Short Communication

Isolation and Identification of Photosynthetic Pigments in the Leaves of Maize (Zea mays) and Water Leaf (Talinium triangulare)

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ABSTRACT
Plants contain photosynthetic pigments which aid photophosphorylation and subsequent carboxylation to yield carbohydrates and other food nutrients. The higher the concentration of these photosynthetic pigments, the higher the rate of carbon dioxide capture and the higher the yield in photosynthesis. Analysis was carried out to investigate and determine the photosynthetic pigments in the acetone extract of Zea mays and Talinium triangulare. Thin layer chromatography was used to separate the pigments and a suitable solvent system of pet ether, chloroform and acetone (3:1:1) was used. The pigments were identified based on both their rf values and their colours in an iodine tank. Five pigments were identified in Zea mays while six were identified in Talinium triangulare. Zea mays contained Xanthophrilly 1 and 2, chlorophyll a and b, and pheophytin. Talinium triangulare contained Xanthophrilly 1 and 2, chlorophyll a and b, pheophytin and carotene. The presence of carotene in Talinium triangulare confers an additional nutritional and clinical importance to the plant which can be exploited by man.

Key words: Zea mays, Talinium triangulare, Thin layer Chromatography, Iodine tank, rf values and Food Nutrients.

INTRODUCTION
Man and other animals, being consumers are completely dependent on plants for food. The production ability of plants is made possible by an intricate and efficient system of carbon dioxide capture and fixation.

The rate of photosynthesis is influenced by two factors: external factors including light, temperature and carbon dioxide; and internal factors which include chlorophyll (Kosova et al., 2005). Chlorophyll is confined in the thylakoids of the chloroplast (Taiz and Zeiger, 1994). It is the most prominent pigment in plants for photosynthesis. It is an important factor in plant determining the rate of photosynthesis, the more the concentration of chlorophyll the more the rate of carbon dioxide capture as there will be more trapping centers and hence there will be increased rate of photosynthesis and growth (Taiz and Zeiger, 2006).

Maize is an important cereal crop with short growing period and high yield and ranks third in the world in terms of cereal production (Raji, 2007). It is a rich source of carbohydrates and also contains vitamins and minerals (Redmond, 2007). Variation in genotypes of various species of maize confers on the plant the ability to be cultivated both in tropical and temperate regions, with tolerance to low temperatures (Fracheboud et al., 1999, Massacci et al., 1995).

Waterleaf is a vegetable crop of the portulacea family which originated from tropical Africa and is widely grown in West Africa, Asia and South America (Schippers, 2000). It is a short duration plant due for harvest between 35-45 days after planting (Rice et al., 1986). It is predominantly consumed in Southern Nigeria (Ibeawuchi et al., 2007). The plant also has some medicinal values in humans and acts as green forage for rabbit feed management (Ekpenyong, 1986; Aduku and Olukosi, 1990). In addition, waterleaf farming provides a complementary source of income to small-scale farming households (Udoh, 2005; Enete and Okon, 2010).

Aims and objectives
This study was aimed at isolating and separating the photosynthetic pigments in Zea mays and Talinium triangulare by the use of their rf values and colours with a view to determining their food values, clinical applications and biotechnology.

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Fig. 1: Thin layer Chromatography Separation of acetone extract maize and water leaf viewed in an iodine tank.

**Solvent System:** Pet ether: Chloroform: Acetone (3:1:1)

**KEY**
- Xan 1 = Xanthophyll 1
- Xan 2 = Xanthophyll 2
- Chl b = Chlorophyll b
- Chl a = Chlorophyll a
- Phe = Pheophytin
- Car = Carotene

**MATERIALS AND METHODS**

**Sample Preparation**

Fresh leaves of the maize and waterleaf plant were collected from a local farm in Awka, Anambra State. The water leaves were left to dry for about two weeks due to their high water content and then pulverized while *Zea mays* leaves were dried for five days before pulverization.

**Extraction procedure**

About 5g of the pulverized dried leaves were weighed and to it was added 10ml of acetone. It was allowed to macerate for 30mins and the contents were filtered using a whatmann filter paper to get the extract.

**Thin Layer Chromatography (TLC)**

**Principle:** TLC is based on the principle that components of a mixture migrate at different rates across a stationary phase (attraction) in the presence of a mobile phase (solubility).

**Procedure:** High-quality chromatograms were cut into appropriate size, 15x20 cm. A mixture of Petroleum ether, Chloroform and Acetone, in the ratio of 3:1:1 was used as the mobile phase. Spots from the leave extracts (maize and water leaf) were applied 2cm from the bottom of the chromatogram using a capillary tube with proper spacing and the chromatogram was allowed to develop until the solvent had traveled more than two-third the chromatogram before being removed. The chromatogram was allowed to dry and then viewed in an iodine tank to reveal the spots (Wagner *et al.*, 1984; Jayaraman, 1992).

**Calculation of Retention factor (Rf)**

The Rf values of pigments were calculated thus;

\[
Rf = \frac{\text{Distance pigment travelled}}{\text{Distance solvent travelled}}
\]

**RESULTS**

In figure 1, the chromatographic plate viewed under iodine tank showed all the pigments (chlorophyll a and b, xanthophyll 1 and 2, pheophytin) without carotene on the maize spot while the water leaf spot showed all pigments including carotene.

**DISCUSSION**

Identification of the separated components was based on comparism with the rf values of standards using the same mobile phase. The rf values obtained were in agreement with those reported by Reiss, 1994 with the same solvent system.

In comparism with the standard, both plants (*Zea mays* and *Talinium triangulare*) showed an appreciable amount of the photosynthetic pigments as observed with the colors in iodine tank (Hall and Rao, 1994; Reiss, 1994).

*Talinium triangulare* was seen to have an appreciable amount of the pigment carotene which also doubles as a plant phytochemical and nutrient (Bowman and Russell, 2001). This may explain its use as a medicinal plant. Intake of carotene-rich foods have been found to reduce the risk of cancer (Omen *et al.*, 1997). In plants they prevent excessive photo-oxidation of chlorophyll molecules (Mercer and Godwin, 1991; Hall and Rao, 1994).

**Table 1:** Rf Values obtained for maize (*Zea mays*)

<table>
<thead>
<tr>
<th>S/N</th>
<th>Plant Name</th>
<th>Rf Value (obtained)</th>
<th>Rf Value (standard)</th>
<th>Pigment Name</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Zea mays</em></td>
<td>0.10</td>
<td>0.15</td>
<td>Xanthophyll 2</td>
<td>Yellow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.22</td>
<td>0.28</td>
<td>Xanthophyll 1</td>
<td>Yellow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.30</td>
<td>0.42</td>
<td>Chlorophyll b</td>
<td>Yellowish - green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.50</td>
<td>0.59</td>
<td>Chlorophyll a</td>
<td>Blue – green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.75</td>
<td>0.81</td>
<td>Pheophytin</td>
<td>Dark blue</td>
</tr>
</tbody>
</table>

**Table 2:** Rf Values obtained for water leaf (*Talinium triangulare*)

<table>
<thead>
<tr>
<th>S/N</th>
<th>Plant Name</th>
<th>Rf Value (obtained)</th>
<th>Rf Value (standard)</th>
<th>Pigment Name</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Talinium triangulare</em></td>
<td>0.11</td>
<td>0.15</td>
<td>Xanthophyll 2</td>
<td>yellow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.28</td>
<td>0.28</td>
<td>Xanthophyll 1</td>
<td>yellow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.40</td>
<td>0.42</td>
<td>Chlorophyll b</td>
<td>Yellowish - green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.62</td>
<td>0.59</td>
<td>Chlorophyll a</td>
<td>Blue - green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.85</td>
<td>0.81</td>
<td>Pheophytin</td>
<td>Dark blue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.91</td>
<td>0.98</td>
<td>Carotene</td>
<td>orange</td>
</tr>
</tbody>
</table>

Tables 1&2 shows the Rf values of the pigments and their corresponding colors on the Maize and Water leaf spots respectively.
The Thin Layer Chromatogram show the presence of chlorophyll a pigment (reaction center) with the accessory pigments in both plant leaves, which attests to their physiologic role and economic importance, with additional carotene pigment accounting for the clinical importance of *Talinium triangulare*.

**Conclusion**

Conclusively, the recorded values for the photosynthetic pigments confirm and support the widespread cultivation and availability of the food plants.

The observed presence of carotene in waterleaf confers on the plant an additional nutritional and clinical importance which may be exploited by man as a potential instrument of war in the fight against cancer and other oxidation-induced diseases.

**REFERENCES**


