Leaves of *Vernonia amygdalina* commonly known as bitter leaf is widely consumed in the sub-Saharan regions of Africa. This study therefore considers the properties of leaves of the plant as alternative sources of an antacid and carminative drug. Bioactive compounds were extracted separately with methanol and distilled water. The neutralizing capacity, duration of neutralizing effects and amounts of carbon dioxide evolved in the antacid and carminative studies respectively were determined for both aqueous and methanolic leaf extracts. Aqueous leaf extract showed a significant antacid and carminative potential (P < 0.05) when compared with the methanolic leaf extract at all the tested concentrations. The highest neutralizing effect and duration of neutralizing effect obtained for the aqueous leaf extract were 2.24 ± 0.000 and 162.56 ± 0.087 minutes respectively as against 1.97 ± 0.007 and 95.55 ± 0.083 minutes of the methanolic leaf extract. Further evidence is provided in the high neutralizing capacity of the aqueous leaf extract (34.93 ± 0.088mL) compared to that of the methanolic leaf extract. Further evidence is provided in the high neutralizing capacity of the aqueous leaf extract (34.93 ± 0.088mL) compared to that of the methanolic leaf extract. Higher doses of the aqueous leaf extract were however needed for comparable results with the control Gastrone® (13.5252g of aqueous extract ≡ ~3.1582g of Gastrone® (antacid); 5.3797g of aqueous extract ≡ ~3.1582g of Gastrone® (carminative). Scientific data in this research work therefore supports the local use of aqueous leaf extract of *Vernonia amygdalina* as an antacid and carminative agent by the people of Tamale, Northern region, Ghana.
Alkaloids in the currently available antacids consist of either one or a combination of the following: magnesium hydroxide, aluminum hydroxide, calcium carbonate, sodium bicarbonate and magnesium carbonate (Orwa et al., 2012; Meija and Kraft, 2009). In recent times, intensive antacid therapy is often not acceptable. This is because the duration of neutralization effect exhibited by antacids is short and also due to the side effects (such as diarrhoea, constipation, interference with drug absorption and rarely, renal, metabolic and acid-base disturbance) exhibited by these synthetic antacids (Schubert et al, 2003; Peura, 2000; Alhara et al, 2003). Formation of gases in

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the stomach is usually due to incomplete digestion of carbohydrates but however occurs during hyperacidity. It also occurs as a metabolic by-product of some foods. Carminatives are the agents which induce the expulsion of gas from the stomach or intestines (Wu and Chen, 2010). Plant species over the years have served as attractive sources of new drugs. Vernonia amygdalina, commonly known as bitter leaf plant is a rapid regenerating soft wooded shrub known to be indigenous to a variety of ecological zones in Africa especially sub-Saharan regions. Various parts of the plant have been used as therapeutic agents in disease conditions including gastrointestinal problems, microbial and parasitic infections, hepatotoxities, diabetes and cancer (Agbogidi and Akpomorine, 2013; Adediran et al., 2014). Its leaf is a soup vegetable which is being used in Nigeria and also the northern part of Ghana for centuries (Utoh-Nedosa, 2010). The potential of Vernonia amygdalina as an antacid and carminative has however not been exploited scientifically hence this research seeks to explore the antacid and carminative properties of the leaves of Vernonia amygdalina.

MATERIAL AND METHODS

Chemicals

NaHCO₃, Gastrone® and gastric acid were obtained from Sigma Chemical Co. (St. Louis, MO, USA). Methanol were obtained from Merck Chemical Supplies (Damstadt, Germany). All reagents were of analytical grade.

Sample collection and preparation

Leaves of Vernonia amygdalina were collected within the environs of Navrongo in the Upper East region of Ghana and authenticated at the Department of Applied Biology, University for Development Studies (UDS). A Voucher specimen was deposited at the herbarium of the Department of Applied Biology (UDS). The fresh leaves were rinsed with distilled water, de-stemmed then chopped into smaller dimensions and air dried for four days at room temperature (25 °C). The dried leaves were ground into fine powder using an electric blender and stored in an air-tight container.

Extraction of phytochemicals

Extraction was carried out by employing the method outlined by Ajetunmobi and Towolawi (2014) with some slight modifications. Extraction time for extracts was extended from 48 to 72 hours. Two hundred grams (200g) of the dried leaf powder were separately soaked in 1000mL of methanol and distilled water in 2.5L amber colored bottles for 72hrs. The percolates were then collected and concentrated at room temperature to obtain dried extracts and the percentage yields (% w/w) calculated.

Qualitative phytochemical screening

Saponins and cardiac glycosides were evaluated using protocols described by Mbatchou et al. (2011), Ajetunmobi and Towolawi (2014) respectively while tannins, flavonoids, alkaloids, steroids and terpenoids were evaluated using protocols by Ankita et al. (2012).

Preparation of extract concentrations

Three concentrations (250mg/90mL, 500mg/90mL and 750mg/90mL) of each extract (methanol and aqueous extracts) were prepared and used for the various tests. Concentrations were always prepared fresh whenever needed. Similar concentrations of active sodium bicarbonate and Gastrone® were prepared to serve as positive controls.

Preparation of artificial gastric acid

Artificial gastric acid was prepared using protocols described by Vandana and Prashant (2013).

Determination of effect of temperature on pH of Extract Concentrations

pH of various concentrations of the leaf extracts were determined at temperatures ranging from 25 – 37°C. pH...
values of NaHCO₃, Gastrone® and water also determined for comparison (Each procedure was done in triplicates for each test solution).

### Determination of Neutralizing Effect on Artificial Gastric Acid

The neutralizing effect of the different concentrations were determined according to protocols described by Vandana and
Phytochemical screening of the leaf extracts revealed positive results for all tested phytochemicals with the exception of cardiac glycoside in the case of the methanolic extract and flavonoids and steroids in the case of the aqueous extract. The effect of temperature on the pH of leaf extracts showed the pH of the extracts as well as that of NaHCO$_3$ and Gastrone® varying slightly within the tested temperature range (25°C to 37°C), wide variations were however observed for distilled water. The leaf extracts and the NaHCO$_3$ and Gastrone® exhibited impressive thermo-stability from room temperature to body temperature. Results indicate that with the exception of the methanolic leaf extract, all treatments possessed significant (P < 0.05) gastric neutralizing effect in comparison with distilled water (1.98 ± 0.000). Comparing leaf extracts at the highest tested concentration with NaHCO$_3$ (2.73 ± 0.007) and Gastrone® (2.15 ± 0.007), as it can be seen from Fig. 3, the aqueous extract exhibited a promising neutralizing effect by increasing the pH of the artificial gastric acid from 1.2 to 2.24 ± 0.000 as compared to 1.97 ± 0.007 produced by the methanolic leaf extract. With regards to the duration of neutralizing effect, all treatments including methanolic leaf extract, aqueous leaf extract, NaHCO$_3$ and Gastrone® showed significantly longer duration when compared with water (76.08 ± 0.020 minutes). NaHCO$_3$ gave the longest duration (203.87 ± 0.091, 330.45 ± 0.180 and 492.33 ± 0.188 minutes) at all tested concentrations followed by Gastrone® then the aqueous leaf extract with the methanolic leaf extract giving
the least (79.63 ± 0.090, 87.57 ± 0.035, 95.55 ± 0.083 minutes) at the same concentrations. The neutralizing effect and duration were thus dose dependent. Also, the leaf extracts, NaHCO₃ and Gastrone® exhibited significant acid neutralizing capacity when compared with water (P < 0.05). The neutralizing capacity of the leaf extracts, NaHCO₃ and Gastrone® were therefore dose dependent. The antacid ability of the aqueous leaf extract were significantly higher relative to the methanolic leaf extract (P < 0.05). The highest neutralizing effect and duration of neutralizing effect obtained for the aqueous leaf extract were 2.24 ± 0.000 and 162.56 ± 0.087 minutes respectively. These values were greater than those obtained for the methanolic leaf extract (1.97 ± 0.007 and 95.55 ± 0.083 minutes). Thus, the aqueous extract presented a better potential as an antacid than the methanolic extract. Further evidence is provided in the high

Fig. 5: A bar chart representing amounts of CO₂ expelled by leaf extracts and control.

Fig. 6: A line graph of the carminative activity of aqueous leaf extract and Gastrone®.
neutralizing capacity of the aqueous leaf extract (34.93 ± 0.088mL) compared to that of the methanolic extract (7.80 ± 0.115mL). However, when compared with the controls NaHCO₃ and Gastrone® at similar concentrations, the leaf extracts exhibited minimal antacid activity owing to the crude nature of the leaf extracts. The minimum recommended dose of Gastrone® per the drug leaflet is two (2) tablets (~3.1582g) or 10mL of the suspension and consumes a total of 36.72734mmoles of H⁺ ions. To produce similar effects, the amount of aqueous crude leaf extract needed was determined to be 13.5252g an indication of higher amounts of the crude extract being needed to produce matching effect as Gastrone®. All treatments possessed significant carminative potential when compared with water (P > 0.05). At all the amounts tested (250, 500 and 750mg), Gastrone® demonstrated the highest carminative potential followed by NaHCO₃. Both methanolic and aqueous leaf extracts exhibited comparable carminative potentials with the aqueous leaf extract producing a better result. The recommended minimum dose of 5.3797g of the aqueous extract is equivalent to that of Gastrone® (2 tablets, ~3.1582g) which expels 11.31952mmol of carbon-dioxide and a positive indication of the aqueous leaf extract possessing very promising carminative ability.

CONCLUSIONS

Vernonia amygdalina leaf extracts displayed diverse phytochemicals accounting for its observed antacid and carminative properties. In all accounts, the aqueous extract exhibited greater neutralizing effect and duration than the methanolic extract. Though both extracts showed promising antacid and carminative properties, that of the aqueous extract at all concentrations were more prominent. The leaves of Vernonia amygdalina therefore provide an alternative means to the treatment of hyperacidity and management of PU/PUD and GERD. Furthermore, the potential of this plant species as an antacid and a carminative agent is of great interest and warrants further studies.

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CONFLICT OF INTEREST

The authors declare that there are no conflict of interest with other people or organizations.

REFERENCES


