Phytochemical analysis and proximate composition of Vernonia amygdalina

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Abstract

Background: Vernonia amygdalina is used to prepare dishes as well as a multi-purpose fodder tree with high biomass yield. This study was conducted to determine phytochemicals and proximate composition of Vernonia amygdalina leaves.

Methods: Evaluation of Vernonia amygdalina for phytochemicals and proximate composition were conducted using standard methods.

Results: Result showed that Vernonia amygdalina contain phytochemicals such as alkaloids, tannins, flavonoids, saponins, triterpenoids, steroids, cardiac glycosides, and reducing sugar. Results obtained on the proximate composition shows that Vernonia amygdalina in percentage (%) contain dry matter (90.68 ± 0.77), crude protein (22.81 ± 0.17), crude fiber (18.17±0.06), moisture (9.32 ± 0.07), ash (16.65 ± 0.09), crude fat (4.34 ± 0.04) and carbohydrate (38.03 ± 0.06).

Conclusion: The presence of phytochemicals like saponins, tannins, alkaloids and flavonoids explains the medicinal potentials of Vernonia amygdalina leaves in therapeutic uses. Also the leafy vegetables if consume in sufficient amount would contribute greatly to the nutritional requirement for human health and to the food security of Nigerian population.

Keywords: Vernonia amygdalina; Phytochemicals; Proximate; Ethanol.

1. Introduction

Vernonia amygdalina, variously known as bitter leaf (English), oríwó (Edo), ewuro (Yoruba), shikawa (Hausa), and olulu (Igbo), is a tropical shrub, 1-3m in height with petiole leaf of about 6mm in diameter, and elliptic in shape [1]. The leaves are dark green coloured with a characteristic odour and a bitter taste. The species is indigenous to tropical Africa and is found wild or cultivated all over sub-Saharan Africa [2]. The leaves are eaten, after crushing and washing thoroughly to remove the bitterness [3]. All parts of the plant are pharmacologically useful. Both the roots and leaves are used in phyto-medicine to treat fever, hiccups, kidney disease and stomach discomfort, among others [4]. The stem and root divested of the bark are used as chew-sticks in Nigeria. More importantly, the leaves are used to prepare the very popular bitter leaf soup in Nigeria, and are also reportedly consumed by goats in some parts of Nigeria [5]. Antihelmintic and antimalarial properties [6] as well as antitumourigenic properties [7], have also been reported for extracts from the plant. Other studies have demonstrated hypoglycaemic and hypolipidaemic effects of the leaf extract in experimental animals [8-10]. This study was conducted to determine nutritional and physicochemical properties Vernonia amygdalina leaves.

2. Materials and methods

2.1. Collection, identification and preparation of plant materials

Vernonia amygdalina leaves were purchased from a local market in Benin City, Edo state, Nigeria. The fresh leaves were identified, separated from the stalk, washed and air-dried at room tempera-
2.4.1. Test for saponins

To 0.5g of extract, 5ml of distilled water was added in a test tube and the solution shaken vigorously and observed for a stable persistent froth. The frothing was mixed with 3 drops of olive oil and shaken vigorously after which it was observed for the formation of an emulsion.

2.4.2. Test for triterpenoids

0.5g of the extract was dissolved in 1ml of chloroform and 1ml acetic anhydride added, followed by the addition of 2ml of concentrated H₂SO₄. Triterpenoids were indicated by formation of reddish violet colour.

2.4.3. Test for tannins

About 0.5g of the extract was boiled in 10ml of water in a test tube and then filtered. A few drops of 0.1% ferric chloride was added and the solution observed for brownish green or a blue-black colouration

2.4.4. Test for reducing sugar (fehling’s test)

0.5g of the extract was dissolved in 5ml distilled water and filtered. The filtrate was hydrolysed with dilute HCl, neutralized with alkali (NaOH) and heated with Ferling’s A and B solutions. Formation of red precipitate indicated the presence of reducing sugars.

2.4.5. Test for anthraquinones

0.5g of the extract was boiled with 10ml of H₂SO₄ and filtered while hot. The filtrate was shaken with 5ml of chloroform, the chloroform layer was pipette into another test tube and 1ml of dilute ammonia was added. The resulting solution was observed for colour changes.

2.4.6. Test for steroids

0.5g of the extract was dissolved in 10ml of chloroform and equal volume of concentrated H₂SO₄ was added by the sides of the test tubes. Reddish upper layer and yellowish sulphuric acid layer with green fluorescence indicate the presence of steroids.

2.4.7. Test for cardiac glycosides (keller-killiani test)

To 0.5g of extract dissolved in 5ml water was added 2ml of glacial acetic acid solution containing one drop of ferric chloride solution. This was underlayed with 1ml of concentrated H₂SO₄. A brown ring at the interface indicated the presence of a deoxysugar characteristics of cardenolides. A violet ring may appear below the brown ring while in the acetic acid layer a greenish ring may form just above the brown ring and gradually spread throughout this layer.

2.4.8. Test for flavonoids

Dilute ammonia (5ml) was added to a portion of an aqueous filtrate of the extract. Then, concentrated sulphuric acid (1ml) was added. A yellow colouration indicated the presence of flavonoids.

2.4.9. Test for alkaloids

Extract was dissolved in dilute HCl and filtered. Filtrates were treated with Mayer’s reagent (potassium mercuric iodide). Formation of a yellow coloured precipitate indicates the presence of alkaloids.

3. Results and discussion

3.1. Phytochemical analysis

Phytochemicals also known as phytoneutrients are naturally occurring substances found in plants [15]. The result of the phytochemical screening of the ethanolic leaf extract of Vernonia amygdalina showed presence of flavonoids, alkaloids, saponins, tannins, triterpenoids, steroids, reducing sugars and cardiac glycosides and absence of anthraquinones (Table 1). These phytochemicals exhibit various pharmacological and biochemical actions when ingested by animals. Flavonoids have been reported to interfere with the activities of the enzymes involved in ROS generation, quenching of free radicals, chelating transition metals and rendering them redox inactive in the fenton reaction [16-17]. Anti-microbial, as well as many physiological activities such as stimulation of phagocytic cells, host-mediated tumor activity and a wide range of anti-infective actions have been attributed to tannins [18]. Tannins are known to be useful for the prevention of cancer as well as treatment of inflamed or ulcerated tissues [19-20]. Most alkaloids have a strong bitter taste and are very toxic and for these reasons they are used by plant to defend themselves against herbivory, and attacks by microbial pathogens and invertebrate pests [21]. Saponins as a class of natural products are involved in complexation with cholesterol to form pores in cell membrane bilayers [22], and as such may be used as anti-cholesterol agents or cholesterol lowering agent. Steroids are very important compounds especially due to their relationship with compounds such as sex hormone, thus its importance and interest in pharmaceutical companies [23-24]. Cardiac glycosides are important class of naturally occurring drugs whose actions helps in the treatment of congestive heart failure [25].

<table>
<thead>
<tr>
<th>Phytochemicals</th>
<th>Vernonia amygdalina</th>
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<tbody>
<tr>
<td>Flavonoids</td>
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<tr>
<td>Saponins</td>
<td>Present</td>
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<tr>
<td>Tannins</td>
<td>Present</td>
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<td>Steroids</td>
<td>Present</td>
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<td>Alkaloids</td>
<td>Present</td>
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<td>Triterpenoids</td>
<td>Present</td>
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<tr>
<td>Anthraquinone</td>
<td>Absent</td>
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<td>Reducing sugar</td>
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<tr>
<td>Cardiac glycosides</td>
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</tbody>
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3.2. Proximate composition

The leaves of Vernonia amygdalina contained crude protein value of 22.81% which was in agreement with the report that Vernonia amygdalina contained 17 to 33% of crude protein out of dry matter [26]. Also the crude protein value of Vernonia amygdalina leaves obtained is higher than protein content of Morinda fic-cide (4.6%) leaves consumed in Nigeria and Swaziland, Lesian-theraeafincas (13.1%) [27-29], Amaranthus candatus (20.5% DW), but lower than Piper guineesis (29.78% DW) and T. triangulare (31.00% DW) [30-32]. Proteins are building block units and the food protein is needed to make vital hormones, important brain chemicals, antibodies, digestive enzymes, and necessary elements for the manufacture of DNA. Some proteins are involved in structural support, while others are involved in bodily movement, or in defense against germs [33].

The leaves of Vernonia amygdalina contained crude fibre value of 18.17% which was in agreement with the report that Vernonia amygdalina contained 6.3 to 29.2% of crude fibre out of dry matter [26]. Also the crude fibre value of the Vernonia amygdalina leaf is high when compared to Ipomea batatas (7.20%), T. triangulare (6.20%), P. guineensis (6.40%), and Corchorus olitorius (7.0%), [30-31]. Fibre cleanses the digestive tract by removing potential carcinogens from the body and prevents the absorption of excess cholesterol. Fibre also adds bulk to the diet and prevents the intake of excess starchy food [34] and may therefore guard against metabolic conditions such as hypercholesterolemia and diabetes mellitus [35]. Other findings [36] also showed evidence
that a high intake of dietary fiber is associated with enhanced insulin sensitivity and therefore may have a role in the prevention and control of Type 2 diabetes. The substantial amount of fibre in Vernonia amygdalina leaves shows that they can help in keeping the digestive system healthy and functioning properly. Vernonia amygdalina had ash value of 16.65% which is a reflection of the mineral contents preserved in the plants leaves. The ash content obtained compare favorably with the values reported for Vernonia colorata (15.86%) and Moringa oleifera (15.09%) [31, 37] and lower than that of some leafy vegetables commonly consumed in Nigeria such as Talinum triangulare (20.05%) but higher than other some other vegetables such as Ocimum gratissimum (8.00%) and Hibiscus esculentus (8.00%) [30], the result therefore suggests a high deposit of mineral elements in the leaves [31]. Vernonia amygdalina had carbohydrate value of 38.03%, lower than reported values for Corchorus tridens (75.0% DW) and sweet potatoes leaves (82.8%) [38] but higher than 20% and 23.7% reported for Senna obtusifolia and Amaranthus incusavus respectively [27, 39]. Thus the high carbohydrate content contributes the highest Kilojoules to the energy value in Vernonia amygdalina. Carbohydrates produced by plants are one of the three main energy sources in food, along with protein and fat. When animals eat plants, energy stored in carbohydrates is released by the process of respiration, a chemical reaction between glucose and oxygen to produce energy, carbon dioxide, and water. Vernonia amygdalina had a crude fat value of 4.34% which was in agreement with Yeap et al (26) reported crude fat value range of 2 to 15%. Also the 4.34% Vernonia amygdalina crude fat value obtained compares favourably when compared to those of Talinum triangulare (5.90%), BaseliaAlba (8.71%), Amaranthus hybridus (4.80%), Calotropis africana (4.20%) [30]. A diet providing 1 - 2% of its caloric of energy as fat is said to be sufficient for human being as excess fat consumption is implicated in certain cardiovascular disorders [31]. The moisture content value of Vernonia amygdalina leaves was relatively low. The low moisture content would therefore hinder the growth of spoilage microorganisms and enhance shelf life.

Table 2: Proximate Analysis of Vernonia amygdalina Leaves

| Proximate composition | Vernonia amygdalina (%)
|-----------------------|-----------------------------
| Dry matter            | 90.68 ± 0.77                |
| Moisture Content      | 9.32 ± 0.67                 |
| Crude protein         | 22.81 ± 0.17                |
| Crude fiber           | 18.17 ± 0.06                |
| Ash content           | 16.65 ± 0.09                |
| Crude fat/oil         | 4.34 ± 0.04                 |
| Carbohydrate          | 38.03 ± 0.06                |

Values are means ± SD for 3 determinations.

In conclusion, the broad distribution of nutrients and phytochemicals in the Vernonia amygdalina leaves studied support, as well as provide a basic rationale for their use as in folk medicine. This study also indicates that Vernonia amygdalina leaves, besides serving as good source of pharmacologically active phytochemicals may also be useful as supplements in human and animal nutrition.

References


