Inhibitory potential of 40 medicinal plant extracts from Madagascar against enzymes linked to type 2 diabetes

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Background: Worlwide, 3.582 million people have diabetes and the estimated figure for 2035 is 592 million.1 Management of blood glucose by inhibition of carbohydrate-hydrolyzing enzymes is important to avoid diabetic complications. The post-meal increase in blood glucose levels, which causes hyperglycaemia in type 2 diabetes, occurs due to hydrolysis of starch by pancreatic α-amylase and intestinal α-glucosidases.2 α-Amylase and α-glucosidase inhibitors are potential targets in the development of lead compounds for the treatment of diabetes.3

Aim: The aim of this study was to assess whether inhibition of α-glucosidase and/or α-amylase by ethanol extracts of 40 Madagascan plants is the scientific rationale behind their traditional anti-diabetic use.

Table 1: Plants included in this work

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Part</th>
<th>Scientific name</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cedrelopsis tsihaninposa</td>
<td>Leaves, Bark</td>
<td>Leptadenia madagascariensis</td>
<td>Leaves, Bark</td>
</tr>
<tr>
<td>Ficus tsafrica indica</td>
<td>Leaves, Bark</td>
<td>Ravenala madagascariensis</td>
<td>Leaves, Bark</td>
</tr>
<tr>
<td>Rhizophora sp</td>
<td>Leaves</td>
<td>Psidium guajava</td>
<td>Leaves, Bark</td>
</tr>
<tr>
<td>Methylxylon afzeliiicum</td>
<td>Leaves</td>
<td>Artocarpus heterophylla</td>
<td>Aerial parts</td>
</tr>
<tr>
<td>Ambrosia maritime</td>
<td>Aerial parts</td>
<td>Dracaena reflexa</td>
<td>Bark</td>
</tr>
<tr>
<td>Rauvolfia madagascariensis</td>
<td>Leaves, Bark</td>
<td>Lepidoptera madagascariensis</td>
<td>Aerial parts</td>
</tr>
<tr>
<td>Cedrela odorata gravis</td>
<td>Leaves, Bark</td>
<td>Euphorbia hirta</td>
<td>Aerial parts</td>
</tr>
<tr>
<td>Furcraea marina</td>
<td>Leaves, Bark</td>
<td>Eugenia jambolana</td>
<td>Dried fruit</td>
</tr>
<tr>
<td>Gynostemma pseuodalearis</td>
<td>Leaves, Bark</td>
<td>Morinda charantia</td>
<td>Fruit</td>
</tr>
<tr>
<td>Gynostemma foeldatalearis</td>
<td>Leaves, Bark</td>
<td>Equisetum ramosissalmon</td>
<td>Aerial parts</td>
</tr>
<tr>
<td>Biloba ploosa</td>
<td>Aerial parts</td>
<td>Jatropha curcas</td>
<td>Leaves, Bark</td>
</tr>
<tr>
<td>Portulaca oleracea</td>
<td>Aerial parts</td>
<td>Catharanthus roseus</td>
<td>Aerial parts, Root</td>
</tr>
</tbody>
</table>

Results: The ethanolic extracts of the plants shown in Table 1 were tested at different concentration in α-glucosidase4 and α-amylase5 inhibition assays.

The extracts were inactive against pancreatic α-amylase, with two exceptions:
- Psidium guajava bark extract: IC_50 = 10.6 µg/mL
- Vangueria madagascariensis bark extract: IC_50 = 11.6 µg/mL

Several extracts showed strong inhibition of yeast α-glucosidase:
- Bark extract of Psidium guajava: IC_50 = 0.5 µg/mL
- Leaf extract of Psidium guajava: IC_50 = 1.0 µg/mL
- bark extract of Antidesma madagascariensis: IC_50 = 1.7 µg/mL
- Bark extract of Vangueria madagascariensis: IC_50 = 1.8 µg/mL
- Leaf extract of Rhizophora sp: IC_50 = 1.8 µg/mL

All extracts with IC_50 below 15 µg/mL were investigated for their content of tannins, known to give false-positive results in enzyme-based in vitro assays due to their non-specific enzyme binding. All active extracts had large amounts of tannins in the HPLC chromatogram, except partials of Euphorbia hirta and leaves of Artocarpus heterophylla, Ravenala madagascariensis, and Zanthoxylum tsihaninposa, which contained only low levels of tannins. These four species were subjected to high-resolution α-glucosidase bioactivity profiling6, in order to determine whether they contained specific enzyme inhibitors. It was, however, found that the α-glucosidase inhibitory profile correlated fully with the elution profile of the tannins.

Conclusion: Natural α-amylase and α-glucosidase inhibitors from plants can be used as an effective therapy for treating post prandial hyperglycaemia with minimal side effects. In this study, the 40 plant species traditionally used in Madagascar to treat diabetes do not hold promise as specific inhibitors of the carbohydrate-hydrolyzing enzymes α-amylase and α-glucosidase.

References: