Pollen Morphology of some Medicinal Plants in Asteraceae form Nigeria

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KEYWORDS

Pollen morphology, Medicinal Plants, Asteraceae

ABSTRACT

The present study investigated the variations and similarities in the pollen morphology of 13 species of Asteraceae from Nigeria used for different medicinal purposes. Mature flowers of these plants were cut off, the pollens dusted on a slide containing a drop of glycerin, observed under microscope and micro-photographed using Leica WILD MPS 52 microscope camera. Generally, the pollens are radially symmetrical, isopolar, tricolporate and spheroidal. The equatorial diameter of the species studied ranged from 17.14µm to 55.72µm while the length of the spines varied generally varied from 1.09µm to 8.45µm. The pollen morphology of the species investigated was found to have diagnostic value and however supports the previous classification of these plants as distinct species.

Introduction

The pollen is the structure used in the transport of the male gamete (sperm cells) to the female part of the flower; it is made up of a fine to coarse powder which consists of micro gametophytes (pollen grains), which produce the male gametes of seed plants. Pollen grains are microscopic; usually about 15 to 100 microns and just a pinch of pollen powder contains thousands of grains (Louise, 2008). Pollen is made up of an outer wall called the exine, composed of a very tough unusual substance known as sporopollenin and an inner wall called the intine which is made up of cellulose similar in construction to an ordinary plant cell wall. Pollen grains come in a wide variety of shapes (most often spherical), sizes and surface markings characteristic to the species. Furrows in the pollen grain called colpi and pores are major criteria for the identification of pollen classes (Dutta, 1964). The differences in these characters can be used in differentiating plants of the same genus or family. It is well known that palynological studies performed by light microscope (LM) and scannini electron microscope (SEM) have great value in plant taxonomy (Skvarla et al., 1977), specifically for the taxonomy of the family Asteraceae (Wodehouse, 1926; Tomsovic, 1997).
Nigeria and other countries, members of Asteraceae family are used for several medicinal purposes. These include ethno-botanical, phytochemical, antimicrobial and other medicinal purposes (Teke, et al., 2007; Kamboj and Saluja, 2008; Chono et al., 2009; Abii and Onuoha, 2011; Adebyo, et al., 2010; Arlene, et al., 2013; Toyang and Verpoorte, 2013; Ajiboye, et al., 2014).

In Nigeria some of these plant species are source from the local markets where the sellers may know the proper scientific names of these specimens. Therefore this study is aimed at showing the importance of plant classification based on their natural differences or similarities and therefore is focused on the pollen morphology and structure of some medicinal plants in Asteraceae (Aspilia africana, Tridax procumbens, Tithonia diversifolia, Chromolaena odorata, Ageratum conyzoides, Bidens pilosa, Spilanthes filicaulis, Emilia praetermissa, Vernonina cinerea, Synedrella nodiflora, Eclipta alba, Spilanthes filicaulis and Vernonina amygdalina) and their usefulness in identification and classification of these species.

Materials and Methods

The plants species were collected within University of Port Harcourt Park and its environs, Rivers State and was taken to the laboratory for microscopic studies. The flowers of the plants were cut off using a scissors, dusted on a slide containing a drop of glycerin to bring out the pollen grains from the anthers and observed under the microscope and micro-photographed using Leica WILD MPS 52 microscope camera. The equatorial diameter of the 20 pollens from each plant species were measured with graticle and the average (mean), standard deviation (STD) and range determine using IBM SPSS Statistics 20.

Results and Discussion

The external morphology of the medicinal plants from Asteraceae studied is presented in Figure 1 while the results of the pollen grain morphological studies are represented in Table 1 and Figure 2. Among the genera studied, the species have some morphological differences and similarities from each other. For instance, the inflorescence of Aspilia africana, Melanthera scandens and Tithonia diversifolia are fairly similar. However, the morphological differences among these genera have described (Hutchinson and Dalziel, 1954; Akobundu and Agyakwa, 1988).

Generally, the pollens morphology of the species studied are tricolporate, tricolpate, triporate, pantoporate or tri-tetracolporate (Table 1). Among this family, tricolporate pollen type occurred in Ageratum conyzoides (Figure 2a-b) Bidens pilosa (Figure 2e-f) and Vernonina amygdalina (Figure 2w-y) while pantoporate and tritetracolporate types were found in Tithonia diversifolia (Figure 2n-o) and Tridax procumbens (Figure 2p-q) respectively. Tricolpate pollen occurred in Chromolaena odorata (Figure 2g-h), Synedrella nodiflora (Figure 2m) and Eclipta alba (Figure 2t). Based on the external morphology and pollen size, these species are different but they are closely related base on their pollen morphology (Figure 2 and Table 1). Triporate pollen type was the predominant pollen type observed and occurred in Aspilia africana (Figures 2c-d), Emilia praetermissa (Figure 2h), Spilanthes filicaulis (Figures 2i-j), Vernonina cinerea (Figure 2q) and Melanthera scandens (Figures 2s-t).

Also, the result showed that the mean equatorial diameter of the pollens in the species studied varied from 17.14µm in Bidens pilosa to 55.72µm in Vernonina
The mean of equatorial diameter of the pollens showed that *Vernonia amygdalina* had the highest Equatorial diameter. This is followed by *Tridax procumbens* (39.43±3.59 µm), *Emilia praetermissa* (32.57±2.35 µm), *Tithonia diversifolia* (30.86±3.59 µm), *Vernonia cinerea* (27.47±2.35 µm), *Aspilia africana* (27.43±2.35 µm) and *Melanthera scandens* (26.57±1.92 µm) while *Bidens pilosa* had the least mean equatorial diameter of (19.72±2.35 µm). The mean equatorial diameters of the other species are presented in Table 1.

The length of the spines varied from species to species. Generally, it varied from 1.09 µm to 8.45 µm among the species studied (Table 2). The maximum mean length of pollen spine was observed in *Melanthera scandens* (7.23±1.05 µm) while the minimum length was observed in *Vernonia cinerea* (1.41±0.27 µm). The mean length of spines in the species include; *Ageratum conyzoides* (3.83±0.71 µm), *Aspilia africana* (7.70±1.24 µm), *Bidens pilosa* (5.54±0.93 µm), *Chromolaena odorata* (1.96±0.58 µm), *Emilia praetermissa* (1.77±0.46 µm), *Spilanthes filicaulis* (5.54±1.39 µm), *Synedrella nodiflora* (4.13±0.90 µm), *Tithonia diversifolia* (7.38±1.02 µm), *Tridax procumbens* (5.32±0.84 µm), *Eclipta alba* (5.18±0.88 µm) and *Vernonia amygdalina* (4.87±0.57 µm). The variation is this character could be used to delimit the species.

### Table 1: Pollen Grain Aperture and Sizes in 13 Plants in the Family Asteraceae Studied

<table>
<thead>
<tr>
<th>S/N</th>
<th>Plants</th>
<th>Pollen types</th>
<th>Equatorial diameter of Pollen size (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Range</td>
</tr>
<tr>
<td>2</td>
<td><em>Bidens pilosa</em> Linn. <em>Chromolaena odorata</em> (Linn.) R. M. King &amp; Robinson <em>Emilia praetermissa</em> Milne-Redhead</td>
<td>Triporate</td>
<td>25.72 - 30.00</td>
</tr>
<tr>
<td>3</td>
<td><em>Spilanthes filicaulis</em> (Schum &amp; Thonn) C. D. Adams</td>
<td>Triporate</td>
<td>17.14 – 21.43</td>
</tr>
<tr>
<td>4</td>
<td><em>Synedrella nodiflora</em> Gaertn. <em>Tithonia diversifolia</em> (Hemsl.) A. Gray</td>
<td>Tricolpate</td>
<td>21.43 – 30.00</td>
</tr>
<tr>
<td>5</td>
<td><em>Tridax procumbens</em> Linn. <em>Vernonia cinerea</em> (Linn.) Less. <em>Melanthera scandens</em> (Schumach. &amp; Thonn) Roberty</td>
<td>Tri- tetracolporate</td>
<td>30.00 – 34.29</td>
</tr>
<tr>
<td>6</td>
<td><em>Eclipta alba</em> (L.) Hassk</td>
<td>Triporate</td>
<td>21.43 – 30.00</td>
</tr>
<tr>
<td>7</td>
<td><em>Vernonia amygdalina</em> Delile</td>
<td>Tricolpate</td>
<td>21.43 – 25.72</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Pantoporate</td>
<td>25.72 – 34.29</td>
</tr>
</tbody>
</table>

167
Figure 1 Picture Showing the External Morphology of the Asteraceae species: (a) Ageratum conyzoides; (b) Aspilia africana; (c) Bidens pilosa; (d) Chromolaena odorata; (e) Emilia praetermissa; (f) Spilanthes filicaulis; (g) Synedrella nodiflora; (h) Tithonia diversifolia; (i) Tridax procumbense; (j) Vernonia cinerea; (k) Melanthera scandens, (l) Eclipta alba and (m) Vernonia amygdalina
Figure 2 Picture Showing the Pollen Morphology of the Asteraceae Species: (a-b) Ageratum conyzoides; (c-d) Aspilia africana; (e-f) Bidens pilosa; (g-h) Chromolaena odorata; (i-j) Emilia praetermissa; (k-l) Spilanthes filicaulis; (m) Synedrella nodiflora; (n-o) Tithonia diversifolia; (p-q) Tridax procumbens; (r-s) Vernonia cinerea; (t) Eclipta alba; (u-v) Melanthera scandens; (w-y) Vernonia amygdalina and scale bar = 15µm

<table>
<thead>
<tr>
<th>S/N</th>
<th>Species Name</th>
<th>Range (µm)</th>
<th>Mean±STD (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ageratum conyzoides</td>
<td>2.86 – 4.77</td>
<td>3.83±0.71</td>
</tr>
<tr>
<td>2</td>
<td>Aspilia africana</td>
<td>5.45 – 9.14</td>
<td>7.70±1.24</td>
</tr>
<tr>
<td>3</td>
<td>Bidens pilosa</td>
<td>4.09 – 6.82</td>
<td>5.54±0.93</td>
</tr>
<tr>
<td>4</td>
<td>Chromolaena odorata</td>
<td>1.36 – 2.73</td>
<td>1.96±0.58</td>
</tr>
<tr>
<td>5</td>
<td>Emilia praetermissa</td>
<td>1.36 – 2.73</td>
<td>1.77±0.46</td>
</tr>
<tr>
<td>6</td>
<td>Spilanthes filicaulis</td>
<td>4.09 – 8.18</td>
<td>5.54±1.39</td>
</tr>
<tr>
<td>7</td>
<td>Synedrella nodiflora</td>
<td>2.73 – 5.45</td>
<td>4.13±0.90</td>
</tr>
<tr>
<td>8</td>
<td>Tithonia diversifolia</td>
<td>5.45 – 8.78</td>
<td>7.38±1.02</td>
</tr>
<tr>
<td>9</td>
<td>Tridax procumbens</td>
<td>4.09 – 6.82</td>
<td>5.32±0.84</td>
</tr>
<tr>
<td>10</td>
<td>Vernonia cinerea</td>
<td>1.09 – 1.91</td>
<td>1.41±0.27</td>
</tr>
<tr>
<td>11</td>
<td>Melanthera scandens</td>
<td>5.45 – 8.45</td>
<td>7.23±1.05</td>
</tr>
<tr>
<td>12</td>
<td>Eclipta alba</td>
<td>3.82 – 6.55</td>
<td>5.18±0.88</td>
</tr>
<tr>
<td>13</td>
<td>Vernonia amygdalina</td>
<td>4.09 – 5.45</td>
<td>4.87±0.57</td>
</tr>
</tbody>
</table>
This present study has revealed the variations and similarities in the pollen morphology of some Asteraceae family in Nigeria. Generally, in Asteraceae, the pollens are radially symmetrical, isopolar, tricolporate and spheroidal. The exine ornamentation is echinate-perforate (El-Ghazaly and Anderberg, 1995). The pollens of the species investigated in this study are tricolporate, tricolpate, triporate, pantoporate or tri-tetracolporate which is typical of the family studied. This is in line with the works of Ozmen, et al., 2009, Adekanmbi, 2009, Mbagwu, et al., 2008, Elaheh, et al., 2013. Also, the equatorial diameter of the species studied ranged from 17.14µm to 55.72µm.

This range has been recorded in species of the family (Elaheh, et al., 2013, 34.69 to 49.03µm) among Centaurea L. (Asteraceae) in Iran, Jafari and Ghanbarian, 2007 (13.9 to 46.0 µm) and Ozmen, et al., 2009 (23.32 to 30.44µm). This confirms that the species investigated are members of Asteraceae. Furthermore, the length of the spines varied generally varied from 1.09µm to 8.45µm.

Previous studies in the family showed that this result conforms to the values observed among the species of this family however, it was slightly higher. In a similar study involving 13 taxa of Scorzonera L. (Asteraceae) from Turkey, it was observed that the pollen spine length among this taxa varied from 1.3 to 4.63 µm (Terkmen, et al., 2010), in Tanacetum L. (Asteraceae) 2.62-3.38 µm (Ozmen, et al., 2009).

The morphology of the pollens of the species investigated was found to have diagnostic value and however supports the previous classification of the species by Hutchinson and Dalziel, 1954. It also supports the importance of length of pollen spines as systematic tool in plant taxonomy.

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