Comparative Phytochemical and Physicochemical Properties of *Aspilia africana* and *Tithonia diversifolia* Leaves

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Abstract: *Aspilia africana* (Pers) C. D. Adams and *Tithonia diversifolia* (Hemsl.) A. Gray belong to the family of Asteraceae. The leaves of *A. africana* and *T. diversifolia* were investigated for their phytochemical constituents, quantitative evaluation, nutritional values and extractive values. Phytochemical screening revealed the presence of saponins, tannins, flavonoids, and cardiac glycosides in *A. africana* and *T. diversifolia* leaves. Alkaloids was absent in both plant leaves probably due to the geographical position and other environmental factors such as soil characteristic etc. Quantitative evaluation shows moisture content (8% and 10%), total ash (11.33% and 11.00%), sulfated ash (4.10% and 2.10%), acid-insoluble ash (4.33% and 1.33%) respectively for *A. africana* and *T. diversifolia* leaves. Nutritional analysis revealed protein content (6.13% and 10.30%), Fats (1.90% and 1.90%), Fibre (17.34% and 5.80%) and carbohydrate content (55.30% and 61%) respectively for *A. africana* and *T. diversifolia* leaves. Extractives determination revealed water-soluble (5% and 5%), diluted Alcohol-soluble (7.5% and 5.0%), Non-volatile ether-soluble (10.0% and 2.5%) and volatile ether-soluble (2.5% and 5.0%) for *A. africana* and *T. diversifolia* leaves respectively. The results of present study further confirm the use of *A. africana* and *T. diversifolia* leaves traditionally for the treatment of different ailments.

Keywords: *Aspilia Africana*, leaves, *Tithonia diversifolia*, phytochemicals, Asteraceae.

1. Introduction

Plant materials as source of medicinal compounds continue to play a dominant role in the maintenance of health since antiquity. Over 50% of all modern chemical drugs are of natural plant
product origin, and is essential in drug development programs of the pharmaceutical industry (Burton, Joyce and Ingold, 1983). Like any therapeutic agent, when overdosed or incorrectly used they also have the potential to induce adverse effects. The historic role of medicinal herbs in the treatment and prevention of disease, and their role as catalysts in the development of pharmacology do not, however, assure their safety for uncontrolled used by an uninformed public (Mathews, Lucier, and Fisher, 1999).

Medicinal plants are used by 80% of the world’s population as the only available medicines especially in the developing countries (El-kamali and El-amir, 2010). Nigeria has a great variety of natural vegetation which is used in trado-medicine to cure various ailments. Some plants are also useful for ornamental purposes while many due to their odoriferous nature are used in flavouring or as food additives and preservatives (Egwaikhinde and Gimba, 2007).

The medicinal value of a plant depends on the chemical constituents in it that produce definite physiological action on the human body (Aiyelaegbe nad Osamudiamen, 2007).

*Tithonia diversifolia* (Hemsl.) A. Gray is a composite shrub common on field boundaries in eastern Africa. In Kenya it is found in Western and Central Provinces as well as in coastal regions and parts of the Rift valley (Hong, Linington and Ellis, 1996).

*Aspilia africana* is very polymorphic with at least four varieties recognized in the region, occurring throughout the region on waste land of savanna and forest zones. However, it is widely distributed across tropical Africa (Burkill, 1985). *Aspilia africana* is used in tradition medicine for the treatment of several ailments in different parts of the world. Such ailments include: gonorrhea, tuberculosis, cough, rheumatic pains, stomach trouble, corneal opacity, wounds and insect bites (Iwu, 19993). Ethnobotanical surveys have shown that extracts from the leaves of *Tithonia diversifolia* exhibits antimalaria, antidiarrhoeic, anti-inflammatory, antibacterial, antiproliferation properties and its effectiveness in the treatment of haematomas and wounds had been reported (Akobunde, 1987; Kuo and Chen, 1998; Rungeler et al., 1998; Tona et al., 1998; Goffin et al., 2002). The decoction of the leaf is used to treat typhoid and stomach pains in Kenya (Kareru et al., 2008).

*Aspilia africana* leaves are found to be efficacious in the treatment of wounds (Okoli, Akah and Okoli, 2007). Also, it has been reported and documented that *Aspilia africana* leaves are effective against malaria (*Plasmodium falciparum*) infection (Okokon et al., 2006). In Kenya, the leaves of A. africana are used to kill intestinal worms while in Uganda it is used to treat gonorrhoea (Page et al., 1992).

*Tithonia diversifolia* has different uses, including use as ornamental plant, animal feed, insecticide, nematicide and soil fertility improvement (Olayeni, 2006; Akanbi et al., 2007; Jama et al., 2000). *Tithonia diversifolia* has medicinal value in the treatment of hepatitis (Lin et al., 1993; Kuo and Chen, 1997).
The objectives of this study is to identify the chemical constituents present in the leaves of the two plants viz: Aspilia africana and Tithonia diversifolia.

2. Materials and Methods

The fresh leaves of Aspilia africana (Pers) C. D. Adams and Tithonia diversifolia (Hemsl) A. Gray were collected from Oron Road, Mbiabong in Uyo Local government Area of Akwa Ibom State. The plant was authenticated by Dr. (Mrs.) U. A. Essiett, a taxonomist in the department of Botany and Ecological Studies, University of Uyo, Uyo, Nigeria.

2.1. Preparation of the Extract

After collection and identification of the two plant leaves were then sun dried and powdered. The powdered material were weighed accurately and 20g each were macerated cold in 400 ml of 70% ethanol for 72 hours (3 days) in a maceration tank at room temperature following Sofowora (2008) method. The plant materials were then filtered and the filtrate obtained was concentrated in water bath at 40°C which yield a semi-solid extract that is then used for the phytochemical screening. The extract was used to carry out phytochemical screening using the selected method (Trease and Evans, 1989; Sofowora, 2008).

2.2. Quantitative Microscopy/Proximate Analysis

The moisture content of the powdered leaves was determined by loss on drying method (African Pharmacopoeia, 1986). The ash value, acid insoluble ash, water-soluble ash and sulphated ash were determined as described in British Pharmacopoeia (1980) and African Pharmacopoeia (1986). The water and alcohol extractive values were obtained using the method outlined by Brain and Turner (1975) and British Pharmacopoeia (1980). The fat (lipids), crude fibre, crude protein and carbohydrate were obtained using the method outlined by Pearson (1976), Okon (2005) and AOAC (2000).

3. Results

3.1. Phytochemical Screening

The results of preliminary phytochemical screening of the leaves of Aspilia africana and Tithonia diversifolia showed the presence of saponins, tannins, flavonoids and cardiac glycosides. Alkaloids was absent in both A. africana and T. diversifolia leaves (Table 1).
Table 1: Result of the phytochemical screening of the ethanolic extract of *A. africana* and *T. diversifolia* leaves

<table>
<thead>
<tr>
<th>Test</th>
<th>Observation</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><em>A. africana</em></td>
</tr>
<tr>
<td>Saponins</td>
<td>Frothing persisted for more than 10 minutes</td>
<td>+++</td>
</tr>
<tr>
<td>Tannins</td>
<td>Blue black ppt. formed in <em>A. africana</em> but blue green ppt. formed in <em>T. diversifolia</em></td>
<td>+++</td>
</tr>
<tr>
<td>Alkaloids</td>
<td>A clear solution formed</td>
<td>-</td>
</tr>
<tr>
<td>Flavonoids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shinoda Reduction Test</td>
<td>Orange colour</td>
<td>++</td>
</tr>
<tr>
<td>Cardiac glycosides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Lieberman’s Test</td>
<td>Pink colour formed at the interphase</td>
<td>++</td>
</tr>
<tr>
<td>(ii) Salkowskis Test</td>
<td>Reddish brown colour formed at the interphase</td>
<td>++</td>
</tr>
<tr>
<td>(iii) Keller Killiani Test</td>
<td>Brown colour formed at the interphase</td>
<td>++</td>
</tr>
</tbody>
</table>

Key: Abundant = +++; Moderate = ++; Trace = +; Absent = -

3.2. Quantitative Evaluation

The result of the quantitative evaluation of *A. africana* and *T. diversifolia* leaves showed moisture content of 8.00% and 10.00%, ash content of 11.33% and 11.00%, sulfated ash of 4.10% and 2.10%, acid-insoluble ash of 4.33% and 1.33% respectively (Table 2).

3.3. Nutritional Analysis

The result of the nutritional analysis showed protein content (6.13% and 10.30%), fat (1.90% and 1.90%), fibre (17.34% and 5.80%) and carbohydrate content of (55.30% and 61.00%) respectively for *A. africana* and *T. diversifolia* leaves respectively (Table 3).

3.4. Extractive Values

The result of extractive values revealed water-soluble extract (5% and 5%), dilute alcohol-soluble (7.5% and 5.0%), non-volatile ether-soluble (10.0% and 2.5%) and volatile ether-soluble (2.5% and 5.0%) for *A. africana* and *T. diversifolia* leaves respectively (Table 4).
Table 2: Result of Quantitative Evaluation of *A. africana* and *T. diversifolia* leaves

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values (% W/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>A. africana</em></td>
</tr>
<tr>
<td>Moisture Content</td>
<td>8.00</td>
</tr>
<tr>
<td>Total Ash Content</td>
<td>11.33</td>
</tr>
<tr>
<td>Acid insoluble</td>
<td>4.33</td>
</tr>
<tr>
<td>Sulphated Ash</td>
<td>4.10</td>
</tr>
</tbody>
</table>

Table 3: Result of the Nutritional analysis of *A. africana* and *T. diversifolia* leaves

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values (% W/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>A. africana</em></td>
</tr>
<tr>
<td>Protein</td>
<td>6.13</td>
</tr>
<tr>
<td>Fats</td>
<td>1.90</td>
</tr>
<tr>
<td>Fibre</td>
<td>17.34</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>55.31</td>
</tr>
</tbody>
</table>

Table 4: Result of the extractive value of *A. africana* and *T. diversifolia* leaves

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values (% W/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>A. africana</em></td>
</tr>
<tr>
<td>Water-soluble Extract</td>
<td>5.00</td>
</tr>
<tr>
<td>Dilute Alcohol-Soluble Extract</td>
<td>7.50</td>
</tr>
<tr>
<td>Non-volatile Ether-Soluble Extract</td>
<td>10.00</td>
</tr>
<tr>
<td>Volatile Ether-Soluble Extract</td>
<td>2.50</td>
</tr>
</tbody>
</table>

4. Discussion

The presence of tannin, flavonoid, saponin and cardiac glycosides in leaves of *A. africana* and *T. diversifolia* as observed in the study is the proper evidence to regard the plants (i.e. *A. africana* and *T. diversifolia*) as medicinal plants (George *et al.*, 2009; Sofowora, 2008). Tannins have astringent and detergent properties. It also has inhibitory effect on many enzymes due to protein precipitation and the presence of these tannins in *A. africana* and *T. diversifolia* leaves extracts could be the reason why *A. africana* and *T. diversifolia* leaves are used locally, for treatment of wound, sores and skin diseases (Trease and Evans, 2002; Bruneton, 1999).
Saponins containing plants are important because of their detergent and haemolytic properties. Saponin when injected into the blood stream is highly toxic because of their reaction with enzymes, but when administered orally, becomes comparatively harmless (George et al., 2009). The presence of saponin in A. africana and T. diversifolia leaves confirmed these plants as anti-inflammatory, antifungal and antiparasitic (Sparg et al., 2004).

The presence of flavonoid in the plants leaves suggests that it can be used as anti-spasmodic, antifungal and anti-bacterial drugs. This confirms the reason for the use of these plants in the treatment of diarrhoea spasmodic bronchitis and other microbial infections. This corresponded with reported work (Trease and Evans, 1978). The presence of cardiac glycosides in both A. africana and T. diversifolia shows that the plants are good for the treatment of diseases associated with heart. The presence of various active ingredients revealed by the phytochemical screening (Table 1) supports the resourcefulness of these plants extract (Sofowora, 1993).

The total Ash content mainly is a measure of the presence of inorganic compounds in a drug. A larger value indicates that the plant material contains more of inorganic compounds (African pharmacopoeia, 1986). The total Ash content of 11.33% for A. africana and 11.00% for T. diversifolia leaves indicated that A. africana contains more of inorganic compounds than T. diversifolia leaf. Moisture content if too high indicates chances of microbial degradation of the drugs during storage. Therefore, moisture content of 8.00% and 10.00% for A. africana and T. diversifolia leaves respectively fall within the accepted range of 14.00% for standard drugs (British pharmacopoeia, 1980) and the results obtained in this work is in agreement with reported work (Edward et al., 1971).

Sulfated ash content gives an estimate of the lignin content that remains after treatment with concentrated sulphuric acid (Mammen, Daniel and Sane, 2010). Sulfated Ash of 4.10% and 2.10% for A. africana and T. diversifolia respectively shows that T. diversifolia extract is purer than A. africana extract, thus, sulfated ash is a good criterium use to judge the identity and purity of crude drug. Acid-insoluble ash of 4.33% and 1.33% for A. africana and T. diversifolia leaves indicated that T. diversifolia leaves are more digestible than A. africana leaves since high value indicates high digestibility when consumed (African Pharmacopoeia, 1986).

Protein content of 6.13% for A. africana and 10.30% for T. diversifolia indicated a higher protein content than A. africana leaf when used as poultry feed or consumed. This coincides with reported work (Nill and Nill, 1993). Fat content of 1.90% and 1.90% for A. africana and T. diversifolia leaves showed that both plants are poor sources of fat in their leaves. The carbohydrate content of 55.31% and 61.00% for A. africana and T. diversifolia leaves also show that they are good source of energy, however T. diversifolia is a little better.
The extractive values of 5.00% and 5.00% water-soluble, 7.50% and 5.00% dilute alcohol-soluble, 10.00% and 2.50% non-volatile and 2.50% and 5.00% volatile ether-soluble extract for A. africana and T. diversifolia leaves respectively indicated that petroleum ether will be a better solvent for extraction of A. africana leaf, while water and alcohol will be a better solvent for extraction of T. diversifolia leaf.

5. Conclusion

The use of A. africana (Pers) C. D. Adams and T. diversifolia (Hemsl.) A. Gray leaves for the treatment of various ailments could be attributed to their phytochemical constituents such as saponin, flavonoids, tannins and cardiac glycoside. The results shows that A. africana and T. diversifolia leaves are rich in both secondary metabolites and nutritive values.

References


