PHYTOCHEMICAL ANALYSIS AND ANTIOXIDANT ACTIVITY OF THREE ETHNO MEDICINAL PLANTS OF PACHAIMALAI S, TIRUCHIRAPPALLI DISTRICT, TAMIL NADU.

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ABSTRACT

Pachaimalai, an unique hill of Tiruchirappalli district is situated in the Southern parts of the Eastern Ghats in Tamil Nadu, India. It is endowed with rich medicinal flora. The Malayali Gounder Tribes are the inhabitants of the hills who inherited rich traditional knowledge about curing properties of the hill flora. The present work was focused on the evaluation of phytochemical constituents and antioxidant activity of the leaves and fruits of *Naravelia zeylanica*, (L.) DC., *Cardiospermum canescens*, Wall. and *Mallotus philippinensis*, Muell. Arg. that are used by these tribes to cure wounds, herpes, viral and bacterial diseases. The phytochemical analysis revealed the presence of various phytochemicals like alkaloids, amino acids, flavonoids, indoles, phenols, polyphenolases, saponins, steroids, tannins and triterpenoids. Further, the quantitative estimation of phytoconstituents also showed markedly high amount of flavonoids, phenols, saponins, tannins, amino acids and sugars. The antioxidant activity of methanolic extracts evaluated by Diphenyl picryl hydrazyl (DPPH) free radical scavenging activity revealed rich amount of antioxidant content in the selected plants. The paper deals with the significance of these three plants in traditional medicine with respect to their phytochemicals.

Key words: Pachaimalais, Phytochemical analysis, antioxidant activity, Diphenyl picryl hydrazyl (DPPH) assay, *Naravelia zeylanica*, *Cardiospermum canescens* and *Mallotus philippinensis*.

To Cite this article:

INTRODUCTION

Tamil Nadu historically has been an agricultural state of India cherishes rich ethnobotanical knowledge about medicinal plants since ancient times. The Siddha system of medicine of Tamil Nadu is one of the oldest systems of medicine in the world. The forests of Tamil Nadu harbour rich medicinal plant wealth which is used in traditional systems of medicine in India since ancient times. Pachamalai is an important unique hill in Tiruchirappalli district and situated in the southern parts of the Eastern Ghats in Tamil Nadu. The hills spread over two districts namely Salem and Tiruchirappalli (75 Km away from Tiruchirappalli city). Its elevation ranges from 400–1200 m above Mean Sea-Level and have a relatively moderate climate owing to its altitude and vegetation. The forest comprises of a tropical thorny, dry deciduous and moist deciduous type of vegetation (Champion, 1961). Total geographical area of hill is about 14,277 ha. In Thamizh (Tamil) language Pachai means green and the Pachaimalai hills are greener than the nearby hills. The hills are rich reservoir of plant diversity including valuable native, endemic and rare medicinal plants. Majority of them are shrubs (115), herbs (71), trees (70) and climbers (20) (Matthew, 1971; Rajadurai et al., 2009; Umavathi and Parvathi, 2012).

The inhabitants of the hills are the “Malayali Gounder Tribes” who possess an intimate knowledge of the plants of hills and depend on the plants for medicines to cure various ailments. Distinction of some plants as medicinal plants conveys an important association between these plants and a set of traditional knowledge on their use in medicinal preparations to treat people, livestock or plant diseases. The traditional knowledge on the application of plants for different medicinal uses that has evolved and maintained is largely determined by the locally available biodiversity (Geetha Rani, 2010; Rekha, 2012).

There is a need to explore the potentiality of the medicinal plants of Pachaimalais that are rich in therapeutic potential. The local communities inherited rich traditional knowledge about curing properties of the hill flora. Due to the decline in the number of traditional healers, the indigenous knowledge on traditional medicines is slowly vanishing away. The developing countries mostly rely on traditional medicines that involve the use of different plant extracts or the bioactive constituents of the plants (Mayank Gangwar et al, 2011).

![Fig 1 Distribution of plant habits in Pachamalais](image-url)
Keeping this view in mind, the present investigation was carried out on three potential medicinal plants of Pachamalai hills namely Naravelia zeylanica (L.) DC., Cardiospermum canescens. Wall., and Mallotus philippinensis. Muell. Arg. for their phyto-chemical constituents and anti-oxidant activity.

The hill plant Naravelia zeylanica, (L.) DC., belongs to the family Ranunculaceae. The genus Naravelia, DC., comprises of only one species. It is locally known as vathamkolli in Tamil language. The root and stem paste of Naravelia zeylanica is used to treat rheumatism, itches, scabies, allergies, headache and back pain (Arun Vijayan et al., 2007; Ramachandran et al., 2009). The leaf and stem of the plant are used traditionally to cure inflammation, skin diseases, arthritis, headache, wounds and ulcers (Ayyanar et al., 2005). Leaf of this plant was reported to be having anti-ulcer, anthelmintic, anti-inflammatory and wound healing activity (Ashoka Shenoy et al., 2009). The traditional medicine practitioners use the juice of leaf and stem for treating intestinal worms, psoriasis and dermatitis (Harsha et al., 2003).

Cardiospermum canescens, Wall., belongs to the family Sapindaceae. The genus Cardiospermum L., comprises of 2 species. It is locally known as periya mudakathan in Tamil language. The whole plant has different properties like diaphoretic, diuretic, emetic, emmenagogue, laxative, refrigerant, rubefacient and stomachic (Duke and Ayensu, 1985). It is used in the treatment of rheumatism, nervous diseases, stiffness of the limbs and snakebite. Leaf juice mixed with cumin is consumed to relieve pain in the joints and given at the time of delivery. The roots are diuretic and used in treating liver disorders and dysentery. The leaf juice is used for the treatment of asthma (Chopra et al., 1986). The leaves are rubefacient and are applied as a poultice in the treatment of rheumatism (William et al., 2005). Mallotus philippinensis. Muell. Arg., belongs to the family Euphorbiaceae. The genus Mallotus Lour., comprises of about 150 species in the world, of which 20 species have been reported from India (Santapau et al., 1973) and 11 species with 2 varieties were reported from Tamil Nadu (Henry et al., 1987). The ethnomedicinal plant Mallotus philippinensis. (Lam.) Muell. Arg., locally known as sindhura manjal has been used medicinally for a long time throughout India (Maheshwari et al., 1980; Sadhale et al., 2004; Thakur et al., 2005). It is used in ayurvedic medicine in the name of Kampillaka to relieve cough, constipation, flatulence, wounds, ulcers, renal hemorrhages and poisonous affections. This plant is applied externally as a treatment for skin disorders such as scabies and cutaneous troubles, tinea, herpes and other parasitic infections. The leaves and bark are used in India as poultice to skin disorders and the pounded seeds are applied over the wounds (Wiart, 2006).

MATERIALS AND METHODS

The materials for the study were collected during October, 2011- February, 2012. The voucher specimens (501,602,703) were deposited at Herbal Study Centre, Department of Botany, Holy Cross College (Autonomous) Tiruchirappalli, India. The plants were taxonomically identified with the aid of “Flora of the Presidency of Madras” (Gamble, 1957) and “Flora of Tamil Nadu Carnatic” (Matthew, 1983).

Extraction of plant material

The collected parts (leaves and fruits) of selected plants were cleaned, shade dried and powdered in an electric grinder. Fifteen grams of powdered plant materials were soaked in 100 ml. of 80% ethanol and incubated for 24 h. using ethanolic extracts various tests were carried out (Gibbs, 1974; Harborne, 1984; Trease and Evans, 1989). The tests included alkaloids, amino acids, carbohydrates, flavonoids, indoles, phenols, polyphenolases, proteins, saponins, steroids, tannins and triterpenoids.

Qualitative detection of Phytochemicals

Qualitative phytochemical tests were performed on fresh and ethanolic extracts of leaves and fruits of the selected medicinal herbs
for the identification of their bioactive components. The extracts were treated with various chemical reagents and their colour reactions were observed to identify the presence of phyto-constituents such as alkaloids, amino acids, steroids, flavonoids, polyphenolases, triterpenoids, proteins, carbohydrates, saponins and tannins.

Quantitative detection of phytochemicals

After the confirmation of presence of amino acids, proteins, carbohydrates, flavonoids, phenols, saponins and tannins by preliminary phytochemical analysis, the coarse powder of the plant material was taken up for the quantitative estimation.

Determination of total protein content:

The total protein content in extracts was determined (Lowry et al., 1951). Fifty milligrams of sample was homogenized with 5 ml of ice-cold phosphate buffer and centrifuged at 2000 rpm for 5 min. To the supernatant solution, equal volume of 10% ice-cold Trichloro acetic acid (TCA) was added and incubated for 10 min. at 4°C for an hour. The precipitated protein was centrifuged and the pellet was dissolved in one ml of 0.1N NaOH. 0.5 ml of the protein solution was mixed with 5 ml of alkaline copper reagent. It was shaken well and allowed to stand at room temperature for 10 min. Then, 0.5 ml of folin–ciocalteau reagent was added and the volume was made up to a known quantity using distilled water. Blank was prepared without the sample extract. After 30 min the optical density of the solution was read at 660 nm in Spectronic–20 D.

Determination of total free amino acid:

Hundred milligram of dried sample powder was homogenized with 5 ml of 80% ethanol and centrifuged at 2000 rpm for 10 min. The pellet was re-extracted with the same solvent and centrifuged again. The supernatant were pooled. To the supernatant equal volume of petroleum ether was added to remove the chlorophyll pigments using separation funnel. The lower layer was taken as sample. 0.5 ml of protein free carbohydrate solution was mixed with 3 ml of the anthrone reagent (0.2% in Conc.H2SO4). The reaction mixture was heated for 5 min. in a boiling water bath at 100°C with the marble on the top of the test tube to prevent loss of water by evaporation. Suitable reagent blank was prepared. The colour intensity was measured at 620 nm in a Spectronic g20 (Mahadevan and Sridhar, 1982).

Determination of total Flavonoids

Two gram of the plant sample was extracted repeatedly with 100 ml of 80% aqueous methanol at room temperature. The whole solution was filtered through whatman filter paper No. 42 (125 mm). The filtrate was later transferred into a crucible and evaporated to dryness over a water bath and weighed to a constant weight (Bohm and Kocipai Abyazan, 1974).

Determination of total phenols:

100 mg of the sample was extracted with 5 ml of 80% ethyl alcohol and centrifuged at 2000 rpm. The supernatant was taken for assay. One ml of folin–ciocalteau reagent was added to 0.5 ml of the alcoholic extract of the sample. 2 ml of 20 % sodium carbonate was added and
heated for one min. After cooling, the solution was made up to 10 ml with distilled water. A blank was prepared by adding all the reagents except the sample. The absorbency was read at 650 nm in Spectrophotometer (Mahadevan and Sridhar, 1982).

**Determination of Saponins**

The ground sample of 2 g of each was placed in a conical flask and 100 ml of 20% aqueous ethanol were added. The samples were heated over a hot water bath for 4 h with continuous stirring at about 55°C. The mixture was filtered and the residue was re-extracted with another 200 ml of 20% ethanol. The combined extracts were reduced to 40 ml over water bath at about 90°C. The concentrate was transferred in to a 250 ml separation funnel and 10 ml of dimethyl ether was added and shaken vigorously. The aqueous layer was recovered and the ether layer was discarded. The purification process was repeated. 10 ml of n-butanol was added to it. The combined n-butanol extracts were washed twice with 10 ml of 5% aqueous sodium chloride. The remaining solution was heated in a water bath. After evaporation, the samples were dried in the hot air oven to a constant weight and the saponin content was calculated (Obadoni and Ochuko, 2001).

**Determination of Tannin:**

500 mg powdered sample material was transferred to 250 ml conical flask containing 75 ml of distilled water. The contents in the flask were boiled for 30 min, centrifuged for 2000 rpm for 20 min. The supernatant was collected in 100 ml volumetric flask and made up to a known volume. One ml of the sample extract was transferred to a 100 ml volumetric flask containing 75 ml of distilled water. To this, 5 ml of Folin-Denis reagent and 10 ml of sodium carbonate solution were added and diluted to 100 ml. It was shaken well and left for 30 min. and the absorbance was read at 700 nm against a reagent blank water (Sadasivam and Manickam, 1992).

### Evaluation of antioxidant activity

#### Extraction of plant materials:

The powdered plant materials were extracted by maceration. About 2.5 g of the dried, pulverized materials were extracted in 10 ml of methanol at room temperature for 3 days. The mixture was filtered using Whatman No. 1 filter paper. The extracts of methanol were stored in air-tight glass bottles at room temperature.

#### Phosphomolybdenum antioxidant assay

The total antioxidant activity of the extract was evaluated by the phosphomolybdenum assay method Prieto et al., (1999). It is based on the reduction of Mo (VI) to Mo (V) by the extract and subsequent formation of a green phosphate-Mo (V) complex in acetic condition. 0.2 ml (100 mg) of extract was combined with 3 ml of reagent solution (0.6M sulfuric acid, 28 mM sodium phosphate, 4 mM sodium phosphate and 4 mM ammonium molybdate). The reaction mixture was incubated at 95°C for 90 min. Then, the absorbance of the solution was measured at 695 nm using a UV-visible spectrophotometer against a reagent blank after cooling to room temperature. The antioxidant activity was expressed as the number of grams equivalent of ascorbic acid.

#### Free Radical Scavenging activity (DPPH Assay)

Free radical scavenging potential of extracts was determined by 2, 2-diphenyl-1-picrylhydrazyl (DPPH) assay by the method established by Brand-Williams et al., (1995). To 3 ml methanol solution of DPPH (20 µg/ml), 2 ml (100 mg/ml) of methanol extract of sample was added. The mixture was incubated in dark at room temperature for 30 min. The degree of free radical scavenging activity in presence of different samples and their absorbance were measured by using UV spectrophotometer at 517 nm. The degree of free radical scavenging activity was expressed as;
Scavenging Activity (\%) = \{(A \text{ control} – A \text{ sample})/ (A \text{ control})\} \times 100

A control = Absorbance of DPPH alone,

A sample = Absorbance of DPPH along with extracts.

RESULTS AND DISCUSSION

Preliminary phytochemical screening of selected plants is presented in the Table-1. From the table, it is noted that the presence of bioactive compounds like alkaloids, amino acids, flavonoids, polyphenolases, saponins, steroids, tannins and triterpenoids are seen in abundance in the leaves and fruits of *N. zeylanica* and *C. canescens*. These results are in par with the reports of Lalitha Easwaran et al., (2011) and Thirupal Reddy et al., (2010). The leaves of *M. philippinensis* showed the presence of amino acids, carbohydrates, cardiac glycosides, flavonoids, phenols, proteins, polyphenolases, steroids, tannins and terpenoids which are similar to previous report (Jayaraman Velanganni et al., 2011).

QUALITATIVE ANALYSIS

Table-1 Test with 80% ethanolic extracts

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of the plants</th>
<th>Parts used</th>
<th>AL</th>
<th>AA</th>
<th>CA</th>
<th>CG</th>
<th>FL</th>
<th>HCN</th>
<th>HW</th>
<th>IN</th>
<th>PH</th>
<th>PR</th>
<th>SA</th>
<th>ST</th>
<th>TA</th>
<th>TRIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>Naravelia zeylanica</em> (L.) DC.</td>
<td>Leaves</td>
<td>+</td>
<td>+++</td>
<td>–</td>
<td>–</td>
<td>+++</td>
<td>–</td>
<td>+++</td>
<td>–</td>
<td>++</td>
<td>+++</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>Fruits</td>
<td>+</td>
<td>+++</td>
<td>–</td>
<td>*</td>
<td>+++</td>
<td>*</td>
<td>–</td>
<td>–</td>
<td>+++ *</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td><em>Cardiospermum canescens</em> Wall.,</td>
<td>Leaves</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
<td>–</td>
<td>+++</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>+++</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fruits</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>*</td>
<td>+++</td>
<td>*</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
<td>*</td>
<td>++</td>
<td>+</td>
<td>–</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

+++ = High intensive; ++ = medium intensive; + = low intensive; − = Negative; * = Not tested

AL= Alkaloids; AA= Amino Acids; CA= Carbohydrates; CG = Cardiac glycoside; FL= Flavonoids; HW= Hot water test; IN= Indoles; PH= Phenols; PR= Proteins; SA= Saponins; ST= Steroids; TA= Tannins; TRIT= Triterpenoids
**QUANTITATIVE ANALYSIS**

Table-2 Estimation of primary metabolites

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Name of the plants</th>
<th>Parts used</th>
<th>Sugars mg/g dry tissue</th>
<th>Amino acids mg/g dry tissue</th>
<th>Proteins mg/g dry tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fruits</td>
<td>11.820</td>
<td>6.750</td>
<td>0.760</td>
</tr>
<tr>
<td>2.</td>
<td><em>Cardiospermum canescens, Wall.</em></td>
<td>Leaves</td>
<td>10.920</td>
<td>6.750</td>
<td>0.550</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fruits</td>
<td>6.480</td>
<td>2.850</td>
<td>0.300</td>
</tr>
</tbody>
</table>

**Fig-2 Quantitative estimation of primary metabolites**
<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of the plants</th>
<th>Parts used</th>
<th>Flavonoids mg/g dry tissue</th>
<th>Phenols mg/g dry tissue</th>
<th>Saponins mg/g dry tissue</th>
<th>Tannins mg/g dry tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Naravelia zeylanica</em>, (L.) Dc.</td>
<td>Leaves</td>
<td>26</td>
<td>4.515</td>
<td>17.747</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fruits</td>
<td>10</td>
<td>5.394</td>
<td>12.676</td>
<td>49</td>
</tr>
<tr>
<td>2</td>
<td><em>Cardiospermum canescens</em>, Wall.,</td>
<td>Leaves</td>
<td>51</td>
<td>3.196</td>
<td>6.227</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fruits</td>
<td>55</td>
<td>3.556</td>
<td>7.561</td>
<td>37</td>
</tr>
</tbody>
</table>

**Fig 3 - Quantitative estimation of secondary metabolites**

![Quantitative estimation of secondary metabolites](chart.png)

- **N. zeylanica**
  - Leaves: 26 mg/g dry tissue, 4.515 mg/g dry tissue, 17.747 mg/g dry tissue, 58 mg/g dry tissue
  - Fruits: 10 mg/g dry tissue, 5.394 mg/g dry tissue, 12.676 mg/g dry tissue, 49 mg/g dry tissue

- **Cardiospermum canescens**
  - Leaves: 51 mg/g dry tissue, 3.196 mg/g dry tissue, 6.227 mg/g dry tissue, 47 mg/g dry tissue
  - Fruits: 55 mg/g dry tissue, 3.556 mg/g dry tissue, 7.561 mg/g dry tissue, 37 mg/g dry tissue

- **Mallotus philippinensis**
  - Leaves: 47 mg/g dry tissue, 6.713 mg/g dry tissue, 21.128 mg/g dry tissue, 39 mg/g dry tissue
### TABLE -4
Antioxidant content and Free radical scavenging activity

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of the plants</th>
<th>Parts used</th>
<th>Total antioxidant content mg/g dry tissue</th>
<th>Free radical scavenging activity in percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fruits</td>
<td>3.20756</td>
<td>87.1287</td>
</tr>
<tr>
<td>2.</td>
<td><em>Cardiospermum canescens, Wall.</em></td>
<td>Leaves</td>
<td>3.11526</td>
<td>78.271</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fruits</td>
<td>2.16914</td>
<td>88.118</td>
</tr>
</tbody>
</table>

**Fig 4-** Antioxidant and Free radical scavenging activity
The plants were also quantified for the metabolites such as amino acids, sugars, proteins, flavonoids, phenols, saponins and tannins. The results are presented in Tables 2 and 3 and Figures 2 and 3. From the tables, it is understood that the sugar content of the fruits of *N. zeylanica* was found to be highest (11.820 mg/g) and low amount in *C. canescens* (6.480 mg/g). Whereas, in the leaves of *C. canescens*, *M. philippinensis* and *N. zeylanica* the sugar content varied from 10.920 mg/g, 10.800 mg/g to 10.560 mg/g respectively. The previous report (Subasini et al., 2011) on *C. halicacabum* is in line with our observation. Similarly, the same amount of amino acids was registered in the fruits of *N. zeylanica* and leaves of *C. canescens* (6.750 mg/g) followed by the leaves of *M. philippinensis* (5.550 mg/g) and leaves of *N. zeylanica* (4.950 mg/g). The lowest amount of amino acids was registered in the fruits of *C. canescens* (2.806 mg/g). The total protein content ranged between 0.300 mg/g (fruits of *C. canescens*) and 1.320 mg/g (leaves of *M. philippinensis*). The fruits of *C. canescens* showed the highest amount of flavonoid content (55 mg/g), whereas, the fruits of *N. zeylanica* showed the lowest amount (10 mg/g). Similarly, the leaves of *C. canescens* registered the high amount (51 mg/g) of flavonoid content followed by *M. philippinensis* (47 mg/g) and *N. zeylanica* (26 mg/g). Our results find supportive evidence from the previous reports (Suthar Singh et al., 2011 and Bimal Kumar Ghimire et al., 2011).

The high amount of phenol content was registered in the leaves of *M. philippinensis* (6.713 mg/g) that followed by fruits of *N. zeylanica* (5.394 mg/g). The phenol content of leaves ranged between 3.196 mg/g (*C. canescens*) and 4.515 mg/g (*N. zeylanica*) as evidenced from the work of Bimal Kumar Ghimire et al., (2011).

The leaves of *M. philippinensis* contained highest amount of saponins (21.128 mg/g) followed by leaves of *N. zeylanica* (17.747 mg/g). The lowest amount (6.227 mg/g) was registered in the leaves of *C. canescens*. On the contrary to our observation, Sutharsingh et al., (2011) in their study reported the minimum amount of saponin. The fruits of *N. zeylanica* showed high amount (49 mg/g) of tannin followed by the fruits of *C. canescens* (37 mg/g). Whereas, the leaves of *N. zeylanica* registered high amount (58 mg/g) of tannin followed by *C. canescens* (47 mg/g) and *M. philippinensis* (37 mg/g).

The results of antioxidant activity and free radical scavenging are presented in Table 4 and Figure 4. From the table, it is understood that the range of antioxidant content was highest in the leaves of *M. philippinensis* (3.69216 mg/g) followed by *N. zeylanica* (3.23064 mg/g) and *C. canescens* (3.11526 mg/g). Whereas the antioxidant content of fruits varied from 3.20756 mg/g (*N. zeylanica*) to 2.16914 mg/g (*C. canescens*). Our results find supportive evidence from the studies of Jagadeesan et al., (2011).

Highest free radical scavenging activity was observed in the fruits of *Cardiospermum canescens* (88.118%) followed by *Naravelia zeylanica* (87.128%). In addition, the leaves of three selected plants exhibited maximum free radical scavenging activity.

**CONCLUSION**

From our studies, it could be concluded that these three selected medicinal plants contained considerable amount of phytotherapeutants like alkaloids, flavonoids, saponins, terpenoids, tannins and strong antioxidant properties. In addition, all the three plants responded negatively for the Hydrogen cyanide (HCN). Therefore, it is suggested that these plant parts could be consumed without any hesitation in the form of various herbal preparations like decoctions, infusions, powders and tonics to cure varied ailments. The results of the study would provide the basis for further isolation and evaluation of major active principles of these plant materials to test their efficacy against various diseases. Further, the development of these phyto-chemicals as herbal drugs could play an important role in health care of developing countries.
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