Review on Ethnomedicinal Claims of *Erythroxylum moonii* Hochr

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**Authors’ contributions**

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

**Article Information**

DOI: 10.9734/EJMP/2020/v31i1730334

Editor(s):
(1) Dr. Elena Maria Varoni, University of Milan, Italy.
(2) Prof. Marcello Iriti, University of Milan, Italy.

Reviewers:
(1) Ronald Fernando Quintana Arias, Universidad Distrital Francisco José de Caldas, Colombia.
(2) Félix Valenzuela Ore, Universidad Peruana Los Andes, Peru.
Complete Peer review History: [http://www.sdiarticle4.com/review-history/63127](http://www.sdiarticle4.com/review-history/63127)

Received 14 September 2020
Accepted 19 November 2020
Published 10 December 2020

**ABSTRACT**

**Introduction:** Since ancient times, plants contributed in the treatment of multiple disease conditions due to their immense therapeutic claims and currently serve as the principal origin of various medicinal preparations. The aim of present study is to agglomerate all available ethnomedicinal information and research updates pertaining to *Erythroxylum moonii* Hochr. that is used by traditional health practitioners.

**Materials and Methods:** Reported ethnomedicinal uses of *E. moonii* were reviewed with the use of books and research articles with especial relevance to ethnobotany and ethnomedicine from December 2019 to September 2020. Information was categorized as per vernacular names, locality, used parts, therapeutic claims, type and mode of administration along with the ingredients and dosage forms of the preparations.

**Results:** *Erythroxylum moonii* is reported in 3 countries and 2 states of India for its presence and it is observed that the plant has been utilized for therapeutic purpose as food preparations and medicinal preparations only in Sri Lanka. Its leaves (majorly) and stem bark are used in 5 different disease conditions either internally or externally. Maximum number of claims are indicated in the management of worm infestation. Among them, the leaves have the maximum application on 4 disease conditions followed by stem bark which has only one. Resent research activities have revealed the presence of anti-fungal and anti-nematodal activities of *E. moonii*.

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Conclusion: Conducting provable scientific studies (pharmacological and clinical) is needed for *E. moonii* to establish its multiple ethnomedicinal claims.

Keywords: Batakirilla; *Erythroxylum moonii*; ethnomedicine; worm infestation.

1. INTRODUCTION

Examination or translation based on inherited knowledge and practices related to medicine, learnt by living in a culture of indigenous ethnic group refers to Ethnomedicine [1]. Plants with ethnomedicinal uses are the main sources of traditional drug discovery and they contribute in the process of drug development massively. Many drugs of synthetic origin like podophyllotoxin, reserpine and vinblastine are manufactured from the plants [2].

*Erythroxylum moonii* Hochr. is a member of ‘coca’ family, Erythroxylaceae and majorly distributed in certain parts of Sri Lanka, India and Borneo [3]. It’s a twiggy or a much branched glabrous shrub or small tree with pale bark that grows nearly 3-6m height. Branchlets are slender and flattened with simple, alternate, distichous, elliptic, lanceolate, entire, petiolate, stipulate leaves, obtusely caudate-acuminate at apex and acute at base and shining beneath as well as above. Flowers are regular, bisexual, small, greenish yellow or whitish, axillary, solitary, pendulous. The fruits or drupes are ellipsoid-oblong with one seed and on ripening they become reddish orange [3,4,5,6,7,8,9] (Fig. 1-5).

Though used extensively, reported information on ethnomedicinal uses of *Erythroxylum moonii* is comparatively less and it is observed that all of them are scattered in different platforms (books, web-based sources, reports). It creates the exploitation of the species with the intention of patenting that provide injustice to the inherited country. Hence the present study has been carried out to agglomerate the available data on ethnomedicinal claims of *E. moonii* into a one treatise.

![Fig. 1. Whole plant of *Erythroxylum moonii* Hochr](image1)

![Fig. 2. Herbarium of *E. moonii* Hochr](image2)

![Fig. 3. Twig of *E. moonii*](image3)
2. MATERIALS AND METHODS

2.1 Data Collection

All reported data on ethnomedicinal uses of Erythroxylum moonii Hochr. were collected from books and research articles related to ethnobotany and ethnomedicine which comprised the opinions of traditional health care professionals and thematic experts in related fields. Library sources as well as electronic search that includes E-Flora, Cabdirect, Semantic scholar, Agris, Google scholar, Research gate, Pubmed, ACS publication, Medline and Sciencedirect were used to congregate data from December 2019 to September 2020.

2.2 Study Selection

2.2.1 Inclusion criteria

Literature that comprised the information on ethnomedicinal uses and pharmacological activities of E. moonii to treat the ailments either in human or animal (alone or as a combination with other herbs) was reviewed. Applicability of E. moonii was also taken into consideration as a food of medicinal value. Formulations of both external application and internal administration of the plant were included in the study without limiting to any language or time factors.

2.2.2 Exclusion criteria

Considering the specific use of E. moonii, other species of Erythroxylum were excluded from the present study. Further, unpublished literature available in the palm and Ola leaf manuscripts were also exempted.

3. RESULTS AND DISCUSSION

3.1 Literature Acquired

Information was collected from 7 books out of 68 books available, pertaining to the ethnobotany. Although a total of 12 abstracts identified in relation to E. moonii from electronic investigation, 4 abstracts were detected from Cabdirect, Agris and Research gate with especial relevance to ethnomedicinal uses and pharmacological activities of E. moonii after removing duplicates and considering the relevancy. All of them were undergone for the full text review. Related information on E. moonii was not mentioned in any of the E-Flora except E-Flora India and Sri Lanka.

3.2 Local Names

E. moonii is known by 5 names, batakirilla [5,6,9,10,11,12,13], badakirilla [14], chiruchemannati [3,5,6,13], chiruchenatti [3,5,6,13] and pookkoli [7,8]; in 3 languages, Sinhala, Tamil and Malayalam.

3.3 Botanical Synonyms

Erythroxylum acuminatum (Arn.) Walp. [3,7,15], Erythroxylum lucidum Moon [3,4,7,14,15], Sethia acuminata Arn. [3,4,7,15] are the synonyms used for E. moonii.

3.4 Area of Reporting

E. moonii is reported to be in 3 countries; Sri Lanka, India and Borneo across the globe [3]. It
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is available in several regions of Sri Lanka; Western, Southern, Central, Sabaragamuwa, Uva provinces and along the river banks up to 1000ft [3,4,5,6,10] and in 2 states of India; Kerala and Tamilnadu [7,8,15,16]. (Fig. 6, Fig. 7) It is observed that only Sri Lanka has utilized the plant for its medicinal purpose for generations. (Table 1)

3.5 Parts Used
Leaves are used in treating the worm infestation, dysentery, anemia, eczema, boils and abscesses while the stem bark is used in the management of worm infestation. (Table 1)

3.6 Therapeutic Indications
E. moonii is used for a total of 5 disease conditions either as medicinal preparations or food preparations. Twelve therapeutic indications are reported in the treatment of worm infestation and 4 claims stand for its therapeutic applicability in dysentery, anemia, eczema, boils and abscesses consecutively. (Table 1, Fig. 8)

3.7 Type and Mode of Administration
Out of 16 ethnomedicinal claims, 9 were observed as food preparations (56%) and 7 (44%) were identified as medicinal preparations. (Fig. 9) Maximum number of 4 medicinal and 8 food preparations were reported in treating worm infestation and 3 medicines have reported in the management of dysentery, anemia, boils and abscesses respectively. One food preparation was observed for eczema conditions. It was recognized that 15 preparations are administered internally and one is applied externally (Table 1).

3.8 Ingredients and Dosage Forms
Leaves of E. moonii were reported for its ethnomedicinal claims alone in 4 medicinal preparations and one food preparation while the stem bark was reported in one medicine. Two medicines and 8 food preparations were observed as combinations. All the combinations have been tabulated with their respective ingredients and dosage forms. (Table 1) The drugs included in such combinations, like Acorus calamus, Trachyspermum ammi, Embelia ribes, Zingiber officinalis, Terminalia bellirica, Aconitum heterophyllum, Baliospermum montanum and Operculina turpethum have reportedly possessed anthelmintic activity [17,18,19,20,21,22,23,24]. Among them, Baliospermum montanum and Operculina turpethum reported for their purgative action [23,24] while Terminalia chebula, Terminalia bellirica and Cassia fistula was showing mild to moderate laxative activity. [21,25,26] Anti-paracytic activity has been revealed by several studies carried out on drugs like Allium sativum [27] and Emblica officinalis [28] while Trachyspermum ammi, Embelia ribes, Syzygium aromaticum, Zingiber officinale, Cassia fistula and Piper longum was eliciting anti-nematodal, larvicidal, ovicidal and antiamoebic activities [18,19,20,26,29,30] which generally related with worm infestation. Acorus calamus and Myristica fragrans have been demonstrated sedative activity [31,32] that may help in deactivating worms.

Further, it was observed that one powder, paste, infusion, decoction and 8 bolus are used in the treatment of helminthiasis and one infusion, powder, green vegetable and a poultice used in the management of dysentery, anemia, eczema, boils and abscess, respectively (Table 1).
Table 1. Ethnomedicinal uses of different parts of *Erythroxylum moonii* Hochr

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Therapeutic claims</th>
<th>Type and mode of administration</th>
<th>Ingredients and dosage form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Worm infestation</td>
<td>Medicine (I)</td>
<td>Dried leaf powder, taken with bee honey [5,11] – powder</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medicine (I)</td>
<td>Leaf juice [3,6,13] – infusion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medicine (I)</td>
<td>Decoction of stem bark [14]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Food (I)</td>
<td>Dried leaf powder, powder of <em>Oryza sativa</em> (after frying alone) mixed with bee honey/ treacle of <em>Cocos nucifera</em> twice/day for 3 days – bolus [5]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Food (I)</td>
<td>Dried leaf powder mixed with jaggery of <em>Cocos nucifera</em> / <em>Caryota urens</em> taken in the morning – bolus [5]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Food (I)</td>
<td>Dried leaf, <em>Embelia ribes</em>, <em>Trachyspermum ammi</em>, popcorn of <em>Oryza sativa</em> (<em>Laja</em>), <em>Zingiber officinale</em> mixed with treacle of <em>Cocos nucifera</em> taken in the morning – bolus [5]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Food (I)</td>
<td>Dried leaf, <em>Embelia ribes</em> mixed with jaggery of <em>Caryota urens</em> taken empty stomach in the morning – bolus [5]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Food (I)</td>
<td>Powdered dry leaves, rice flour mixed with bee honey – bolus [3]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Food (I)</td>
<td>Dried leaf powder, powder of <em>Oryza sativa</em> (after frying alone) mixed with jaggery of <em>Caryota urens</em>/ bee honey – bolus [14]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Food (I)</td>
<td>Powdered dried leaves, <em>Embelia ribes</em> (after frying alone), powdered <em>Oryza sativa</em> (after frying alone) mixed with treacle of <em>Cocos nucifera</em> – bolus [14]</td>
</tr>
<tr>
<td>2</td>
<td>Dysentery</td>
<td>Medicine (I)</td>
<td>Leaf juice [10] – infusion</td>
</tr>
<tr>
<td>4</td>
<td>Anemia</td>
<td>Medicine (I)</td>
<td>30g of powdered <em>Embelia ribes</em>, <em>Triphala</em>, <em>Trikatu</em>, <em>Trivarga</em>, <em>Aconitum heterophyllum</em>, <em>Allium sativum</em>, <em>Cuminum cymimum</em>, <em>Trachyspermum ammi</em>, <em>Baliospermum montanum</em>, <em>Cassia fistula</em> from each mixed with 10g each from powdered <em>Operculina turpethum</em> and leaves of <em>E. moonii</em> and given 2.5g with bee honey [5,11] - Powder</td>
</tr>
<tr>
<td>5</td>
<td>Eczema</td>
<td>Food (I)</td>
<td>Fresh leaves cooked as a green vegetable [33]</td>
</tr>
</tbody>
</table>

'I' – Internal administration; 'E' – External application

3.9 Recent Researches

3.9.1 Phytochemistry

Kindo et al. (2014) conducted a preliminary phytochemical analysis of aqueous and ethanolic leaf extracts of *E. moonii* [34] which revealed the presence of tannins and flavonoids and absence of starch and glycosides in both the extracts. It was observed that saponin and steroids are present only in aqueous extract. Several tropane alkaloids have isolated and structures have been identified by Khattak et al. [35] and [36] from the leaves of *E. moonii*. (Table 2)
Table 2. Reported chemical constituents of *E. moonii* Hochr [37]

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Name of the chemical compound</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>3 α-benzoyloxytropane/</td>
<td><img src="image1.png" alt="Structure 1" /></td>
</tr>
<tr>
<td></td>
<td>Benzoyltropeine</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>3 alpha-phenylacetoxytropane</td>
<td><img src="image2.png" alt="Structure 2" /></td>
</tr>
<tr>
<td>3.</td>
<td>3 alpha-trans-cinnamoyloxytropane</td>
<td><img src="image3.png" alt="Structure 3" /></td>
</tr>
<tr>
<td>4.</td>
<td>3 alpha-phenylacetoxy-6 beta,7 beta-dihydroxynortropane</td>
<td><img src="image4.png" alt="Structure 4" /></td>
</tr>
<tr>
<td>5.</td>
<td>3 alpha-isobutyryloxy-7 beta-hydroxynortropane</td>
<td><img src="image5.png" alt="Structure 5" /></td>
</tr>
<tr>
<td>6.</td>
<td>3 alpha-hydroxy-7 beta-phenylacetoxyrnortropane</td>
<td><img src="image6.png" alt="Structure 6" /></td>
</tr>
<tr>
<td>7.</td>
<td>3 alpha-cis-cinnamoyloxytropane</td>
<td><img src="image7.png" alt="Structure 7" /></td>
</tr>
<tr>
<td>8.</td>
<td>3 alpha-hydroxy-6 beta-(3'-hydroxy-2'-methyl-3'-phenylpropionyloxy)-7 beta-hydroxytropane</td>
<td><img src="image8.png" alt="Structure 8" /></td>
</tr>
<tr>
<td>9.</td>
<td>Mooniine A</td>
<td><img src="image9.png" alt="Structure 9" /></td>
</tr>
<tr>
<td>10.</td>
<td>Mooniine B</td>
<td><img src="image10.png" alt="Structure 10" /></td>
</tr>
</tbody>
</table>
3.9.2 Pharmacological studies

Anti-microbial activity of the leaves of *E. moonii* has elicited during the study of Khattak et al. [35]. Accordingly alcoholic extract of the leaf has subjected to determine anti-microbial activity which revealed a strong anti-fungal effect against *Candida albicans*, *Aspergillus niger*, etc. but not against the bacteria like *Staphylococcus aureus*, *E. coli*, etc. It was observed that, 75% and 100% concentrations of the aqueous leaf extract of *E. moonii* shows the maximum mortality against *Meloidogyne incognita* (94%) at 3 hr of exposure time in a study that carried out to assess the efficacy of controlling root-knot nematode, *Meloidogyne incognita* [38].

4. CONCLUSION

Current review reveals the diverse ethnomedicinal uses of *Erythroxylum moonii* which has its maximum use in the treatment of worm infestation. Robust scientific evaluation based on pharmacological and clinical studies may help in establishing these ethnomedicinal claims. Additionally, reviewed drug encourages the researchers to investigate its different aspects related to mentioned therapeutic applications and chemical constituents.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

ACKNOWLEDGEMENT

The authors are thankful to IPGT & RA, Gujarat Ayurved University, Jamnagar, India for providing facilities to carry out the research work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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