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Evaluation of Acid-Neutralizing Capacity and Acid-Neutralizing Contents of Pachmeena Antacid Suspension

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ABSTRACT

Background: Hyperacidity, heartburn, acid regurgitation, flatulence and indigestion are common gastrointestinal problems that significantly affect quality of life. Emerging concerns regarding the safety of conventional therapies have increased interest in herbal formulations as natural alternatives for managing acid-related gastrointestinal conditions. Pachmeena Antacid (Mfd. Multani Pharmaceuticals Ltd.), is a sugar-free suspension containing goodness of Yastimadhu, Satavari, Haritaki, Ajwain, Methi, Khatika, and Jeera etc., ingredients traditionally used to relieve acidity, bloating, and indigestion. Objective: To evaluate the Acid-Neutralizing Capacity (ANC) and Acid-Neutralizing Contents of Pachmeena Antacid Suspension. Methods: The ANC was determined using the United States Pharmacopeia (USP) back-titration method. A 5 ml sample of the formulation was reacted with 30 ml of standardized 1.0696 N hydrochloric acid under continuous stirring for 15 min. The excess acid was back-titrated with 0.3058 N sodium hydroxide to a stable endpoint of pH 3.5. The ANC was calculated from the difference between the milliequivalents of hydrochloric acid added and the excess acid recovered by back titration. Results: Pachmeena Antacid Suspension demonstrated an Acid Neutralizing Capacity (ANC) of 19.49 mEq/5 ml. Post addition of 32.09 mEq of hydrochloric acid, 12.60 mEq of acid remained unneutralized, indicating that 19.49 mEq were neutralized by the formulation under the prescribed test conditions; confirming effective acid-neutralizing activity of the Pachmeena Antacid Suspension. Conclusion: The current study demonstrates that Multani Pachmeena Antacid Suspension has substantial Acid-Neutralizing Capacity, supporting its potential as an effective therapeutic agent for managing hyperacidity and associated symptoms like dyspepsia, flatulence and indigestion etc. The benefits may be attributed to acid neutralizing herbal contents.

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KEYWORDS: *Antacid, Acid-Neutralizing Capacity, herbal, suspension, Back titration, USP.*

INTRODUCTION

Acidity is a common gastrointestinal disorder characterized by excessive secretion of gastric acid, primarily hydrochloric acid (HCl), by the parietal cells of the stomach. This condition is associated with a wide spectrum of acid-related disorders, including gastritis, peptic ulcer disease, heartburn, dyspepsia, and gastroesophageal reflux disease (GERD). It arises from an imbalance between aggressive factors that promote gastric acid secretion and the protective mechanisms of the gastric and proximal intestinal mucosa, making it a significant global health concern that adversely affects the quality of life of millions of individuals [1,2]. Gastric juice is composed of water, electrolytes, hydrochloric acid, digestive enzymes, mucus, and intrinsic factor [1]. In healthy adults, the stomach secretes approximately 1.5–2.5 L of gastric

juice daily, with a highly acidic pH of approximately 1.5 [1,3]. Gastric acid secretion is physiologically stimulated during food intake and plays a crucial role in digestion and protection against ingested pathogens [4]. However, excessive acid production or impairment of the gastric mucosal defense system can damage the epithelial lining, resulting in inflammation, mucosal erosion, ulceration, bleeding, and pain [2]. Persistent exposure of the gastric mucosa to excess acid and pepsin contributes to the development and progression of acid-related gastrointestinal disorders [2]. Antacids are weak alkaline agents widely used as over-the-counter (OTC) medications and prescription drugs for the symptomatic management of hyperacidity and related gastrointestinal disorders. They act by neutralizing excess gastric hydrochloric acid, thereby increasing gastric pH, reducing the activity of the proteolytic enzyme pepsin, and providing rapid relief from symptoms such as heartburn, acid indigestion, dyspepsia, peptic ulcers, stomach discomfort, and GERD [5].

Owing to their rapid onset of action, antacids remain among the most frequently used medications worldwide. The global burden of acid-related disorders continues to increase, with GERD emerging as one of the most prevalent gastrointestinal diseases. Epidemiological studies indicate that approximately 35–40% of adults in Western countries experience symptoms of GERD, with nearly one-third reporting episodes at least once every month [6,7]. Consequently, billions of dollars are spent annually on antacid medications and related therapies to alleviate acid-induced gastrointestinal symptoms and improve patients' quality of life [6]. The therapeutic effectiveness of an antacid depends primarily on its Acid Neutralizing Capacity (ANC) and its ability to maintain gastric pH within the therapeutic range for a prolonged period, commonly referred to as buffering capacity (BC)[8]. Acid Neutralizing Capacity, expressed in milliequivalents (mEq), represents the quantity of hydrochloric acid that an antacid can neutralize under standardized conditions [8]. An ideal antacid should possess a high ANC and adequate buffering capacity to maintain gastric pH above 3.5 for a sustained duration, thereby minimizing acid-mediated mucosal injury and promoting symptom relief [8,9]. Accordingly, commercially available antacid formulations are commonly evaluated and compared based on their ANC, determined under standardized conditions at 37 ± 3°C, to assess their acid-neutralizing efficiency and overall therapeutic performance. Since herbal medicines have been widely used for centuries as effective remedies for the management of gastrointestinal disorders (David et al., 2015).

The current study was designed to evaluate the Acid-Neutralizing Capacity and Acid-Neutralizing Contents of Pachmeena Antacid Suspension using the USP back-titration method, manufactured by the Multani Pharmaceuticals Ltd.

MATERIALS & METHODS

Chemicals/Reagents

1 N HCL Solution (Prepared from AR Grade HCL having 35 % Purity), 0.5 N NaoH Solution (Prepared from AR Grade NaOH Pallets).

Test Formulation

Pachmeena Antacid Suspension is a Proprietary Ayurvedic Formulation manufactured by, MULTANI PHARMACEUTICALS LTD. The composition of test formulation is as below: -

Pachmeena Antacid Suspension (Batch No: FD250905, Mfg.: 09/25, Exp.: 08/27)

Each 5 mL is prepared from: *Satavari* (*Asparagus racemosus), Yastimadhu* (*Glycyrrhiza glabra*), *Mustak* (*Cyperus rotundus*), *Haritaki* (*Terminalia chebula*), *Ajwain* (*Trachyspermum ammi*), *Maricha* (*Piper nigrum*), *Methi* (*Trigonella foenum graecum*), *Jeera* (*Cuminum cyminum*), *Lavang* (*Syzygium aromaticum*), along with permitted: Excipients, Colours and Preservatives.

Experimental site

All analytical studies were conducted under controlled laboratory conditions at Eurofins Analytical Services India Private Limited, Gurugram, India, in accordance with established standard procedures and analytical protocols.

Determination of Acid Neutralizing Capacity of the Test Formulation

The Acid Neutralizing Capacity of the test formulation was determined as per United States Pharmacopeia (USP) by titration against standardized hydrochloric acid followed by back titration with standardized sodium hydroxide. In brief, 30.0 mL of 1.0 N HCl was added to an accurately measured aliquot of the test suspension while stirring magnetically; if preliminary testing indicated an ANC > 25 mEq, 60.0 mL of 1.0 N HCl was used instead. After adding acid, the mixture was stirred for 15 minutes (timed) and titration was begun immediately; if necessary, titration continued for up to an additional 5 minutes. The excess HCl was then titrated with 0.5 N NaOH until a stable pH of 3.5 was attained for 10–15 seconds.

Calculation of Acid-Neutralizing Capacity

The Acid-Neutralizing Capacity was calculated using the following USP equation:

$$ANC\ (mEq) = (30 \times N_HCl) - (V_NaOH \times N_NaOH)$$

Where, N_HCl and N_NaOH denote the normalities of HCl and NaOH, respectively and V_NaOH is the volume of NaOH required to achieve a stable pH of 3.5.

Data Analysis

The Acid-Neutralizing Capacity was calculated as the difference between the total milliequivalents of hydrochloric acid added and the milliequivalents of residual acid determined by back titration method. Results are expressed as milliequivalents (mEq) of hydrochloric acid neutralized per 5 ml of formulation**.**

RESULTS

Determination of Acid Neutralizing Capacity of the Test Formulation

The Acid-Neutralizing Capacity (ANC) of the test formulation was evaluated using the United States Pharmacopeia (USP) back-titration method. The test quantified the amount of hydrochloric acid neutralized by a 5 ml dose of the test formulation under standardized laboratory conditions. The experimental procedure involved reacting the test formulation with a known quantity of hydrochloric acid, followed by back titration of the residual acid using standardized sodium hydroxide to an endpoint of pH 3.5**.** The experimental parameters employed during the determination of ANC are summarized in **Table 1**.

Table 1. Experimental conditions used for Acid-Neutralizing Capacity determination

Parameter	Value
Test Formulation	Pachmeena Antacid Suspension
Sample volume	5.0 ml
Hydrochloric acid added	30.0 ml
Hydrochloric acid normality	1.0696 N
Sodium hydroxide used	41.2 ml
Sodium hydroxide normality	0.3058 N
Reaction time	15 min
Endpoint pH	3.5

The Acid-Neutralizing Capacity (ANC) was calculated according to the United States Pharmacopeia (USP) using the following equation:

$$ANC\ (mEq) = (30 \times N_HCl) - (V_NaOH \times N_NaOH)$$

The milliequivalents (mEq) of hydrochloric acid initially added were calculated as:

$$30 \times 1.0696 = 32.088\ mEq$$

The milliequivalents of excess hydrochloric acid remaining after neutralization, as determined by back titration, were calculated as:

$$41.2 \times 0.3058 = 12.599\ mEq$$

Therefore, the acid-neutralizing capacity was calculated as:

$$ANC = 32.088 - 12.599$$

$$= 19.489\ mEq$$

$$\boxed{ANC = 19.489\ mEq/5ml}$$

Thus, the Acid-Neutralizing Capacity of the test formulation, Pachmeena Antacid Suspension was 19.49 mEq/5ml. The total milliequivalents of hydrochloric acid initially added to the test formulation were 32.088 mEq**,** whereas the residual acid recovered by back titration corresponded to 12.599 mEq. Consequently, the test formulation neutralized 19.489 mEq of hydrochloric acid, equivalent to 19.49 mEq per 5 ml after rounding. The detailed calculation is summarized in **Table 2**.

Table 2. Calculation of Acid-Neutralizing Capacity of Pachmeena Antacid Suspension

Calculation	Formula	Result
Total hydrochloric acid added	30.0 × 1.0696	32.088 mEq
Residual hydrochloric acid (back titration)	41.2 × 0.3058	12.599 mEq
Acid neutralized	32.088 – 12.599	19.489 mEq

The neutralization profile indicated that a 5 ml dose of the test formulation effectively consumed nearly 19.49 mEq of hydrochloric acid. The relatively low amount of residual acid remaining after the neutralization reaction demonstrated that the test formulation possesses significant buffering capacity under USP testing conditions.

Comparative Chart of ANC of Marketed Antacid Products

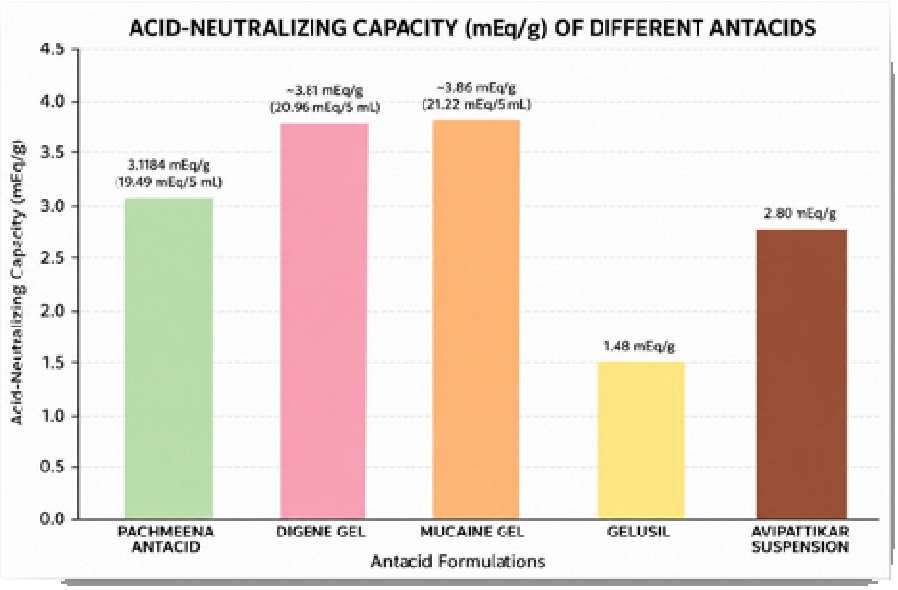


Figure 1: Comparative bar graph of ANC of Pachmeena Antacid with selected marketed Formulations

Table 3. A Comparison of ANC value of marketed products

Formulation	ANC Value (Approx. values in mEq/g) [Ref: [13,14,15]]
Pachmeena Antacid Suspension	19.49 mEq/5 mL (3.1184 mEq/g)
Digene Gel	20.96 mEq/5 mL (~3.81mEq/g)
Mucaine Gel	21.22 mEq/5 mL (~3.86mEq/g)
Gelusil	1.48 mEq/g
Avipattikar suspension	2.80 mMol/g (~2.80 mEq/g)

The bar graph shows the Acid-Neutralizing Capacity (ANC) of Pachmeena Antacid Suspension and some selected marketed antacid formulations as reported in the published data. As visualized- ANC of Pachmeena Antacid Suspension is similar to some selected marketed formulations, indicating it can offer good antacid efficacy. The ANC value classifications based on published data are summarized in **Table 4.**

Table 4: ANC Value Classification

ANC (mEq/mL)	Classification	Published Data
< 5 mEq	Very low (fails USP)	USP minimum requirement [16]
5 – 10 mEq	Low	Sodium bicarbonate (~7.4 mEq) [17]
10 – 20 mEq	Moderate	Typical single-ingredient antacids [16]
20 – 30 mEq	Good/High	Al-Mg combinations [17]
> 25–30 mEq	Very high	Hydrotalcite (~28 mEq) [16]

Acid-Neutralizing Contents of the Formulation

The Acid-neutralizing contents of the Pachmeena Antacid Suspensions are derived from the published data are illustrated in **Table 5.**

Table 5: Acid-Neutralizing Contents based on Published Data

Ingredients	Scientific Name	Functions
Yastimadhu	***Glycyrrhiza glabra***	Antacid & Anti-ulcer activity, suppress gastric acid secretion, enhance protective mucus production [18].
Satavari	***Asparagus racemosus***	Antioxidant, helps prevents ulcer formation, effective in relieving dyspepsia (indigestion) & promoting gastric protection [19].
Haritaki	***Terminalia chebula***	Significant antacid and gastroprotective effects, protects gastric mucosa by inhibiting the proton pump activity [20].
Ajwain	***Trachyspermum ammi***	Carminative, stomachic, and laxative agents to treat flatulence, soothe indigestion, & abdominal pain [21].

Khatika	-	Khatika is widely used in the management of peptic ulcer. It is a fast-acting antacid and reduces the gastric acidity resulting in an increase in pH of stomach [22].
Methi	***Trigonella foenum graecum***	Anti-ulcer activity by inhibiting gastric proton pump (H^+/K^+-ATPase) [23].
Jeera	***Cuminum cyminum***	Modulate pepsin activity, helps manage dyspepsia, gastritis, flatulence and diarrhea [24].

Significance of the Study

The USP back-titration method showed that the Pachmeena Antacid Suspension had an Acid Neutralizing Capacity (ANC) of 19.49 mEq/5 ml. Out of the 32.088 mEq of hydrochloric acid initially added, 12.599 mEq remained unneutralized after the reaction, confirming the formulation's ability to neutralize gastric acid and achieve the pharmacopeial endpoint of pH 3.5. Overall, the study findings demonstrate that the test formulation possesses good Acid-Neutralizing Capacity, supporting its potential in the management of hyperacidity and associated symptoms like heartburn, flatulence, indigestion etc.

DISCUSSION

Acid-Neutralizing Capacity is considered one of the most important quality attributes of an antacid because it directly reflects the amount of gastric acid that can be neutralized after administration. Unlike proton pump inhibitors (PPIs) and histamine-2 receptor antagonists (H_2RAs), which reduce gastric acid secretion through pharmacological inhibition of acid-producing pathways, antacids act immediately by chemically neutralizing hydrochloric acid already present in the stomach. This rapid neutralization increases gastric pH, decreases the proteolytic activity of pepsin, and reduces irritation of the gastric mucosa, thereby providing prompt symptomatic relief from heartburn, acid indigestion, and gastroesophageal reflux. Therefore, the determination of ANC is an essential quality control parameter for evaluating the effectiveness of both conventional and herbal antacid formulations [1-3,4,5].

In the current study, 32.088 mEq of hydrochloric acid was initially added to the formulation, whereas only 12.599 mEq remained after the neutralization reaction, resulting in an ANC of 19.49 mEq. These findings demonstrate that the test formulation effectively neutralized the acid challenge under the prescribed USP test conditions. The relatively low amount of residual acid recovered during back titration demonstrates that the test formulation possesses effective buffering capacity and is capable of consuming a considerable proportion of gastric acid. The acid-neutralizing activity observed in this study is likely attributable to the combined effects of the formulation's herbal actives. In addition to this direct neutralizing effect, the herbal ingredients may provide complementary gastroprotective benefits that enhance the overall therapeutic value of the test formulation [6-8,9,10].

The United States Pharmacopeia (USP) describes the ANC assay as a back-titration method in which sodium hydroxide solution (0.5 N) is added to a fixed endpoint of pH 3.5 to determine the number of milliequivalents of hydrochloric acid (1 N) neutralized by the minimum labeled dose (MLD) of the antacid [11]. One of the strengths of the study is the use of the USP-recommended back-titration method, which provides a standardized, reproducible, and internationally recognized approach for evaluating antacid preparations. The use of standardized hydrochloric acid and sodium hydroxide solutions, controlled reaction time, continuous stirring, and endpoint determination at pH 3.5 minimizes analytical variability and enables reliable comparison with other antacid formulations evaluated under identical experimental conditions [11,12]. Consequently, the findings generated in this study may serve as an important quality control parameter for routine product evaluation and batch-to-batch consistency. Overall, the study key findings demonstrate that the Pachmeena

Antacid Suspension exhibits substantial Acid-Neutralizing Capacity, supporting its intended application as a natural antacid formulation. The combination of measurable acid-neutralizing activity together with the documented gastroprotective properties of its herbal constituents provides a scientific rationale for its use in the symptomatic management of acid-related gastrointestinal conditions [9,10].

CONCLUSION

The current study evaluated the Acid-Neutralizing Contents and Acid Neutralizing Capacity (ANC) of Multani Pachmeena Antacid Suspension using the United States Pharmacopeia (USP) back-titration method. Results demonstrated Multani Pachmeena Antacid Suspension possesses an ANC of 19.49 mEq per 5ml, indicating a substantial capacity to neutralize hydrochloric acid under standardized *in vitro* conditions. The observed neutralizing activity reflects the combined contribution of the formulation's herbal

actives and supports its intended use for the symptomatic management of acid-related gastrointestinal problems. Overall, the study findings demonstrate that Multani Pachmeena Antacid Suspension has substantial Acid-Neutralizing Capacity, supporting its potential as an effective therapeutic agent for managing hyperacidity and associated symptoms like dyspepsia, flatulence and indigestion etc.

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Nil.

Conflicts of Interest

The authors declare that this work was conducted in accordance with Multani Pharmaceuticals Ltd. Pachmeena Antacid Suspension is an ayurvedic proprietary formulation manufactured by Multani.

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