

Review on Ethnomedicinal Claims of *Erythroxylum moonii* Hochr.

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 was to agglomerate the 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 were categorized as per vernacular names, locality, used parts, therapeutic claims, type and mode of administration along with ingredients and dosage forms of the preparations. **Results:** *Erythroxylum moonii* is reported in 3 countries and 2 states of India for its presence and only Sri Lanka is observed to be utilized the plant for therapeutic purpose in food preparations as well as in medicinal preparations. 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, leaves have the maximum application on 4 disease conditions followed by stem bark which has only one. Recent research activities have revealed the presence of anti-fungal and anti-nematodal activities of *E. moonii*. **Conclusion:** Conducting provable scientific studies (pharmacological and clinical) is needed for *E. moonii* to establish its multiple ethnomedicinal claims.

Key words: *Erythroxylum moonii*, vernacular, ethnomedicine, worm infestation

1. INTRODUCTION

Examination or translation based on inherited knowledge and practices related with medicine, learnt by living in a culture of indigenous ethnic group is referred 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 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, 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.



Fig. 2 Herbarium of *E. moonii* Hochr.



Fig. 3 Twig of *E. moonii*



Fig. 4 Flower of *E. moonii*



Fig. 5 Drupe of *E. moonii*

(Sources: Fig 1 <https://www.asia-medicinalplants.info/erythroxylum-moonii-hochr/> , Fig 3 & 4 <https://biodiversityofsrilanka.blogspot.com/2017/05/bata-kirilla-erythroxylum-moonii.html> , Fig 5 https://commons.wikimedia.org/wiki/File:Erythroxylum_moonii.jpg)

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 field. Library sources as well as electronic search that include 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 present study. Further unpublished literature available in palm and ola leaf manuscripts were also excluded.

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 underwent 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], *chiruchemannatti* ^[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 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 been utilized the plant for its medicinal purpose since generations. (Table 1)

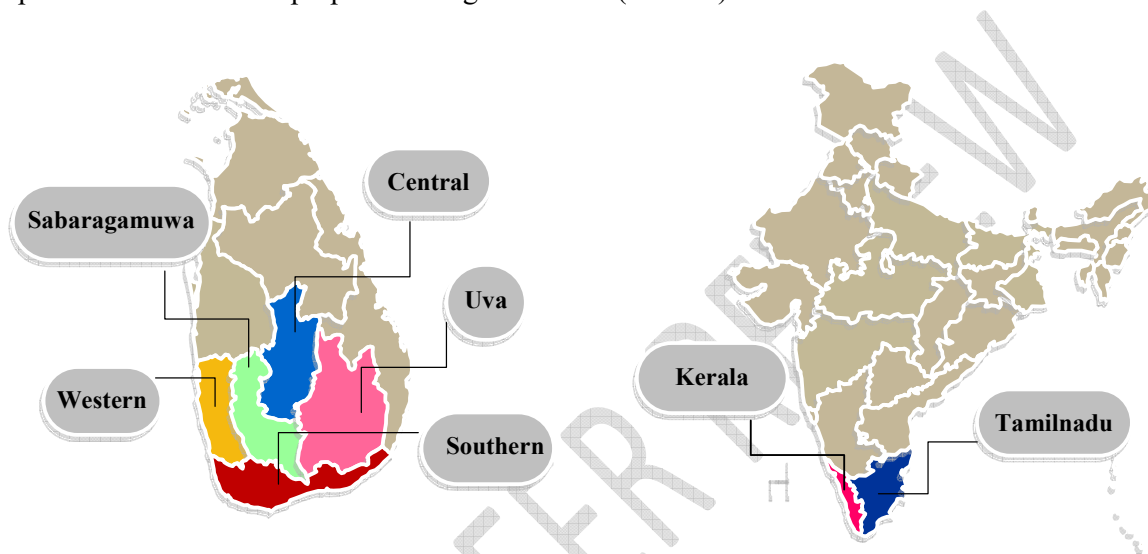


Fig. 6 Distribution of *E. moonii* in Sri Lanka

Fig. 7 Distribution of *E. moonii* in India

3.5 Parts Used

Leaves are used in treating 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 being used for a total of 5 disease conditions either as a medicinal preparation or a food preparation. 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 reportings, 9 food preparations (56%) and 7 (44%) medicinal preparations were identified as per ethnomedicinal claims. (Fig. 9) Maximum number of 4 medicinal and 8 food preparations are reported in treating worm infestation and 3 medicines have reported in the management of dysentery, anemia, boils and abscesses respectively. One food preparation is

observed for eczema conditions. It is recognized that 15 preparations are administered internally while one is applying externally. (Table 1)

3.8 Ingredients and Dosage forms

Leaves of *E. moonii* is reported to be used for its ethnomedicinal claims alone, in 4 medicinal preparations and one food preparation while stem bark is reporting in one medicine. Two medicines and 8 food preparations are observed as combinations. All the combinations are tabulated with their respective ingredients and dosage forms. (Table 1) The drugs included in such combinations, like *Acorus calamus*, *Trachyspermum ammi*, *Embelia ribes*, *Zingiber officinale*, *Terminalia bellirica*, *Aconitum heterophyllum*, *Baliospermum montanum* and *Operculina turpethum* have reportedly possess anthelmintic activity. Among them, *Baliospermum montanum* and *Operculina turpethum* reported to be have purgative action while *Terminalia chebula*, *Terminalia bellirica* and *Cassia fistula* showing mild to moderate laxative activity. Anti-paracytic activity has been revealed by several studies carried out on drugs like *Allium sativum* and *Emblica officinalis* while *Trachyspermum ammi*, *Embelia ribes*, *Syzygium aromaticum*, *Zingiber officinale*, *Cassia fistula* and *Piper longum* eliciting anti-nematodal, larvicidal, ovicidal and antiamoebic activities which generally related with worm infestation. It is found that *Acorus calamus* and *Myristica fragrans* to be possessed with sedative activity that may help in deactivating worms.

It is further observed that one powder, paste, infusion, decoction and 8 bolus are used in the treatment of helminthiasis while one infusion, powder, green vegetable and poultice are using in the management of dysentery, anemia, eczema, boils and abscess, respectively. (Table 1)

3.9 Resent Researches

3.9.1 Phytochemistry

Kindo et al (2014) conducted a preliminary phytochemical analysis of aqueous and ethanolic leaf extracts of *E. moonii* ^[33] 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 (1998) ^[34] and (2002) ^[35] from the leaves of *E. moonii*. (Table 2)

3.9.2 Pharmacological studies

Anti-microbial activity also has elicited during the study of Khattak et al (1998) ^[34]. 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* ^[36].

Table 1: Ethnomedicinal uses of different parts of *Erythroxylum moonii* Hochr.

Sr. No.	Therapeutic claims	Type and mode of administration	Ingredients and dosage form
1.	Worm infestation	Medicine (I)	Dried leaf powder, taken with bee honey ^[5,11] – powder
		Medicine (I)	Dried leaf, <i>Allium sativum</i> , <i>Acorus calamus</i> , <i>Trachyspermum ammi</i> ground with bee honey taken with <i>Embelia ribes</i> water ^[5] – paste
		Medicine (I)	Leaf juice ^[3,6,13] – infusion
		Medicine (I)	Decoction of stem bark ^[14]
		Food (I)	Dried leaf powder, powder of <i>Oryza sativa</i> (after frying alone) mixed with bee honey/ treacle of <i>Cocos nucifera</i> twice/ day for 3 days – bolus ^[5]
		Food (I)	Dried leaf powder mixed with jaggery of <i>Cocos nucifera</i> / <i>Caryota urens</i> taken in the morning – bolus ^[5]
		Food (I)	Dried leaf, <i>Embelia ribes</i> , <i>Trachyspermum ammi</i> , popcorn of <i>Oryza sativa</i> (<i>Laja</i>), <i>Zingiber officinale</i> mixed with treacle of <i>Cocos nucifera</i> taken in the morning – bolus ^[5]
		Food (I)	Dried leaf, <i>Embelia ribes</i> mixed with jaggery of <i>Caryota urens</i> taken empty stomach in the morning – bolus ^[5]
		Food (I)	Powder of dry leaves, <i>Embelia ribes</i> (after frying alone), <i>Zingiber officinale</i> , <i>Oryza sativa</i> (after frying alone) mixed with treacle of <i>Cocos nucifera</i> taken in the morning – bolus ^[5,11]
		Food (I)	Powdered dry leaves, rice flour mixed with bee honey – bolus ^[3]
		Food (I)	Dried leaf powder, powder of <i>Oryza sativa</i> (after frying alone) mixed with jaggery of <i>Caryota urens</i> / bee honey – bolus ^[14]
		Food (I)	Powdered dried leaves, <i>Embelia ribes</i> (after frying alone), powdered <i>Oryza sativa</i> (after frying alone) mixed with treacle of <i>Cocos nucifera</i> – bolus ^[14]
2.	Dysentery	Medicine (I)	Leaf juice ^[10] - infusion
3.	Boils and abscesses	Medicine (E)	Bruised leaves ^[3,13] – poultice
4.	Anemia	Medicine (I)	30g of powdered <i>Embelia ribes</i> , <i>Triphala</i> , <i>Trikatu</i> , <i>Trivarga</i> , <i>Aconitum heterophyllum</i> , <i>Allium sativum</i> , <i>Cuminum cyminum</i> , <i>Trachyspermum ammi</i> , <i>Baliospermum montanum</i> , <i>Cassia fistula</i> from each mixed with 10g each from powdered

			<i>Operculina turpethum</i> and leaves of <i>E. moonii</i> and given 2.5g with bee honey ^[5,11] - Powder
5.	Eczema	Food (I)	Fresh leaves cooked as a green vegetable ^[37]

‘I’ – Internal administration ; ‘E’ – External application

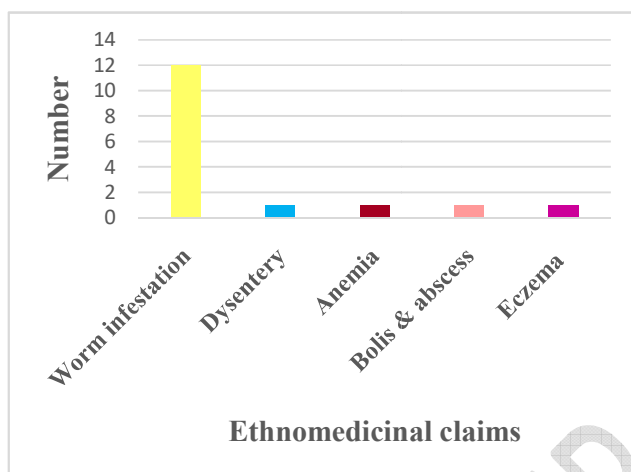


Fig. 8 Reported ethnomedicinal claims of *E. moonii*

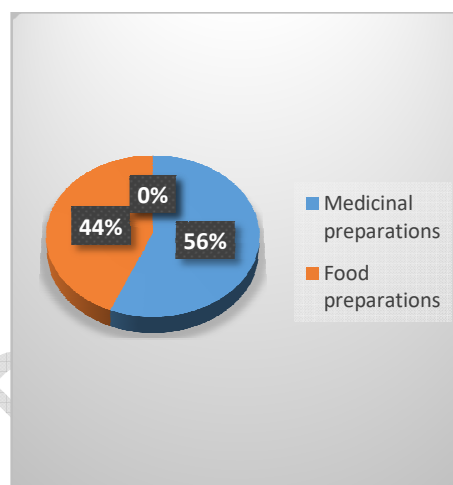
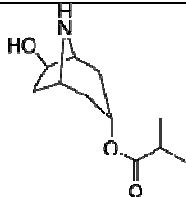
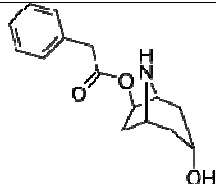
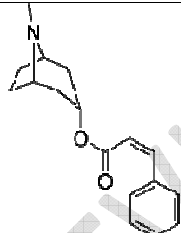
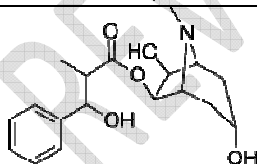
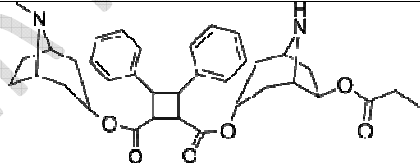
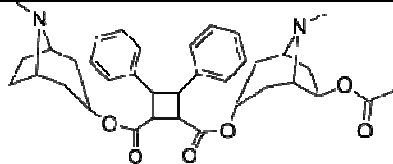


Fig. 9 Type of ethnomedicinal claims of *E. moonii*

Table 2: Reported chemical constituents of *E. moonii* Hochr.^[38]

Sr. No.	Name of the chemical compound	Structure
1.	3 α -benzoyloxytropane/ Benzoyltropeine	
2.	3 alpha-phenylacetoxytropane	
3.	3 alpha-trans-cinnamoyloxytropane	
4.	3 alpha-phenylacetoxty-6 beta,7 beta-dihydroxynortropane	

5.	3 alpha-isobutyryloxy-7 beta-hydroxynortropane	
6.	3 alpha-hydroxy-7 beta-phenylacetoxynortropane	
7.	3 alpha-cis-cinnamoyloxytropane	
8.	3 alpha-hydroxy-6 beta-(3'-hydroxy-2'-methyl-3'-phenylpropionyloxy)-7 beta-hydroxytropane	
9.	Mooniine A	
10.	Mooniine B	

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 with mentioned therapeutic applications and chemical constituents.

REFERENCES

1. Quinlan MB, Editors: Singer M, Erickson PI. Ethnomedicine. A Companion to Medical Anthropology. Wiley. 2011. 379-403.
2. Current Trends in Ethnobotany, available at https://www.tjpr.org/vol8no4/20098_41_Editorial.pdf (Accessed on 11th September 2020)
3. Jayaweera D. M. A. Medicinal Plants (Indigenous and Exotic) Used in Ceylon. National Science Council. Colombo. 1980; 187-188.
4. Hooker JD, CB. The Flora of British India. Part 1. Printed at L. Reeve & Co., 5, Henrietta street, Covent Garden, London. 1872; 415.
5. Compendium of Medicinal Plants A Sri Lankan Study. Vol. 4. 1st edn. Colombo: Department of Ayurveda. 2004; 138-141.
6. Dassanayake MD, Clayton WD. A Revised Handbook to the Flora of Ceylon. Vol X. New-Delhi: Oxford and IBH Publishing Co. Pvt. Ltd. 1996; 143-144.
7. India Biodiversity Portal, available at <https://indiabiodiversity.org/species/show/11454> (Accessed on 17th July 2020)
8. Erythroxyllum moonii, available at http://keralaplants.in/keralaplantsdetails.aspx?id=Erythroxyllum_moonii (Accessed on 19th July 2020)
9. Ayurvedic Medicinal Plants of Sri Lanka, available at http://www.instituteofayurveda.org/plants/plants_detail.php?i=472&s=Local_name (Accessed on 20th July 2020)
10. Biodiversity of Sri Lanka, available at <https://biodiversityofsrilanka.blogspot.com/2017/05/bata-kirilla-erythroxyllum-moonii.html> (Accessed on 21st July 2020)
11. Osuturu Visituru 4. Colombo: Department of Ayurveda; 131
12. Botanical names / Sinhala names, available at <https://www.dh-web.org/bot2sinhala.html> (Accessed on 23rd July 2020)
13. *Erythroxyllum moonii* Hochr. available at <https://www.asia-medicinalplants.info/erythroxyllum-moonii-hochr/> (Accessed on 24th July 2020)
14. Nyanavimala VK. Desiya Vaidya Shabda Koshaya. Ratnapura: Shasthrodaya. 1959; 326-327.
15. Gamble JS. Flora of the Presidency of Madras. Vol 1. Printed at Shiva Offset press, 14, Old Connaught Place, Dehradun, India. 2011; 127.
16. The Wealth of India, Vol III, National Institute of Science Communication and Information Resources, Council of Science & Industrial Research New-Delhi. Reprinted 2006; 202.
17. Watt JM, Breyer-Brandwijk MG. The medicinal and poisonous plants of southern and eastern Africa. E and S Livingstone Ltd. Edinburgh and London. 1962; 600-601.
18. Pathak AK, Nainwal N, Goyal BM, Singh R, Mishra V, Nayak S, Bansal P, Gupta V. Pharmacological activity of *Trachyspermum ammi*: A Review. Journal of Pharmacy Research. 2010; 3(4): 895-899.
19. Souravi K, Rajasekharan PE. Ethnopharmacological Uses of *Embelia ribes* Burm. F. - A Review. Journal of Pharmacy and Biological Sciences. 2014; 9(3): 23-30.

20. Kumar G, Karthik L, Rao KVB. A Review on Pharmacological and Phytochemical Properties of *Zingiber officinale* Roscoe (Zingiberaceae). Journal of Pharmacy Research. 2011; 4(9): 2963-2966
21. Beigi M, Haghani E, Alizadeh A, Samani ZN. THE PHARMACOLOGICAL PROPERTIES OF SEVERAL SPECIES OF TERMINALIA IN THE WORLD. Int J Pharm Sci & Res. 2018; 9(10): 4079-88.
22. Paramanick D, Sharma N, Parveen N, Patel N, Keshri M. A REVIEW ARTICLE ON AYURVEDIC/ HERBAL PLANT "ARUNA" (ACONITUM HETEROPHYLLUM). Int. J. Adv. Res. 2017; 5(2): 319-325.
23. Siba Prasad Rout, Rabinarayan Acharya and Shibani Dash. A CRITICAL REVIEW ON DANTI (BALIOSPERMUM MONTANUM WILLD.) WITH SPECIAL REFERENCE TO AYURVEDIC NIGHANTUS (LEXICONS). Ejbps. 2017; 4(4): 348-353.
24. Vasudesan NV. Indian Medicinal Plants. Vol. IV. Orient Longman Ltd, Chennai. 1995: 172.
25. Upadhyay A, Agrahari P, Singh DK. A Review on the Pharmacological Aspects of *Terminalia chebula*. International Journal of Pharmacology. 2014; 10: 289-298.
26. Ali MA. CASSIA FISTULA LINN: A REVIEW OF PHYTOCHEMICAL AND PHARMACOLOGICAL STUDIES. IJPSR. 2014; 5(6): 2125-2130.
27. Mikaili P, Maadirad S, Moloudizargari M, Aghajanshakeri S, Sarahroodi S. Therapeutic Uses and Pharmacological Properties of Garlic, Shallot, and Their Biologically Active Compounds. Iran J Basic Med Sci. 2013; 16(10): 1031-1048.
28. Variya BC, Bakrania AK, Patel SS. *Embolica officinalis* (Amla): A review for its phytochemistry, ethnomedicinal uses and medicinal potentials with respect to molecular mechanisms. Pharmacol Res. 2016; 111: 180-200.
29. Kaur K, Kaushal S. Phytochemistry and pharmacological aspects of *Syzygium aromaticum*: A review. Journal of Pharmacognosy and Phytochemistry. 2019; 8(1): 398-406
30. Zaveril M, Khandhar A, Patel S, Patel A. CHEMISTRY AND PHARMACOLOGY OF PIPER LONGUM L. International Journal of Pharmaceutical Sciences Review and Research. 2010; 5(1): 67-76.
31. Rajput SB, Tonge MB, Karuppayil SM. An overview on traditional uses and pharmacological profile of *Acorus calamus* Linn. (Sweet flag) and other Acorus species. Phytomedicine. 2014; 21(3): 268-76.
32. Grover JK, Khandkar S, Vats V, Dhunnoo Y, Das D. Pharmacological studies on *Myristica fragrans*--antidiarrheal, hypnotic, analgesic and hemodynamic (blood pressure) parameters. Methods Find Exp Clin Pharmacol. 2002; 24: 675-680.
33. Kindo I, Britto SJ, Arulappan MT, George M. Phytochemical Evaluation of the Ethanolic and Aqueous Leaf Extracts of *Erythroxylum moonii* (Hochr), *Henckelia humboldtiana* (Gardner) A.Weber & Burt and *Cipadessa baccifera* (Roth) Miq. International Journal of Innovative Drug Discovery. 2014; 4(3): 145-147.
34. Rahman AU, Khattak KF, Nighat F, Shabbir M, Hemalal KD, Tillekeratne LM. Dimeric tropane alkaloids from *Erythroxylum moonii*. Phytochemistry. 1998; 48(2): 377-383.

35. Khattak KF, Rahman AU, Choudhary MI, Hemalal KD, Tillekeratne LM. New tropane alkaloids from *Erythroxylum moonii*. J. Nat. Prod. 2002; 65, 929–931.
36. Effect of aqueous leaf extracts of two medicinal plant species (*Erythroxylum moonii*, *Lantana camara*) against root-knot nematode, *Meloidogyne incognita* [Conference poster], available at <https://www.cabdirect.org/cabdirect/abstract/20153384214> (Accessed on 27th July 2020)
37. Jones M, Liyanage C. Traditional Medicine and Primary Health Care in Sri Lanka: Policy, Perceptions, and Practice. The Asian review of World Histories. 2018; 6(1): 157-184.
38. The Chemical Synthesis and Applications of Tropane Alkaloids, available at https://www.researchgate.net/publication/327523535_The_Chemical_Synthesis_and_Applications_of_Tropane_Alkaloids (Accessed on 30th July 2020)