

## Research Article

# Acid Neutralization Capacity of Some Commercial Brands of Antacids Available in the Libyan Market

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## Abstract

Antacids are weak bases that have been widely prescribed by physicians for the treatment of excessive amount of hydrochloric acid in the stomach to relief the heart burn, which known as acid reflux. These antacids have been manufactured and marketed by different companies all over the world with wide variability in their acid neutralizing capacity (ANC), when measured. Generally, information on ANC is not included in the leaflets of the antacid products. Therefore, there is a necessity for assessing the efficacy of these antacids. This study is based on the evaluation of ANC of four different commercial brands of antacids, including three for tablet and one for liquid samples, manufactured by different companies and sold in various pharmacies in Tripoli, Libya. The ANC of the antacids was determined by the titrimetric method and found to differ considerably; it was highest with Reinne tablet (11.4 mEq/tablet) and lowest with Gaviscon tablet (6.06 mEq/tablet). The in vitro observed values of ANC of the four brands of antacid were compared with the theoretical ones. Results showed that the observed values of ANC of all types of antacid were close to the theoretical values with exception to the Reinnie brand which showed a variation. Due to the variation in neutralizing ability of antacids, it is recommended that values of ANC should be incorporated on labels of the antacid products for the benefit of both doctors and patients.

**Keywords:** Acid; Neutralization; Capacity; Antacid; Titration.

## Introduction

Antacids are the common prescribed medications for neutralizing the excess stomach acidity, which causes heartburn. They are basic substances with a pH above 7.0 that chemically react with the stomach acid to neutralize them by forming salts and water [1] as shown in Table 1. Antacid medications frequently contain one or more of the following ingredients (weak bases): calcium carbonate, magnesium carbonate, magnesium hydroxide, aluminium hydroxide and sodium hydrogen carbonate [2-4]. These antacids are commercially available in different formulations such as tablet and liquid forms. The acid neutralizing capacity (ANC) is one of the most important factors in evaluating the effectiveness of the antacid. It can be defined as the ability of the antacid to neutralize the acid. The ANC of the antacids vary considerably [5,6] due to the variations in the active ingredients amounts, manufacturer and formulation [7].

Many brands of antacids formulations have been marketed. However, most labels on antacids products do not include information about ANC. Physicians can not recommend suitable antacids for patients without knowing the value of ANC. Therefore, it is important to evaluate the efficacy of these antacid drugs.

The titrimetric method has been widely reported in literature for the evaluation of ANC of antacids [3,8,9]. It is considered as simple, convenient and rapid method. The present in-vitro study is aimed at evaluating the ANC of four commercial brands of antacid available in different pharmacies in Tripoli, Libya by applying the titrimetric method of analysis.

## Materials and methods

### Materials

The four brands of commercial antacids (Rennie, Tonusca and Gaviscon tablets as well as Gaviscon suspension) used in this research work were

purchased from different pharmacies located in Tripoli, Libya. Details are summarized in Table 2. All reagents used were of analytical grade and used without further purification.

**Standardization of hydrochloric acid and sodium hydroxide solutions**

0.5 N of hydrochloric acid was prepared and then standardized with sodium carbonate in the presence of the methyl orange indicator. 0.1 N of sodium hydroxide was also prepared and followed by standardization with potassium hydrogen phthalate using the phenolphthalein indicator.

**Method**

In Vitro acid neutralizing capacity of the four commercial antacids was measured by a strong acid-strong base titration. Briefly, each tablet was weighed and then ground to a fine powder using a mortar and pestle. The powder (or 5ml of the suspension) was transferred to flask and

dissolved in a known excess amount of the acid. Heating was applied to ensure a complete reaction. The excess amount of the acid that remained unreacted in the solution was determined by back- titration of the solution with the standardized solution of NaOH in the presence of drops of phenolphthalein indicator. Formation of a pale pink was the indication of reaching the end point. Each titration was carried out in triplicate and the average value was recorded. The ANC was expressed as milliequivalents (mEq) of acid consumed per one tablet according to the following formula:

$$\text{mEq of acid consumed per a tablet} = (V_{\text{HCl}} \times N_{\text{HCl}}) - (V_{\text{NaOH}} \times N_{\text{NaOH}})$$

where:

$V_{\text{HCl}}$  and  $V_{\text{NaOH}}$  are the volumes of HCl and NaOH used in ml respectively.

$N_{\text{HCl}}$  and  $N_{\text{NaOH}}$  are the normalities of HCl and NaOH respectively.

Table 1. Neutralization reactions of some common active ingredients present in commercial antacids

| Ingredient name           | Chemical formula  | Chemical reaction  |
|---------------------------|-------------------|--|
| Calcium carbonate         | $\text{CaCO}_3$   | $\text{CaCO}_3 (s) + 2\text{HCl} (aq) = \text{CaCl}_2 (aq) + \text{H}_2\text{O} (l) + \text{CO}_2 (g)$ |
| Magnesium carbonate       | $\text{MgCO}_3$   | $\text{MgCO}_3 (s) + 2\text{HCl} (aq) = \text{MgCl}_2 (aq) + \text{H}_2\text{O} (l) + \text{CO}_2(g)$  |
| Sodium hydrogen carbonate | $\text{NaHCO}_3$  | $\text{NaHCO}_3 (s) + 2\text{HCl} (aq) = \text{NaCl} + \text{H}_2\text{O} (l) + \text{CO}_2(g)$        |
| Magnesium hydroxide       | $\text{Mg(OH)}_2$ | $\text{Mg(OH)}_2 (s) + 2\text{HCl} (aq) = \text{MgCl}_2 (aq) + 2\text{H}_2\text{O} (l)$                |
| Aluminium hydroxide       | $\text{Al(OH)}_3$ | $\text{Al(OH)}_3 (s) + 3\text{HCl} (aq) = \text{AlCl}_3 (aq) + 3\text{H}_2\text{O} (l)$                |

Table 2. List of the commercial antacids, used in this study, and their composition

| Brand Name | Country | Colour | Dosage form | Mass of antacid tablet (g) | Name and mass of active ingredients                          |
|------------|---------|--------|-------------|----------------------------|--|
| Reinne     | France  | white  | tablet      | 1.3                        | Calcium carbonate 680mg<br>Magnesium carbonate 80mg          |
| Tonucal    | Tunisia | white  | tablet      | 1.9                        | Calcium carbonate 500 mg                                     |
| Gaviscon   | UK      | white  | tablet      | 1.6                        | Sodium hydrogen carbonate 267 mg<br>Calcium Carbonate 160 mg |
| Gaviscon   | UK      | white  | suspension  | -                          | Magnesium hydroxide 267 mg<br>Aluminium hydroxide 160 mg     |

## Results and discussion

Table 3 shows the ANC values of the four types of antacids, which were expressed in terms of mEq. Considerable variations in the ANC values of the antacids were observed; the highest ANC value was observed with Rennie tablet (11.4 mEq/tablet) and the lowest value was obtained from Gaviscon tablet (6.06 mEq/tablet). The order of ANC values of the tested antacids

formulations from greatest to lowest efficacy are Rennie, Tonucal, Gaviscon liquid and Gaviscon. This variation in ANC could be attributed to the variations in the formulation and active ingredients amounts of the antacids. These results show agreement with earlier study demonstrated by Al-Mudhafar et al [10] who reported that Rennie tablet brand had the highest ANC value among six brands of antacids.

Table 3. Acid neutralizing capacity and relative effectiveness of the four antacids

| No. | Brand Name      | ANC (mEq/tablet or 5 ml) |             | Relative Effectiveness |
|-----|-----------------|--------------------------|-------------|------------------------|
|     |                 | Observed                 | Theoretical |                        |
| 1   | Rennie          | 11.40                    | 15,50       | 100                    |
| 2   | Tonucal         | 9.89                     | 10.00       | 86.75                  |
| 3   | Gaviscon        | 6.06                     | 6.30        | 53.16                  |
| 4   | Gaviscon liquid | 6.25                     | 6.30        | -                      |

Since the Rennie brand has the highest ANC value comparing to the other brands, the relative effectiveness of the other types of antacids was calculated considering Rennie brand as 100, as shown in Table 3. The ANC value of Rennie is higher 1.15 times comparing to the ANC value of the Tonucal antacid brand and higher almost twice in comparison to the ANC value of Gaviscon brand. The in vitro observed values of ANC of the four brands of antacid were compared with the theoretical ones, which were calculated according to the information provided by the manufacturer. Results showed that the observed values of ANC of all types of antacids were close to the theoretical ones except the Rennie brand which showed a variation. These observations are in a compliance with previous studies conducted in different parts of the world, which showed variations in the ANCs of various brands of antacids in different forms [2,6,11-13]. The variation in neutralizing ability of antacid brands may lead to wrong choices of them when they are being recommended by physicians if the ANC is not known.

## Conclusions

This study has shown that there is a variation in the ANC of different brands of antacids and that the Rennie brand has the highest ANC value in comparison to the other brands. An antacid with a high ANC value is preferred due to its high neutralization capacity (faster relief of heartburn) with minimum dose. This fact should be taken into consideration when antacids are prescribed. The absence of ANC values from the label

products makes it difficult for the physician to select the right antacid for the patient. Therefore, it is recommended that the ANC values of antacids should be shown on the label of all products to avoid the misuse of these medications. The authors also suggest that further studies should be carried out on other antacids brands for fully understanding of their neutralizing capacity.

## Conflict of interest

The authors declare that there is no conflict of interests relevant to this paper.

## References

- [1] Udeze AO, Jayeoba TM, Innocent-Adiele, HC, Okerentugba PO, Nwanze, JC, Onoh CC and Okonko IO. Bacteriological Assessment of Some Selected Antacid Suspension Products In Nigeria. *N Y Sci J* 2012;5(5):28-32.
- [2] Katakam P, Tantosh NM, Aleshy AM, Rajab LJ, Elfituri AA. Comparative Study of the Acid Neutralizing Capacity of Various Commercially Available Antacid Formulations in Libya. *Libyan Journal of Medical Research* 2010;7(1):41-9.
- [3] Bhoir S, Bhagwat AM. Comparison of Seven Oxethazaine Containing Antacids Available in the Indian Market. *Journal of the Association of Physicians of India* 2013;61:400-3.
- [4] Rohman A, Musfiroh A, Wijaya EG. Quantitative Determination of Simethicone in Antacid Suspension and Chewable

- Tablet Using FTIR Spectroscopy. Global Journal of Pharmacology 2013;7(3):270- 5.
- [5] Kibwage IO, Machine A, Hagos B, Hoogmartens J. The Neutralizing Capacity and Sodium Content of Antacid Brands on the Kenyan Market. East African Medical Journal 1995;72(3):194-7.
- [6] Ebenezer O, Samuella BI, Ken E. Phrmaco-Economic Analysis of some Brands of Antacid Formulations Available in Southern Nigeria, Using Titrimetric Method. Canadian Open Pharmacy Journal 2015;2(1):1-8.
- [7] Temple ME, Nahata MC. Comparative Palatability of 22 Liquid Antacids. Journal of Alimentary Pharmacology and Therapeutics 2000;14(4):421-5.
- [8] Jagadesh K, Chidananda KN. Study of Acid Neutralizing Capacity of Various Antacid Formulations. Asian Journal of Pharmaceutical Technology & Innovation 2015;3(12):113-20.
- [9] Venkateswara Rao S, Chamundeswari B, Padmalatha K. Acid Neutralization Capacity and Cost Effectiveness of Antacid Suspensions Sold Across Various Retail Pharmacies in Vijayawada. International Journal of Pharmaceutical Sciences and Research 2018;9(5):1963-8.
- [10] Al-Mudhafar MMJ, Abdulhadi SL and Talib AB. Evaluation of Commercial Antacid Tablets in Iraq. Der Pharma Chemica 2016;8(19):283-8.
- [11] Vedavathi H, Tejasvi T S, Revankar SP. Evaluation of cost effectiveness and efficacy of commonly used different antacid gel preparations. International Journal of Basic and Clinical Pharmacology. 2013;2(6):788-91.
- [12] Jakaria M, Rashaduz Zaman, Parvez M, Islam M, Areeful Haque M, Abu Sayeed M, Hazrat Ali M. Comparative Study among the Different Formulation of Antacid Tablets by Using Acid-Base Neutralization Reaction. Global Journal of Pharmacology 2015;9(3):278-81.
- [13] Jacob S, Shirwaikar A, Anoop S, Khaled R, Imtiaz M, Nair A. Acid Neutralization Capacity and Cost-Effectiveness of Antacids Sold in Various Retail Pharmacies in the United Arab Emirates. Hamdan Medical Journal 2016;9:137-46.

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