UTILIZATION OF SELECTED PHILIPPINE ENDEMIC PLANTS AS A SUSTAINABLE AND ENVIRONMENT-FRIENDLY PISCICIDE FOR AQUACULTURE MANAGEMENT

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INTRODUCTION

- Unwanted organisms: predators & competitors
  - Negative impacts to aquaculture
- Measures to control/ eradicate unwanted organisms in pond:
  - Manual picking
  - Crack drying
  - Installation of screens
  - Use of commercial insecticides as fish toxicants
PROBLEM

- Commercial insecticides are too hazardous in the pond/water environment
  - Possibility of residue accumulation
  - Limit natural food production
  - Affect the biodiversity of some natural flora and fauna
  - Health hazards
There is a need to find an alternative fish toxicant that are **effective**, **abundant (locally available)**, and **environment-friendly**

**Alternative solution:**
- **Use of locally-available botanicals as piscicides**
SIGNIFICANCE

- Additional information on potential botanicals that can be used as piscicide
- Greater control and benefit for small-scale fish farmers (minimize production costs)
- Reduced environmental and health risks
METHODS

Experimental fish
- African catfish and tilapia fingerlings

- Experimental plants

Figure 1. *Tinospora rumphii* Boerl
Figure 2. *Manihot esculenta* Linn.
METHODS

- Experimental plants

Figure 3. *Pithecellobium dulce* (Roxb.) Benth.

Figure 4. *Muntingia calabura* Linn.
MATERIALS AND METHODS

- Experimental plant

Figure 5. *Albizia procera* (Roxb.) Benth.
A. Preparation of plant extracts and test solutions

1. Collection, chopping, weighing and soaking of leaves and bark
2. Preparation of different volumes of plant extract
3. Separation of extract from the solid particles using strainer and cheesecloth

Preparation of the different volumes of plant extract
METHODS

B. Static Bioassay

- Addition of the plant extract to the pre-aerated freshwater
- Distribution of the pre-conditioned experimental fish to the test solution
- Observation of fish behavior and recording of mortality and water quality parameters
Table 1. The experimental plants used in the study

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Local Name</th>
<th>Family Name</th>
<th>Part Used</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Tinospora rumphii</em> Boerl</td>
<td>Makabuhai/manunggal</td>
<td>Menispermaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td><em>Manihot esculenta</em> Linn</td>
<td>Kamoteng-kahoi</td>
<td>Euphorbiaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td><em>Pithecellobium dulce</em> (Roxb.) Benth</td>
<td>Kamatsili</td>
<td>Leguminosae</td>
<td>Bark</td>
</tr>
<tr>
<td><em>Muntingia calabura</em> Linn.</td>
<td>Datiles</td>
<td>Tiliaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td><em>Albizia procera</em> (Roxb.) Benth</td>
<td>payhod</td>
<td>Mimosaceae</td>
<td>Bark</td>
</tr>
</tbody>
</table>

Table 2. The concentrations (mL.L$^{-1}$) for each plant that were used in the study

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Concentrations (mL.L$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Tinospora rumphii</em> Boerl</td>
<td>0, 0.5, 0.75, 1.5, 3, 6</td>
</tr>
<tr>
<td><em>Manihot esculenta</em> Linn</td>
<td>0, 5, 15, 30, 45, 60</td>
</tr>
<tr>
<td><em>Pithecellobium dulce</em> (Roxb.) Benth</td>
<td>0, 0.5, 1, 2, 4, 6</td>
</tr>
<tr>
<td><em>Muntingia calabura</em> Linn.</td>
<td>0, 10, 20, 40, 60, 80</td>
</tr>
<tr>
<td><em>Albizia procera</em> (Roxb.) Benth</td>
<td>0, 0.25, 0.5, 0.75, 1, 2</td>
</tr>
</tbody>
</table>
Determination of lethal concentrations

\( LC_{50} \) or median lethal concentration
- the concentration at which 50\% of the fish survived and 50\% of the fish died.
- the basis of most toxicity and tolerance tests.

\( LC_{100} \) is the lowest concentration
- 100\% of the fish died.
- the basis of the piscicidal activity of test plants.
RESULTS

Fish behavior and mortality avoidance-response reaction was observed

- Gasping at the surface of the water, rapid opercular movement, restless swimming and crowding of the fishes at the sides and bottom of the plastic containers were observed.
- Fishes also exhibited jerky movements, swimming in vertical position and swimming upside down which indicates loss of equilibrium.
- As concentration increases, mortality also increase
## RESULTS

Table 2. Lethal Concentrations ($\text{LC}_{50}$ and $\text{LC}_{100}$) values of the different test plants to *C. gariepinus* and *O. niloticus* at 6-hr duration

<table>
<thead>
<tr>
<th>Test Plant</th>
<th>Toxic (active) substance</th>
<th><em>Clarias gariepinus</em></th>
<th><em>Oreochromis niloticus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$\text{LC}_{50}$</td>
<td>$\text{LC}_{100}$</td>
</tr>
<tr>
<td><em>T. rumphii</em></td>
<td>Picroretine, alkaloids, glucoside</td>
<td>1.756288</td>
<td>4.786775</td>
</tr>
<tr>
<td><em>M. esculenta</em></td>
<td>hydrocyanic acid</td>
<td>21.83709</td>
<td>51.63091</td>
</tr>
<tr>
<td><em>P. dulce</em></td>
<td>tannin</td>
<td>2.042609</td>
<td>4.842161</td>
</tr>
<tr>
<td><em>M. calabura</em></td>
<td>Saponin</td>
<td>28.91112</td>
<td>74.58573</td>
</tr>
<tr>
<td><em>A. procera</em></td>
<td>Saponin</td>
<td>0.946078</td>
<td>1.926471</td>
</tr>
</tbody>
</table>

*LC$_{50}$ and LC$_{100}$ were based on 12-hour duration of exposure since no mortality occurred in any concentration of the plant extract at 6-hour exposure.*
Per cent mortality of *C. gariepinus* exposed to different concentrations of *A. procera* extract within 3 to 48 hours.
RESULTS

- Per cent mortality of *O. niloticus* exposed to different concentrations of *A. procera* extract within 3 to 48 hours.
RESULTS

Toxicity and piscicidal effects
- were determined using the 6-hour lethal concentrations
- For *C. gariepinus*, the 6-hour LC$_{50}$ and LC$_{100}$ are 0.95 and 1.93 ml l$^{-1}$, respectively.
- The 6-hour LC$_{50}$ and LC$_{100}$ values for *O. niloticus* are 0.46 and 1.71 ml l$^{-1}$, respectively.

Tolerance
- catfish is more tolerant to tilapia if both are exposed to the extracts of *A. procera*
DISCUSSION

- **Saponin** present in plant extracts of *Albizia procera* may have caused the red blood cells (RBC) to undergo **hemolysis**.
- With the destruction of RBC, the transport of oxygen and carbon dioxide is prevented.
- Result: decrease in oxygen and increase in carbon dioxide levels in the blood.
- fish die due to **asphyxiation** or **suffocation**.
DISCUSSION

- Hydrocyanic acid (HCN), or prussic acid, may block the ability of cells to use oxygen.
- The cyanide affects the enzyme in the blood responsible for transporting oxygen, thereby decreasing the oxygen carrying capacity of the blood.
- Tannins have the ability of forming precipitates with albumin. It transforms proteins into insoluble products resistant to decomposition.
- The organism may die due to blood coagulation.
PERSPECTIVES

- Botanicals are potential source of piscicides for aquaculture management
- Follow-up study on the effects of these piscicides to other finfishes, mollusks and crustaceans in ponds.
- Use of other methods to extract the toxin and separation of the chemical components, specifically, the active ingredient present in the plant extract
- Use of molecular diagnostic techniques for toxicity studies
- Synthetic preparation of bioactive compounds present in the plant extracts
MARAMING SALAMAT!!!