Impact of Roasting to Total Phenolic, Flavonoid and Antioxidant Activities in Root, Bark and Leaf of Polyscias fruticosa

Minh Phuoc Nguyen¹*

¹Faculty of Biotechnology, Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam.

Author’s contribution
The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT
Polyscias fruticosa belongs to Araliaceae family widely cultivated in Vietnam. It is a medical plant highly valued recently owing to its diversified therapeutic functions. It’s exploited in all parts including root, bark and leaf for medicinal purposes. In the herbal tea production, the final step is normally ended with the roasting in order to improve its flavor and aroma. There’s a concern about the detrimental effect of thermal roasting to the stability of phytochemical constituents. In this research, we attempted to evaluate the reduction of total phenolic (mg GAE/100 g), total flavonoid (mg QE/100 g), DPPH radical-scavenging ability (mM TE/100 g), FRAP ferric reducing antioxidant power assay (mM TE/100 g) in root, bark and leaf of Polyscias fruticosa under different roasting conditions. All samples were steamed in vapor for 30 seconds before being dried by convective dryer at 45°C for 6 hours to final moisture content around 12%. Then these samples would be roasted in different conditions (125/15, 130/12, 135/9, 140/6, 145/3, °C/minutes). Our results revealed that roasting at 135/9°C/minutes was appropriate to preserve the most phytochemical constituents.

Keywords: Polyscias fruticosa; root; bark; leaf; roasting; total phenolic; flavonoid; antioxidant power.

*Corresponding author: E-mail: minh.npl@ou.edu.vn;
1. INTRODUCTION

Polyscias fruticosa (L.) Harms (Araliaceae) is widely cultivated in Vietnam, China and other tropical countries. P. fruticosa has been utilized as folk medicine in Vietnam to cure ischemia and inflammation and to accelerate blood flow in the brain [1]. Polyscias fruticosa is commonly utilized as food spice, herbal medicine, and ornamental. Its root is cylindrical, lengthly, and slightly fasciculated in appearance, yellowish brown in colour, usually much branched and woody. The taste of the roots is slightly bitter followed by sweet and mucilaginous [2]. The roots smell and taste like parsley [3]. The root is used as a diuretic, febrifuge, antisyphilitic, and for treatment of neuralgia, rheumatic pain, asthma [3,4,5]. Bark is hollow in the internode and solid at the node. Leaf has alternate, petiolate, irregular pinnate with conspicuous toothed margins, yellowish in color and fragrant if crushed. The leaves of this plant are also eaten as a salad The leaf is used as atonic, anti-inflammatory, antitoxic, and antibacterial [6,4]. The most active components in Polyscias fruticosa are total phenolics, flavonoids, saponin triterpenoids etc. These constituents are highly sensitive to thermal treatments like blanching, steaming, drying and roasting in herbal tea production.

There were some notable literatures mentioned to the application of thermal treatment on the phytochemical components of Polyscias fruticosa. Nguyen PM, Nguyen TT [7] identified some basic chemical components of the leaf Polyscias fruticosa as moisture, ash and saponin content through vacuum drying method. Nguyen PM et al. [8] studied some technical parameters influencing to production of Polyscias fruticosa tea. However, there was not any research indicated the relationship of thermal treatment by roasting to the degradation of functional constituents in three main plant segments: root, bark or stem, leaf. Objective of our study investigated the degradation of total phenolic (mg GAE/100 g), total flavonoid (mg QE/100 g), DPPH radical-scavenging ability (mM TE/100 g), FRAP ferric reducing antioxidant power assay (mM TE/100 g) in root, bark and leaf of Polyscias fruticosa under different roasting conditions.

2. MATERIALS AND METHODS

2.1 Materials

Polyscias fruticosa plants were harvested from Soc Trang province, Vietnam. After harvesting, they must be kept in dry cool place and quickly conveyed to laboratory for experiments. They were subjected to washing, slicing, steaming, drying and roasting. All standards and reagents such as Folin-Ciocalteu reagent, Na2CO3, gallic acid, Al(NO3)3, potassium acetate, DPPH, methanol, ethanol, acetic acid, 2,4,6-tripyridyl-s-triazine, HCl, FeCl3.6H2O were analytical grade and purchased from Sigma-Aldrich. Lab utensils and equipments included weight balance, hot air dryer, roasting oven, spectrophotometer.

2.2 Researching Methods

Polyscias fruticosa plants were divided into three groups: root, bark and leaf. Root or bark was sliced into pieces at 2 mm thickness. Leaf was chopped into pieces at 1.5 cm length. All samples were steamed in vapor for 30 seconds before being dried by convective dryer at 45°C for 6 hours to final moisture content around 12%. After that, these samples would be roasted in different conditions (125/15; 130/12, 135/9, 140/6, 145/3, °C/minutes). After that, all samples were cooled at ambient temperature before analyzing total phenolic (mg GAE 100 g), total flavonoid (mg QE/ 100 g), DPPH radical-scavenging ability (mM TE/100 g), FRAP ferric reducing antioxidant power assay (mM TE/100 g) to verify the degradation of phytochemical constituents and antioxidant capacity through thermal treatment.

2.3 Chemical and Statistical Analysis

Total phenolic content (mg GAE/g) was evaluated using Folin–Ciocalteu assay [9]. Total flavonoid content (mg QE/g) was evaluated by the aluminum calorimetric method [10]. DPPH (mM TE/g) assay and FRAP (mM TE/g) were performed according to Ivanov et al. [11]. The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Statgraphics Centurion XVI.

3. RESULTS AND DISCUSSION

Thermal treatments normally decreased the chemical, enzymatic and microbiological reactions to extend product shelf-life. However they also created undesirable effects on product quality such as overall appearance and degradation of bioactive components leading to low commercial acceptance [12]. It’s totally depended on the severity of thermal conditions [13]. Roasting is normally applied to enhance the flavor, color, texture, and overall palatability of
Table 1. Total phenolic (mg GAE/ 100 g) in root, bark and leaf of *Polyscias fruticosa* affected by thermal treatments

<table>
<thead>
<tr>
<th>Sample</th>
<th>Raw</th>
<th>Dried</th>
<th>Roasted (°C/minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>125/15</td>
</tr>
<tr>
<td>Root</td>
<td>769.35±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>644.13±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>319.83±0.02&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bark</td>
<td>531.12±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>420.45±0.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>194.12±0.01&lt;sup&gt;de&lt;/sup&gt;</td>
</tr>
<tr>
<td>Leaf</td>
<td>344.68±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>201.56±0.02&lt;sup&gt;b&lt;/sup&gt;</td>
<td>103.24±0.00&lt;sup&gt;de&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Table 2. Total flavonoid (mg QE/ 100 g) in root, bark and leaf of *Polyscias fruticosa* affected by thermal treatments

<table>
<thead>
<tr>
<th>Sample</th>
<th>Raw</th>
<th>Dried</th>
<th>Roasted (°C/minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>125/15</td>
</tr>
<tr>
<td>Root</td>
<td>284.29±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>241.35±0.00&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>182.19±0.03&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bark</td>
<td>201.17±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>192.83±0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>153.09±0.00&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Leaf</td>
<td>154.65±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>138.29±0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>104.31±0.02&lt;sup&gt;de&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Table 3. DPPH (mM TE/100 g) in root, bark and leaf of *Polyscias fruticosa* affected by thermal treatments

<table>
<thead>
<tr>
<th>Sample</th>
<th>Raw</th>
<th>Dried</th>
<th>Roasted (°C/minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>125/15</td>
</tr>
<tr>
<td>Root</td>
<td>69.25±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>60.14±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>32.16±0.01&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bark</td>
<td>50.13±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>43.77±0.00&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>25.07±0.02&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Leaf</td>
<td>39.17±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>31.84±0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>15.31±0.00&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Table 4. FRAP (mM TE/100 g) in root, bark and leaf of *Polyscias fruticosa* affected by thermal treatments

<table>
<thead>
<tr>
<th>Sample</th>
<th>Raw</th>
<th>Dried</th>
<th>Roasted (°C/minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>125/15</td>
</tr>
<tr>
<td>Root</td>
<td>94.15±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>80.25±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>68.45±0.00&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bark</td>
<td>72.34±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>59.17±0.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>49.87±0.01&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Leaf</td>
<td>51.29±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>38.20±0.02&lt;sup&gt;b&lt;/sup&gt;</td>
<td>30.29±0.03&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)
the end-user products [14]. Phenolic constituents which are related to the flavor, color, shelf life of herbal products, strongly correlated with the antioxidant capacity [15]. In our research, the root, bark and leaf samples were roasted at different conditions (125/15; 130/12, 135/9, 140/6, 145/3, °C/minutes). Our results revealed that roasting at 135/9 (°C/minutes) was suitable to retain the most phytochemical constituents (Tables 1, 2, 3, 4). Our results were similar to other findings. There was a strong correlation between antioxidant activity with total phenolic and total flavonoid content after the roasting process. It's necessary to observe the roasting process to preserve the most thermal-sensitive components.

4. CONCLUSION

Polyscias fruticosa is a good source of bioactive compounds. The major changes that occur during roasting are the formation of melanoidins in the Maillard reaction and caramelization reactions. By this mechanism, the roasted herbal tea had excellent flavor and aroma. In this research, we have successfully investigated the possible degradation of total phenolic, total flavonoid, DPPH radical-scavenging ability, FRAP ferric reducing antioxidant power assay (in root, bark and leaf of Polyscias fruticosa) under different roasting conditions. It’s necessary to observe the roasting process to preserve the most thermal-sensitive components.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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12. Larrosa APQ, Cadaval TRSJr, Pinto LAA. Influence of drying methods on the characteristics of a vegetable paste formulated by linear programming maximized antioxidant activity. LWT Food Science and Technology. 2015;60:178-185.


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