an alternate solution for mild symptoms.**

Index Terms: **Acid neutralizing capacity, Alternate medicine, Antacid, Gastric Acidity, traditional remedy.**

I. INTRODUCTION

Gastric Acidity in the form of heartburn, flatulence, dyspepsia, etc. is a common disorder seen to affect a vast number of people all over the world.Gastric Acidity is formed due to Excessive secretion of Stomach Acid, HCl and it can inflame the stomach and cause ulcers. "The prevalence of Gastro Esophageal Reflux Disorder or GERD was reported to be 22.2 % in southern India alone" as per a prevalence study conducted in 2016 (Wang et al., 2016)

For the relief of acidity, people commonly take antacid drugs which help to rapidly reduce the symptoms. Antacids are commonly used self-prescribed medications and are easily available in all pharmaceutical outlets as Over The Counter Drugs (OTC). According to Food and Drug Administration, antacids are medicines that neutralize stomach acids. Antacids work by either increasing the pH, neutralizing acidity, or by lowering or blocking the secretion of acid by gastric cells to reduce acidity in the stomach (Bagade et al., 2014). They also inhibit the proteolytic enzyme, pepsin (Maton and Burton, 1999).

Unfortunately, these drugs are so common that they are handed out for countless cases of mild indigestion or heartburn. "Antacids are the third most commonly sold over the counter (OTC) drugs after analgesics and antiallergics. There is lot of possibility of misuse of antacids due to their easy availability." (H et al., 2013, p. 788).

While antacid drugs may offer temporary symptomatic relief for heartburn; they are not devoid of adverse side effects. When the antacid increases the stomach pH, release of the hormone gastrin takes place-causing a high rebound secretion of HCl, thereby requiring more antacids to neutralize the increased acid output in response to gastrin. As a result, the parietal cell mass that secretes the acid ceases to function normally, resulting in low stomach acid (hypochlorhydria) or sometimes, no stomach acid (achlorhydria) (Moayyedi et al, 2003). Antacids reduce the acidity of the gastrointestinal tract and, in doing so; diminish the absorption of many nutrients. In particular, aluminum- and magnesium-based antacids are capable of binding with calcium and prevent its absorption. "Common antacids are also known to lower blood levels of phosphorus. Besides, they may also deplete B-12, vitamin D, potassium and decrease absorption of folic acid, zinc, and iron. Presence of Sodium bicarbonate and calcium

carbonate can significantly reduce iron absorption as well as blood levels of the mineral".(Smith D, 2002, p. 276).

The controversies related to the regular use of antacids and the numerous studied side effects lead one to think of alternative approaches to finding the solution for the problem of acidity that affects millions daily. Several natural antacids have been in use since time immemorial in Indian homes and most of them are common kitchen ingredients and pose no threat of any adverse effects. The present study aims at evaluating the efficacy of these traditional remedies and comparing them with the common commercially available over the counter antacid drugs.

II. MATERIALS AND METHODS

A. Selection of samples

Commonly consumed commercial antacid drugs and natural antacid remedies were identified based on a literature survey and their availability.

B. Preparation of samples

Commonly consumed commercial antacids drugs and natural antacid remedies were collected and the juice was extracted from the samples.

C. Analysis of the antacid content of the selected sample

Analysis of Acid neutralizing capacity was done following the Rossett-Rice test. Back titration method is the basis of this test. In this method, an antacid is dissolved in an excess of acid and is titrated against a known concentration of base until an endpoint is reached. The molarity of neutralized acid is equal to the difference between the moles of acid added and therefore the moles of base required for the back titration.

1) Procedure

The antacid formulation is dissolved in a known amount of surplus HCl and is titrated with an alkali, NaOH(aq) until enough OH– (from the NaOH solution) has been added to completely react with the excess H+ (from the excess HCl in the solution). A portion of the added acid is neutralized by the antacid, the remainder is neutralized by the NaOH added. An equilibrium is reached when the number of moles of NaOH added is equal to the number of moles of HCl remaining after the reaction with the antacid. HCl acts as the source of H+(aq) and NaOH as the source of OH–(aq). At the endpoint of the titration, the acid will be totally neutralized by the base.

1 g of each formulation was weighed and crushed using mortar and pestle. It was then transferred into a conical flask and 25ml of 0.1 molarity of HCL was added to each sample, 2-3 drops of phenolphthalein indicator were added. The samples were then titrated against 0.1 M NaOH. The titrations were repeated until concordant values were obtained. The experiments were undertaken under standard laboratory conditions. Standardization of HCl and NaOH was carried out as per the USP method.

2) Calculation

Eq.(1) $moles\ of\ acid\ neutralized = moles\ of\ acid\ added - moles\ of\ alkali\ required$

$= (Volume_{HCl}\ x\ Molarity_{HCl}) - (Volume_{NaOH}\ x\ Molarity_{NaOH})$

Eq. (2) $acid\ neutralizing\ capacity\ per\ gram\ of\ antacid = \frac{moles\ of\ HCL\ neutralized}{grams\ of\ antacid}$

D. Data Analysis

The antacid values of the commercial and traditional antacids were expressed as mean ± standard error of the mean (SEM). An independent t test was administered to check the difference between the different categories of antacids to check their efficacy.. Data were analyzed using the Statistical Package for Social Sciences (SPSS) (version 19.0) software. The significance level for the difference between was set at $p<0.05$.

III. RESULTS AND DISCUSSION

A. Selected commercially available antacid drugs

A number of antacids are available as over the counter drugs in all pharmaceutical stores. Common locally available antacids drugs used by the general population and those readily available in pharmaceutical outlets were selected and the details are presented in Table I.

Table I
Selected commercially available antacid drugs

Sl no	Sample	Price /unit(Rs)	Active ingredient
1	ENO	1.50	Sodium bicarbonate
2	Puthinhara	3	*Mentha piperata*
3	Digel	1.50	Magnesium hydroxide
4	Gelusil	2.50	Aluminium hydroxide
5	Carnitozine	5	Zinc carnitozine

Five common commercial antacids drugs were selected to check their acid neutralizing property. The selected samples are available in all pharmacy stores and they are available at low price. (Rs 1.5 to 5).

B. Antacid value of selected commercial antacid drugs

The results of the analysis of the antacid content of the selected commercially available antacids drugs by back titration method are given in table II

Table II
Antacids value of selected commercial antacids drugs

Antacid	ENO	Gelusil	Pudinhara	Dygil	Carnitozine
Active ingredient	Sodium bicarbonate	Aluminum hydroxide	Mentha piperata	Magnesium hydroxide	Zinc carnitozine

Weight of active ingredient per tablet	2.32 mg	2.5mg	180 mg	28mg	50mg
Weight of Tablet	1 g	1g	1g	1g.	1g
% of active ingredient	45	50	55	54	50
Volume of NaOH used for titration (ml)	8	10.2	22.5	24.2	11.5
Volume of HCl neutralized by NaOH (ml)	25	25	25	25	25
Volume of HCl neutralized by antacids	17	14	2.5	0.8	14
Moles of HCl neutralized by antacid	1.7	1.4	0.25	0.08	1.4

1 gm of each antacid tablet was taken and each of them contained strong base as an active ingredient .The higher the amount of Hydrochloric acid neutralized by antacids, the better is the acid neutralizing capacity.

The antacids property of the commercial tablet are summarized in Table III

Table III
Antacid Value of the selected commercial antacid drugs

Sl no	Sample	Moles of antacids
1	ENO	1.7
2	Pudinhara	0.45
3	Dygil	0.4
4	Gelusil	1.48
5	Carnitozine	0.94

It was observed that the tablet ENO and Gelusil showed the highest value of antacids. It shows that sodium bicarbonate and Aluminum hydroxide found in ENO and Gelusil respectively showed better acid neutralizing power, when compared to magnesium hydroxide, Zinc carnitozine and the herbal mint oil present in Pudin hara.

C. Selected traditionally used antacid remedies

In India numerous herbal remedies are used for treatment of a number of ailments. Among them symptoms of acidity such as heart burn are treated at the household level by use of substances such as ginger, cinnamon etc. The commonly used antacid remedies were identified from available literature and common practice. Ten traditionally used antacid sample were identified which are shown in Table IV

Table IV
Selected traditionally used antacid remedies

Sl no	Sample	Common Name
1	*Aloe barbadensis*	Aloe vera
2	*Ocimum basilicum*	Basil leaves
3	*Cinnamomum verum,*	Cinnamon
4	*Cuminum cyminum*	Cumin
5	*Cucumis sativus,*	Cucumber
6	*Allium sativum,*	Garlic
7	*Zingiber officinale*	Ginger
8	*Carica papaya*	Papaya
9	*Curcuma longa.*	Turmeric
10	*Honey*	Honey

They were studied to assess their antacid property .50gm of each sample were taken. Most of these substances were found in kitchens or backyards and thus they were easily available.

D Antacid value of selected traditional remedies

To assess the antacid property of the traditionally used remedies, the method used is the same as that used for commercial antacids (Back titration).the antacid property of the selected sample. The observed data are shown in Table V

Table V
Antacid value of selected traditional remedies

Antacid	**Aloe vera**	**Basil leaves**	**Cinnamon**	**Cumin**	**Cucumber**
Mass of sample (g) measured	50	50	50	50	50
Average Volume of NaOH used for titration (ml)	28.3	24.8	24.7	24.9	28.9
Volume of HCl neutralized by NaOH (ml)	25	25	25	25	25

Moles of HCl neutralized by antacid	-0.2	0.02	0.03	0.01	-0.39

E. Antacid value of traditional remedies

Table VI
Antacid value of traditional remedies

Sl No	Sample	Moles of antacids
1	Aloe vera	-0.33
2	Basil leaves	0.02
3	Cinnamon	0.03
4	Cumin	0.01
5	Cucumber	-0.39
6	Garlic	0.01
7	Ginger	-0.02
8	Honey	0.01
9	Papaya	0.15
10	turmeric	0.1

It is evident from Table VI that papaya and turmeric showed the highest antacid property (0.15 and 0.1 Moles of antacid respectively). Three of the samples had negative value which implies that they contained innate acids which used more base (std NaOH) for titration. The other samples showed varying degree of acid neutralizing capacity (0.01 to 0.15).

A study by Orwa et al. showed little acid composition in ginger, cucumber, almond and potato,on the other hand curcuma showed good antacid property (Orwa *et al*. ,2012).

F. Formulation of traditional remedies

Based on the availability of the sample and antacid value five home remedy formulae were prepared. Five formulae of 50g of each were prepared by combining two or three antacid containing substances in equal proportions. Table VII gives the details of the prepared formulae.

Table VII
Preparation of traditional remedies

Sl No	Prepared formula	Amount (g/l)
1	Cumin +Turmeric	50
2	Papaya +Honey	50
3	Turmeric +Honey	50
4	Basil leaves +Turmeric	50
5	Cumin+ Turmeric +Basil leaves	50

Five traditional formulae were made by combining the traditional remedies which possess high antacid value.

G. Antacid value of the prepared formulae

The acid neutralizing property of the prepared formulae were analyzed using back titration using standard NaOH and HCl. The result of the analytical study is stated below as moles of antacids present.

Table VIII
Antacid value of prepared formula

Sl No	Sample	Moles of antacids
1	Cumin +turmeric	0.11
2	Papaya+Honey	0.2
3	Turmeric+Honey	0.09
4	Basil leaves +turmeric	0.1
5	Cumin+turmeric+Basil leaves	0.09

From the Table VIII it is seen that, Antacids in prepared formula is slightly higher than the traditional remedies used alone. Here papaya and honey combination has good antacid property.Papaya is traditionally known to convey anti-acid and anti-ulcer effects. Chen et al. investigated the effects of papaya on ulcer and histamine induced acid secretion. The study compared the effectiveness of papaya latex treatment with the intravenous application of the enzyme, papain and concluded that it was papain that exert the ulcer-protective effect (Ezike et al., 2009).

A study conducted by Adeneye and others also gave result that among most of the conventional anti-ulcer treatment, *Carica papaya* is safe for long term use. The antacids formulated with calcium, magnesium type products work by neutralizing acid and coating the stomach wall with a chalky protective layer. The unripe C.papaya contain large amount of potassium, which possess alkaline effect (Adeneye et al., 2009). In another study *Curcuma Longa* extract showed significant results for antacid effect at different doses (Vir et al., 2014).

H. Comparison of antacid property of different categories of antacids

The effectiveness of the various remedies available was compared. Table IX provides the quantitative value of the antacid present in commercially available antacid and prepared formulae.

Table IX
Statistical analysis of commercial and Traditional Remedies

Sample	Mean	SD	P value obtained
Commercial antacids	0.994	0.5430339	0.027**
Traditional remedies	0.082	0.19352	

**significant at 5%

When a comparison of commercial and prepared formula was made, it shows that commercial has increased antacid content than prepared formula and there is a significance difference between

commercial and herbal remedies. Details of Statistical Analysis is given in Table X.

Table X

Statistical analysis of commercial antacids and Prepared formulae

Sample	Mean	SD	P value obtained
Commercial antacid	0.99	0.54	0.02234**
Prepared formula	0.12	0.02	

** Significance at 5%

When a comparison of commercial and traditional remedies was made, it shows that commercial has increased antacid content. And there is a significant difference between commercial and herbal remedies. Thus, as far as effectiveness is concerned, undoubtedly commercial antacids have an upper hand. However, taking into account the number of side effects that can affect a person on prolonged intake gives an impetus to the use of traditional remedies especially in the initial stages of mild acidity or indigestion. A study by Hoffman also showed that the benefit of using natural antacid is that there are no side effects (Hoffman, 2000). One can prepare simple, cheap remedies for acidity by combining antacid containing materials commonly used at home such as papaya, honey, turmeric, etc. Which find its use almost daily.

CONCLUSION

The side effects related to the use of antacids on a regular basis and their chances of overuse leads one to think of alternative approaches to find solution for the problem of acidity. As more and more common people approach internet search engines asking for home remedies, they are led to believe many hoaxes which are far from scientifically proven facts.

From the present study it was observed that some of the common remedies intended for acidity relief such as ginger showed little to no acid fighting capacity. In fact, some of the herbs showed little acid composition such as Aloe Vera, ginger and cucumber. The use of ginger has wide acceptance and they are commonly used among local people. However ginger is proven to improve digestion and act as antibacterial and antihelminthic agent. And its carminative properties have been mistaken for antacid character. On the other hand some of the less known remedies such as the combination of honey and papaya showed comparable acid neutralizing property. The formulae prepared from the combination of effective traditional remedies can act as quick relief of mild acid reflux at home without any fear of adverse effects.

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