IJPSR (2018), Volume 9, Issue 5 (Research Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 27 July, 2017; received in revised form, 13 October, 2017; accepted, 20 October, 2017; published 01 May, 2018

ACID NEUTRALIZATION CAPACITY AND COST EFFECTIVENESS OF ANTACID SUSPENSIONS SOLD ACROSS VARIOUS RETAIL PHARMACIES IN VIJAYAWADA

S. Venkateswara Rao [*1], B. Chamundeswari [1] and K. Padmalatha [2]

Department of Pharmaceutics [1], Department of Pharmacology [2], Vijaya Institute of Pharmaceutical Sciences for Women, Enikepadu, Vijayawada - 521108, Andhra Pradesh, India.

Keywords:

Antacids, Acid neutralizing capacity, Cost effectiveness and Titrimetric method

Correspondence to Author:
S. Venkateswara Rao

Associate Professor,
Department of Pharmaceutics,
Vijaya Institute of Pharmaceutical Sciences for Women, Enikepadu,
Vijayawada - 521108, Andhra Pradesh, India.

E-mail: venkateshsadhu@gmail.com

ABSTRACT: Antacids are the commonly prescribed drugs for treating gastroesophageal reflux disease (GERD). As these are manufactured and marketed by various multinational and local companies there is a need for evaluating the cost effectiveness and efficacy of these antacids as a matter of public concern. In the present study an attempt has been made to determine and compare the acid neutralization capacity of antacid preparations sold across various retail pharmacies in Vijayawada, Andhra Pradesh, India to find out unit cost and effectiveness of antacid with respect to its composition and manufacturer. Six different antacid suspensions manufactured by different companies were evaluated for the oraganoleptic properties, viscosity, pH and particle size and were compared with each other. Acid neutralizing capacity was determined by titrimetric method. Cost effectiveness was done by calculating the cost per ml of antacid and efficacy was evaluated based on acid neutralizing capacity of antacid preparation. Suspension Medicaine® having higher acid neutralization capacity (30.22 mEq) with unit cost Rs.0.52/ml was found to be the most effective brand as this product exhibited the highest neutralization capacity with the lowest dose and price. Good acid neutralization capacity and the cost effectiveness of antacid medicaine® suspension have beneficial parameters in improving the prescribing pattern. It benefits both doctor as well as patient.

INTRODUCTION: Antacids are widely used to neutralize excess acid and relieve the condition of heartburn or acidity in many patients. A wide spectrum of antacids is now available in the world pharmaceutical market as over the counter (OTC) drugs. These one or multiple component drugs contain medical ingredients suitable for treating symptoms such as heartburn and dyspepsia, which are associated with hyperacidity in the stomach.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.9(5).1963-68

Article can be accessed online on: www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.9(5).1963-68

The principal characteristics of the antacids are their rapid action and effective neutralization of acid. The potency of an antacid is generally expressed in terms of its Acid neutralizing capacity (ANC). ANC is defined as the number of milli equivalents (mEq) of 1N HCl that is brought to a pH of 3.5 in 1 hour by a unit dose of an antacid preparation [1].

Commonly, antacids are available as solid dosage forms and as suspensions. In comparison to solid dosage forms liquid antacids are generally preferred as they possess a higher neutralization capacity due to their smaller particle size and greater surface area. The ANC and price of the product are two important attributes for an ideal antacid product in addition to the safety and

palatability. Hence there is a need to study the marketed antacid formulations on regular basis for their safety and efficacy along with economic considerations [2]. Several countries have conducted several comparative studies on ANC, palatability, sodium content and cost aspects of different marketed antacid formulations. However, there is no single study till now to assess the available antacid preparations in the Vijayawada market.

The present work was aimed to study and compare the ANC and other physicochemical properties of different generic antacid suspensions sold in the Vijayawada market. All the selected formulations containing aluminium hydroxide and magnesium hydroxide as main active ingredients except Medicaine suspension, which contained the drug in the form of aluminium hydroxide gel.

MATERIALS AND METHODS:

Materials: Antacid Suspensions were purchased from local market at Vijayawada. NaOH from S.D. Fine Chem. Ltd, Mumbai, HCl was obtained from Qualigens Fine Chem, Mumbai and all other ingredients used were of analytical grade.

Methods: In all suspensions the minimum dose was 5 ml where as for Gel MPS was 10 ml. The strength of aluminium hydroxide, magnesium hydroxide and other ingredients were given in **Table 1**. The quantities were different in different preparations.

TABLE 1: COMPOSITION OF ANTACID SUSPENSIONS

Brand Name	$Al(OH)_3$ (mg)	$Mg(OH)_2$ (mg)	Others (mg)	Batch no.	Mfg - Exp Date
Alcid	200	200	Dimethicone 25	ALCL6041SK	2016-2018
Gel MPS	250	250	Activated polydimethylsiloxane 50	INS15L11	2015-2017
Medicaine	291	98	Oxetacaine 10	AL15185	2015-2017
Oxecaine	291	98	Oxetacaine suspension 10	GS5R17	2015-2017
Omee	200	200	Dimethicone 25	OME16019SK	2016-2018
Dynacid	200	200	Activated Dimethicone 25	AK1L6125	2015-2017

***In-vitro* Evaluation:** *In-vitro* analysis was carried out on antacid suspension formulations as per USP32/NF27 methodology at 37±3 ^{o}C [3].

Organoleptic Properties: The organoleptic tests were explained about the products before the test procedure. During the study, all the formulations were evaluated by human volunteer with one hour interval for each formulation testing. The colour was visually identified and the odour was inspected by nasal inhalation by healthy human volunteers and the average qualitative values were noted. The taste of the formulations were inspected by placing the required dose of the formulation on the tongue, allowing to stay in the mouth for 30 seconds and the taste was perceived and the qualitative value was reported [4, 9].

Particle Size: Particle size was measured by using Olympus optical microscope. The microscope was calibrated using the objective micrometer, Tokyo. Two hundred particles were considered for the measurement and the average particle size was reported [5, 6].

Specific Gravity: Specific gravity was determined by using specific gravity bottle [6, 7].

Measurement of pH: The pH meter was calibrated using buffer solutions 4 and 7. The pH of each generic suspension was read from the monitor of the pH meter [6].

Viscosity: 100 ml of the antacid was taken in a beaker and the viscosity determination in triplicate was carried out by Brookfield viscometer LVDV-1 Prime fitted with spindle 62 and at an angular velocity of 60 rpm at room temperature (28 ^{o}C) [7, 8].

***In-vitro* Acid Neutralizing Capacity:** Preparation and standardization of NaOH: 4 gm of NaOH was weighed and dissolved in 1000 ml distilled water to obtain 0.1 N NaOH. Further it was standardized against Potassium hydrogen phthalate (KHPh). For standardization, 0.004 gm KHPh was dissolved in 50 ml distilled water and 2-3 drops phenolphthalein was added to it. NaOH solution was added drop-wise to the above solution till light pink colour appears. The volume of NaOH used was noted down and the molarity of NaOH solution was calculated by equation [7, 8].

Preparation and Standardization of HCl: 8.8 ml of conc. HCl was taken and 1000 ml of distilled water was added to obtain 0.1 N HCl. This solution

was standardized against previously standardized NaOH. 10 ml HCl was taken and 2 - 3 drops phenolphthalein was added and was titrated with NaOH until the appearance of pink colour [7].

$$N2 = V1N1/ V2$$

V1 = Volume of 0.1N HCl, N1 = Normality of HCl

V2 = Volume of NaOH consumed, N2 = Normality of NaOH

Method: The acid neutralizing capacity was carried out as per USP32/NF27. In short, all tests were conducted at a temperature 37 ± 3 ^{o}C. A pH meter was standardized using potassium biphthalate and potassium tetra oxalate (0.05 M each) standardized buffers respectively. Magnetic stirrer was used to maintain a stirring rate of 300 ± 30 RPM [9].

Samples of the antacid suspension (5 ml) were pipetted into a 250 ml conical flask. 10 ml of 0.1M HCl was added to the flask and swirled. The pH was checked with continuous addition of the acid until a pH range of 2 was reached. The amount of excess acid added was recorded. The solution was boiled for 2 min, cooled and the pH was rechecked. An additional amount of acid was added to attain excess acidity (the volume was noted). After which 10 drops of thymol blue was added and titrated against 0.1M NaOH to a blue end point. The titration was repeated twice. The number of milliequivalent of acid used up was calculated by the equation as follows:

$$\text{Total mEq} = (V_{HCl} \times N_{HCl})\ (V_{NaOH} \times N_{NaOH}).$$

In which N_{HCl} and N_{NaOH} are the normalities of the HCl and the NaOH, respectively and V_{NaOH} is the volume of NaOH used for titration. The results were expressed as total mEq per g of substance (USP). We have received the sodium and calorie contents of the respective antacids from the manufacturers [9].

Cost Effectiveness: The cost effectiveness of suspensions was determined depends on ANC and cost per unit dose of the antacid suspension[2,5].

RESULTS AND DISCUSSION

Organoleptic Properties: Six marketed antacid suspensions were tested for various properties and the average perception about the organoleptic qualities was summarized in **Table 2**. All the suspension formulations have shown pink colour, mint flavour and sweet taste; whereas the Medicaine® suspensions have shown white colour, mint flavour and sweet taste.

The colour of the antacids does not influence any other properties including patient acceptance of the products. Most of the formulations were flavoured with mint. This shows that mint could be the popular flavouring agent in the marketed antacid products of different dosage forms. The chewable tablet dosage forms have shown better palatability comparable with suspension antacids.

TABLE 2: ORAGANOLEPTIC PROPERTIES OF ANTACID SUSPENSIONS

S. no.	Brand name	Organoleptic properties		
		Colour	Flavour	Taste
1	Alcid	Pink	Mint	Sweet
2	Gel mps	Pale pink	Mint	Sweet
3	Dynacid	Pink	Mint	Sweet
4	Omee	Pink	Mint	Sweet
5	Medicaine	White	Mint	Sweet
6	Oxecaine	Pink	Mint	Sweet

Particle Size Analysis: Particle size was determined by optical microscope, the average particle size for all antacid suspensions was shown in **Fig. 1** and the units were analyzed in triplicate. The mean particle size for all antacid suspensions ranged from 15.09 - 32.25µm. The results indicate that the antacid formulation Gel mps® has shown highest mean particle size of 32.25 µm and the suspension Medicaine® has shown lowest mean particle size of 15.09 µm.

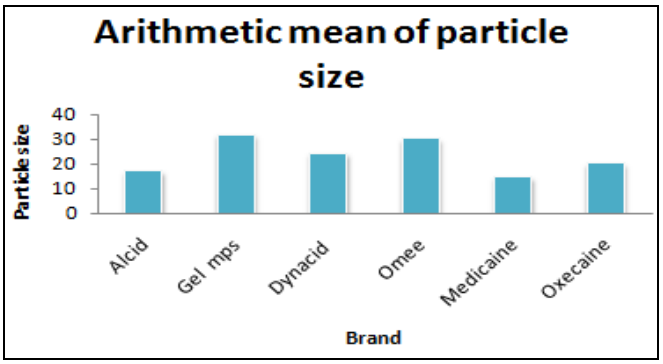

FIG. 1: PARTICLE SIZE ANALYSIS

Specific Gravity: The specific gravity of all antacid suspensions was determined by using specific gravity bottle and the values were found almost equal for all the suspensions.

TABLE 3: SPECIFIC GRAVITY OF ANTACID SUSPENSIONS

S. no.	Brand name	Specific Gravity (gm/cm^3)
1	Alcid	1.091 ± 0.03
2	Gel mps	1.043 ± 0.07
3	Dynacid	1.100 ± 0.04
4	Omee	1.095 ± 0.03
5	Medicaine	1.108 ± 0.05
6	Oxecaine	1.093 ± 0.02

Mean ± S.D. of three determinations

Viscosity: The viscosity of all antacid suspensions was determined by using Brookfield viscometer and it was found to be 341 - 470 centipoises (Speed 60 RPM, Spindle - 62). The results of viscosity were shown in **Fig. 2**. It reveals that stability of selected antacid suspensions. The viscosity of antacid suspension was found to be highest for Oxecaine® (470 cps) and lowest for Gel mps® (341 cps).There was a small variation in the consistency values among the suspensions selected.

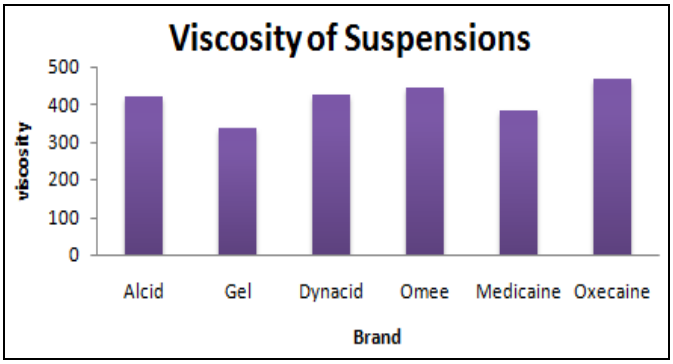

FIG. 2: VISCOSITY OF ANTACID SUSPENSIONS

pH: The pH of all six antacid suspensions were determined by using digital pH meter and it values were found to be 7.78 - 8.63. This indicates that the pH of all the antacids can be maintained well above 3.5, which is the threshold pH for acidity of the stomach.

TABLE 4: pH OF ANTACID SUSPENSIONS

S. no.	Brand name	pH
1	Alcid	8.56 ± 0.13
2	Gel mps	8.48 ± 0.21
3	Dynacid	7.78 ± 0.14
4	Omee	8.63 ± 0.22
5	Medicaine	8.61 ± 0.16
6	Oxecaine	8.29 ± 0.24

Mean ± S.D. of three determinations

Therefore, all the formulations have passed this test. Omee ® antacid suspension has shown highest pH of 8.63 and Dynacid® antacid suspension has shown the lowest pH of 7.78.

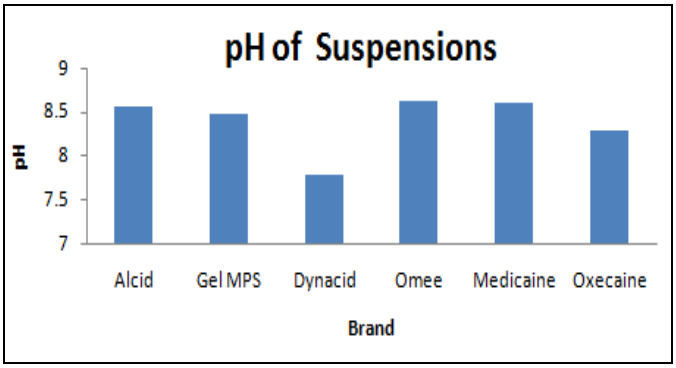

FIG. 3: pH OF ANTACID SUSPENSIONS

***In-vitro* Acid Neutralizing Capacity (ANC):** The acid neutralizing capacity of an antacid is ≥ 5mEq per dose (FDA). The ANC of brand Medicaine® (30.22 mEq) per 5 ml of the suspension was found to be highest while brand Gel mps® (0.216 mEq) had the lowest. ANC values of these suspensions were reported in **Table 5**. The reported ANC values did not depend up on the quantity of aluminium hydroxide and magnesium hydroxide. The effectiveness of antacids based on chemical composition was found to be interesting. It was found that Oxetacaine containing antacid (Medicaine®) has shown highest ANC with 30.22 mEq per dose.

The effectiveness is followed by magnesium hydroxide and aluminium hydroxide. It was observed that brands Medicaine® consumed the highest volume of 0.1M HCI (75 ml) per unit dose and thus with highest Acid neutralizing capacity's per unit dose.

This literarily suggested that liquid antacids were better compared to chewable tablets and this study has proven same. The possible reason for this observation is that the antacid particles in the suspension exposes more surface areas (fine powders) than the tablet formulation, which is compressed from granules

TABLE 5: *IN-VITRO* ACID NEUTRALIZING CAPACITY

Brand name	Volume of HCl consumed (ml)	Titrated value (ml)	ANC (mEq/5ml)
Alcid	37	5.4	1.998
Gel mps	9	2.4	0.216
Dynacid	60	11.3	6.78
Omee	17	11	1.87
Medicaine	75	40.3	30.225
Oxecaine	41	42.6	17.46

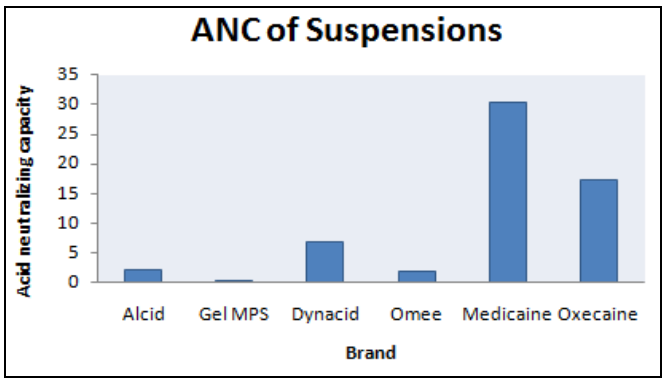

FIG. 4: *IN-VITRO* ACID NEUTRALIZING CAPACITY OF SUSPENSIONS

Cost Effectiveness: The antacids with a higher ANC will provide cost effectiveness with the lowest dosage volume. The cost effectiveness of an antacid is interplay between the ANC and the unit cost of the antacid. The unit price of Antacid suspension was found to be between Rs. 1.23 - Rs. 2.67 per 5ml dose, the most expensive antacid suspension was oxecaine® with unit price of Rs.0.53/ml while the cheapest brand is Dynacid® Rs.0.24/ml. Medicaine® having higher ANC (30.225 mEq) is expected to be providing effectiveness at lower dosage volume compared to other antacids in the study. As a function of their cost, this study has been able to show that the effectiveness of an antacid is not a function of the price but on its acid neutralizing capacity.

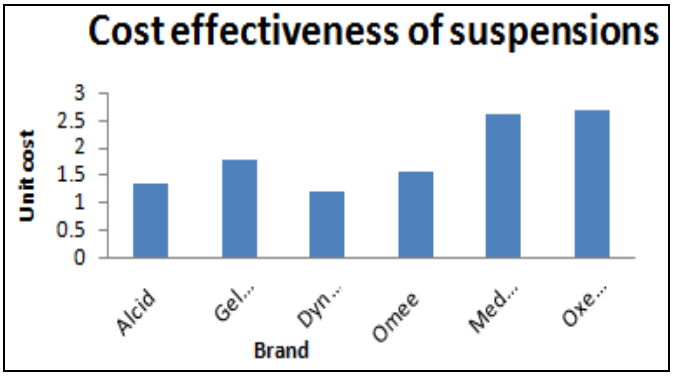

FIG. 5: COST EFFECTIVENESS OF SUSPENSION

TABLE 6: COST EFFECTIVENESS OF ANTACID SUSPENSIONS

Brand name	Volume (ml)	Cost (Rs.)	Unit cost for 5 ml	ANC (mEq/5ml)
Alcid	170	46.00	1.35	1.998
Gel mps	170	61.50	1.80	0.216
Dynacid	170	42.00	1.23	6.78
Omee	170	54.00	1.58	1.87
Medicaine	200	104.00	2.6	30.225
Oxecaine	170	91.00	2.67	17.46

CONCLUSION: Many parameters such as organoleptic properties, particle size, pH, viscosity, ANCs and price of the antacid formulations play an important role in the selection of a proper antacid as per the patients' needs. Most of the marketed antacid suspensions were mint flavoured. It was found that oxetacaine containing antacid suspension (Medicaine®) has shown highest ANC (30.225 mEq) with unit cost Rs.2.6 per unit dose. Based on results, the Medicaine antacid suspension was recommended as cheaper antacids with respect to price and daily dose. No positive correlation was found between cost and effectiveness of antacids. Antacids of lower cost were found to be equally effective compared with the costly preparations.

The strengths of aluminium hydroxide and magnesium hydroxide did not reflect the effectiveness (ANC) of the antacids making it difficult for the physician to select preparation of suitable strength. Hence drug regulatory authorities should take appropriate measures to display information about ANC values on the label of the antacid preparations.

ACKNOWLEDGEMENT: The presenting authors are thankful to management and principal of Vijaya Institute of Pharmaceutical Sciences for Women, Vijayawada for their valuable support in carrying out this work.

CONFLICTS OF INTEREST: Nil

REFERENCES:

1. Jakaria M, Rashaduz, Zaman, Parvez M, Islam M, Haque MA, Sayeed MA and Md. Ali H: Comparative study among the different formulation of antacid tablets by using acid-base neutralization reaction. GJ Pharmcology. 2015; 9: 278 - 281
2. Nasim S, Mustufa MA, Zaidi SIH, Khan MT and Wajid A: Liquid antacids: A comparative study on palatability and cost effectiveness. Pak J Med Sci. 2012; 28: 183-186
3. United States Pharmacopoeia National Formulary, USP 32-NF 27. 2009; 1: 139.
4. Katakam P, Tantosh NM, AIEshy AM, Rajab LJ and Elfituri AA: Comparative study of the acid neutralizing capacity of various commercially available antacid formulations in Libya. LJMR. 2010; 7: 41-48
5. Katakam P, Tantosh NM, AIEshy AM, Rajab LJ and Elfituri AA: Evaluation of cost effectiveness and efficacy of commonly used different antacid gel preparations. IJBCP. 2013; 2: 788-791.
6. Ajala TO, Oreagba MI AND Odeku OA: The pharma-ceutical equivalence and stability of multisource metronidazole suspensions. Afr J Med Med Sci. 2014; 43: 139-148.

7. Ajala TO and Silva BO: The effect of pharmaceutical properties on the acid neutralizing capacity of antacid oral suspensions. J Ph Investigation. 2015; 45: 433-439.
8. Upma, Jalwal P, Singh B, Lata S and Mehndiratta P: Formulation and stabilization of antacid formulation. IJPPR. 2015; 6: 1226-1229.
9. Benezer OE, Amuella BIS and Ken E: Pharmaco economic analysis of some brands of antacid formulations available in Southern Nigeria using titrimetric method. Can Open Ph J. 2015; 2: 1-8.

How to cite this article:
Rao SV, Chamundeswari B and Padmalatha K: Acid neutralization capacity and cost effectiveness of antacid suspensions sold across various retail pharmacies in Vijayawada. Int J Pharm Sci Res 2018; 9(5): 1963-68.doi: 10.13040/IJPSR.0975-8232.9(5).1963-68.