



## A REVIEW STUDY ON PHYTOCHEMISTRY, PHARMACOLOGICAL PROPERTIES & TRADITIONAL USES OF *CHLORANTHUS ELATIOR*

Umme Tabassum Arobi Katha and Yesmin Begum\*

Department of Pharmacy, Southeast University, Banani, Dhaka, Bangladesh.

\*Corresponding Author: Yesmin Begum

Department of Pharmacy, Southeast University, Banani, Dhaka, Bangladesh.

Article Received on 27/06/2021

Article Revised on 18/07/2021

Article Accepted on 08/08/2021

### ABSTRACT

*Chloranthus elatior*, a medicinal plant belongs to the family Chloranthaceae, is native to Andaman Is., Assam, Bangladesh, Bismarck Archipelago, Borneo, Cambodia, China South-Central, China Southeast, East Himalaya, Jawa, Laos, Lesser Sunda Is., Malaya, Maluku, Myanmar, Nepal, New Guinea, Nicobar Is., Philippines, Sulawesi, Sumatera, Thailand, Vietnam. This valuable medicinal plant is used in traditional healing for many generations by herbal practitioners. All parts of this plant can be used to make a tea and beverage with softly bitter taste, wonderful aroma, mildly peppery, slightly sweet and of rather masculine character. This plant's infusion, decoction or tinctures are taken orally as a treatment for fevers, infections, inflammations, pregnancy & delivery, breathing problems, pain, muscle spasms, emesis, wound, swelling, bone fractures, injury etc. The potential biological properties and presence of responsible metabolites increases its importance and uses day by day. As a therapeutic plant, *C. elatior* added great value in ethnobotanical sources and the current review study is focused to summarize all folklore uses, chemical potentials and pharmacological properties.

**KEYWORDS:** *Chloranthus elatior*, traditional uses, pharmacological properties, phytochemistry.

### INTRODUCTION

The species *Chloranthus elatior* is emerged from the genus *Chloranthus* belonging to Chloranthaceae family. The genus *Chloranthus* mainly allotted in Eastern Asia & Southern Asia while Europe and North America had also been reported previously. Current assessments of the genus revealed that almost all species of this genus are found in China.<sup>[1]</sup> Within 15 species, 14 species have been inquired for their chemical components.<sup>[2]</sup> Among the genus of *Chloranthus*, *C. elatior* and *C. glaber* species have been practiced traditionally in India, China, Indonesia, Sudan and so many countries. The whole plants of all the species of *Chloranthus* have long been employed as folk medicine in China for detumescence, treating on snake bite and wound.<sup>[2]</sup> Various species of such genus could be habituated as herbal medicines to relieve the sufferings of furuncles, carbuncles, bruises, and dysmenorrhea.<sup>[3]</sup> Chemical and pharmacological activities have been investigated intimately of all species that integrates the presence of biologically active compound inclusively sesquiterpenoids, dimeric sesquiterpenoids, coumarin, diterpenoids, and other compounds.<sup>[4]</sup> Moreover, 50 sesquiterpene dimers have been observed in *Chloranthus* plants that proved the potential of extensive properties like - antitumor, antifungal, anti-inflammatory, antibacterial and

hepatoprotective activities, and inhibition of the rectifier (IK) K<sub>p</sub> current and tyrosinase.<sup>[4]</sup> In this retrospect we desire to sum-up traditional use, chemical constituents and containing biological activities of the species *C. elatior*.

### Plant Description

The name of the genus comes from two Latin words: chloros, which means green, and anthus, which means flower. In the meantime, the species name comes from the Latin word erectus, which refers to the inflorescences.<sup>[5]</sup> *C. elatiors* is an erect shrub which means a shrub that grows upright.<sup>[6]</sup> Flowers of *C. elatiors* are bisexual as well as colors are white; leaves are 10–20 × 4–8 cm, apex slowly narrowed to caudate, border glandular serrate; central lobe of connective entire<sup>[7,8]</sup>, the male component encloses the ovary, which is oval in shape. The fruits are creamy white in color and obovoid in shape, 3–4 mm in length and 6–7 mm in width. *C. elatior's* fruits are green initially young and turn white as they mature.<sup>[5,9,10]</sup> The leaves, stems, and roots of this plant have a peppery, slightly bitter flavor. When mashed, all parts of this plant are fragrant. The scent of crumpled roots and twigs is scented as camphor with spicy and bitter flavor. The leaves contain an essential oil and β-coumaric acid, a phenolic substance comparable to that found in Piperaceae.<sup>[11,12]</sup>

The synonyms of this plant are *Chloranthus elatior* R.Br., *Chloranthus erectus* (Buch.-Ham.)<sup>[13]</sup>

According to nomenclatural priority it seems that the name of *Chloranthus elatior* was published before the name *Cryphaea erecta*. Nevertheless, the genuine identity of *C. elatior* remains uncertain since the only (sterile) specimen fragmentarily labelled by the name *Link* was destructed in Berlin during the Second World War.<sup>[13]</sup> This plant is higher, very lofty that's why it is named as *Elatior*. Its leaves are upright, perpendicular that's why it is represents as *Erecta* or *Erectus*. *Officinalis* name is occupied because of practical use to man; official species in commerce, especially used for medicinal purposes. It's another name is *Salicifolius* because it has leaves like *Salix* (Willow) *Sumatranus* name comes from Sumatra, indigenous people of Indonesia use it.<sup>[13]</sup> However, the most used botanical name for this plant is *Chloranthus erectus* but *Chloranthus elatior* is also used very often, and the name *Chloranthus officinalis* is still somewhere used now.<sup>[11]</sup>

#### Taxonomical Classification<sup>[14]</sup>

Kingdom: Plantae  
Division: Magnoliophyta  
Class: Magnoliopsida  
Order: Chloranthales  
Family: Chloranthaceae  
Genus: Chloranthus  
Species: elatior R.Br.

#### Vernacular Names

- ❖ Indonesia: keras tulang (Malay), uyah-uyahan (Javanese), harostulang (Sumatra)
- ❖ Malaysia: dikut-dikut, langut-langut (Sarawak), sambau paya (Peninsular)
- ❖ Philippines: barau-barau (Luzon), tul-an hinbad (Samar), tunggao (Tagbanua)
- ❖ Cambodia: kbâ:k dâmréi
- ❖ Thailand: hom kai (northern), kraduk kai (central).<sup>[15]</sup>
- ❖ Bangladesh: Rantas<sup>[16]</sup>

#### Traditional Uses

Medicinal plants in the form of traditional formulations have been used for basic health care as well as the treatment of a variety of disorders by people throughout the world since earlier civilizations. *C. elatior* has also been used in ethnomedicinal medicine on a number of occasions. It was used for a multitude of topics, including debility, body soreness, fever, pain, carbuncle, headache, skin disease, antibacterial, antispasmodic, pus, and chronic constipation and malaria treatment. It has been reported that the consumption of it as an herbal remedy was demonstrated in China, some region of Indonesia, India, Thailand and Malaysia.

In Indonesia Chloranthus tea was very renowned drinks for a long period of time.<sup>[16]</sup> In north-eastern India, southern China, and Asia, this beverage is known as

Assam tea, China tea, and keras tulang.<sup>[17]</sup> All portions of the *C. elatior* is being used to make tea. (Her) Besides its dried roots and leaves were used for making tea in Malaysia and some region of Indonesia. Attributable to its sudorific, detoxifying, and anti-inflammatory qualities of this plant had assured its use in fever.<sup>[18]</sup>

A tea-like beverage made from this plant can also help with back discomfort and coughing. It is also employed to treat malarial fevers. It has been shown that the roots of *C. elatior*, *C. nervosus* Collett & Hemsley, and *Senna occidentalis* (L.) Link are boiled and ingested by tribal people in northern Thailand to prevent malaria.<sup>[12,15,19]</sup> An infusion is supposed to facilitate with headaches, asthma, and 'internal ailments' in the Philippines.<sup>[20]</sup> Ankle edema and fractures, rheumatoid arthritis, skin eruptions, pus, and persistent constipation are all healed with leaf paste of *C. elatior*.<sup>[10]</sup>

Poultice for carbuncles and boils, diaphoretic and excitant, malaria cure but fatal in overdose, backache, and a tea-like drink for coughs are among the medical uses. Both the leaves and the roots of *C. elatior* are used in medicine and as a tea.<sup>[20]</sup> In addition it has known that on the Malay Peninsula after boiling the powdered root rubbed on the body to get antipyretic effect.<sup>[21]</sup> The juice of boiled branch employed as a contraceptive and root, bark used as an antispasmodic during childbirth in India and in Indonesia leaves are employed as postpartum remedy.<sup>[8,9,20,22]</sup> The leaves and roots of this plant are utilized as aphrodisiacs, especially by women.<sup>[9,23]</sup> Usually, a decoction of the crushed roots is used, but an infusion of the leaves and bark is also noted, which is used as an antispasmodic during parturition when combined with *Cinnamomum* bark. *C. elatior*'s roots that have been bruised are used as a poultice for blisters and carbuncles.<sup>[24,25]</sup> The medicinal plants of Myanmar In "Medicinal plants of the Mien (Yao) in Northern Thailand and their potential value in the primary healthcare of postpartum women" have been inquired that the decoction or maceration of the stem and leaves were used for the indication of postpartum pain & inflammation.<sup>[26]</sup>

According to an ethnobotanical survey, the Khampti tribe in Arunachal Pradesh's Eastern Himalayan region utilizes leaf paste to treat localized swelling, joint pain, skin inflammation, fever, and bodyache.<sup>[27]</sup> A combination bark paste especially useful for its astringent properties mixed with dried flowers of *Mimusops elengi* L., ground together with *thanakha* are employed to cure heat rashes and prickly heat.<sup>[21]</sup> In the diabetes treatment decoction of roots of *C. elatior* are orally ingested by the Karen community.<sup>[28]</sup> The infusions or decoctions are often used to treat renal calculus, localized edema, bone fractures, contusions, and traumatic damage, as well as overstrain impairment, wound healing, and nausea.<sup>[11]</sup> In India the extract from the leaves and in Indonesia little packets of stem with

root and leaves are used as a restorative during certain stages of venereal disease.<sup>[21]</sup>

For the therapy of Flank or axilla symptom/complaint, the decoction of root is orally consumed.<sup>[25]</sup> In Gua Musang, Kelantan *Chloranthus elatior* used by the Tai Yai healers in Chiang Mai Province. They treated Scabies with boiled leaves utilizing in a bath.<sup>[29]</sup> In the treatment of loose bowel movement, roots are used by indus (Talaingod manobo), kalibanga (Bisaya). It is also reported that they assembling a thumb-sized root then boiling into 2 glasses of water and drink that decoction three times a day till get well.<sup>[24]</sup> According to Philippine Traditional Knowledge Digital Library on Health, roots are used in tooth ache. A fistful amount of roots are masticated until pain is gone.<sup>[30]</sup>

In China, damaged and fractured bones are repaired with roots and stem bark of *C. elatior*.<sup>[31]</sup> Decoction or macerated *C. elatior* root and whole plant are also used as blood tonics as well as in the treatment of beriberi by Tai Yai healers.<sup>[32]</sup>

It is found on the List of Medical Plants to treat diseases and disturbances of the Baduy Community that they used *C. elatior* stem as an appetite stimulant and tonic for Exhaustion.<sup>[33]</sup> Joint pain, ankle edema, shattered bones, rheumatoid arthritis, skin eruptions, pus, and prolonged constipation are all healed with leaf paste. A paste of young leaves and leaf extract applied to the pierced region of the elephant foot to treat elephant foot edema and wounds caused by prickly penetration.<sup>[10,34]</sup>

Plants of the genus *C. erectus* are used to encourage the cultivation and production of tea (*Camellia sinensis*). The Dutch colonial authority banned the growing of *Chloranthus* in the late 1800s in order to encourage tea (*Camellia sinensis*) farming and yields. During this time, *Chloranthus* had faded from prominence. *C. erectus* species are currently exclusively in China utilized locally as a flavoring component in home-grown tea.<sup>[15]</sup>

### Phytochemistry

Chloranthaceae family usually contains terpenoids, lignans, flavonoids, coumarins and some other chemical substances. It has been demonstrated that sesquiterpenes like eudesmane, guaiane, germacrane, cadinane, lindenane and aromadendrane-type compounds are abundant in Chloranthaceae plants.<sup>[2]</sup> Among of them Eudesmanes; Lindenranes; Guaianes; Aromadendranes; Labdanes; Sesquiterpene polymers and Other sesquiterpenes type compounds like 2-methoxy-3,4-methylenedioxy benzene formaldehyde; turpentine phenol; 4,5,7-trimethoxyflavonols; flavokawain A; ferulic aldehyde and 5-hydroxy-7,4dimethoxyflavanone have been identified from *C. elatior*. According to the researchers, Chloranthes A–D, four new naturally occurring diastereoisomers of dinor-eudesmanes, were identified as minor components from an EtOH extract of its aerial parts.<sup>[35]</sup> Furthermore two novel eudesmane-

type sesquiterpenoid lactones; chlorelactone A and chlorelactone B; and one new labdane-type diterpenoid; elatiorlabdane were isolated from the entire plants of *Chloranthus elatior*, together with seven known sesquiterpenoids and one known disesquiterpenoid. The phytochemical study of entire plants also revealed six new eudesman-12,8-olides; designated chlorantholides A–F, besides 12 previously identified compounds.<sup>[36]</sup> It is reported that the EtOH extract of the aerial portions of this plant possess thirteen sesquiterpenoids and the preceding three compounds are newly discovered naturally occurring compounds: (1R,4R,5R,8S,10R)-1-hydroxy-4-methoxy-eudesm-7(11)-en-12,8-olide; 1aH,5b-H,6aH,7aH-4b,10b,15-trihydroxyaromadendrane;(1S,4S,5S,6R,7R,10S)-1,4-dihydroxyamaalane.<sup>[37]</sup> One of the major classes of Dimeric Sesquiterpenoids (DSs) is Lindenane Disesquiterpenoids. For several biological functions, certain DSs have been shown to be more powerful than their monomeric progenitors. The biological actions of the DSs, particularly their anti-inflammatory, antimalarial, anticancer, antiviral, immunosuppressive, neurotropic, and potassium channel blocking features, have made them intriguing candidates for further therapeutic development. *C. elatior* plant have been reported to produce this type of DSs.<sup>[38]</sup> Moreover, an investigation reported that eudesmane-type sesquiterpenoids like 1 $\beta$ ,4 $\beta$ -Dihydroxy-5 $\alpha$ ,8 $\beta$ (H)-eudesm-7(11)Z-en-8,12-olide; 1 $\beta$ ,4 $\alpha$ -Dihydroxy-5 $\alpha$ ,8 $\beta$ (H)-eudesm-7(11)Z-en-8,12-olide; 5-Eudesmene-1 $\beta$ ,4  $\alpha$ -diol; (1R,4R,5R,8S,10R)-1-Hydroxy-4-methoxy-eudesm-7(11)-en-12,8-olide; Chloranthon A; Chloranthon B; Chloranthon C; Chloranthon D; Guaianes -type sesquiterpenoids (1S,4S,5S,8R,10S)-4,10-Dihydroxyguai-7(11)-en-12,8-olide(zedoalactone A); Zedoalactone E (1 $\beta$ H,5 $\beta$ H,8 $\beta$ H-4 $\alpha$ ,10 $\alpha$ -Dihydroxyguai-7(11)-en-12,8-olide); Aromadendranes -type sesquiterpenoids 4 $\beta$ ,10 $\alpha$ -Dihydroxyaromadendrane ((+)Alloromadendrane-4 $\beta$ ,10 $\alpha$ -diol);other types of sesquiterpenes (1S,4S,5S,6R,7R,10S)-1,4-Dihydroxyamaalane from the aerial part and from the leaves, lindenanes -type of sesquiterpenoids 9-Hydroxy heterogorgiolide; Chloranthalactone B; and eudesmane-type sesquiterpenoids Chloranrectuslactone V have been isolated as well as whole plant contains eudesmane-type sesquiterpenoids 4 $\alpha$ -Hydroxy-5 $\alpha$ ,8 $\beta$ (H)-eudesm-7(11)-en-8,12-olide;4 $\alpha$ -Hydroxy-5 $\alpha$ ,8 $\alpha$ (H)-eudesm-7(11)-en-8,12-olide; 4 $\alpha$ ,8 $\beta$ -Dihydroxy-5 $\alpha$ (H)-eudesm-7(11)-en-8,12-olide (multislactone A); Chlospicate B (chlorelactone A);Chlorelactone B (9  $\alpha$ -Hydroxy-5 $\alpha$ ,8 $\beta$ (H)-2-oxoeudesma 3,7(11)-dien-12,8  $\alpha$  -olide);Chloranthalic acid; Chlorantholide A (2-Oxoeudesma-3,7(11),8-trien-12,8 olide); Chlorantholide B (2-Oxoeudesma-3,7(11)-dien-12,8 $\alpha$ -olide);Chlorantholide C (2-Oxoeudesma-3,7(11)-dien-12,8 $\beta$ -olide); Chlorantholide D (8 $\beta$ -Hydroxy-2-oxoeudesma-3,7(11)-dien-12,8-olide); Chlorantholide E (8 $\beta$ ,9 $\alpha$ -Dihydroxy-2-oxoeudesma-3,7(11)-dien-12,8-olide);Chlorantholide F (5 $\alpha$ ,8 $\beta$ -Dihydroxy-2-oxoeudesma-3,7(11)-dien-12,8-olide);Aromadendranes -

type sesquiterpenoids Spathulenol; Sesquiterpene polymers-types Chloramultilide C (henriol A); Labdanes- type of sesquiterpenoids Elatiorlabdane; Lindenane Disesquiterpenoids -type Dimeric Sesquiterpenoids Chloramultilide C.<sup>[2,35,39]</sup> Another important study was conducted that is the essential oil from the leaves of *C. elatior* was extracted by hydrodistillation and yielded 1.74 percent v/w on a dry weight basis.<sup>[39]</sup> According to research, bicyclogermacrene (11.3%); bicycloelemene (11.2%); (Z)- $\alpha$ -ocimene (7.8%); allo-ocimene(6.3%), and germacrene D were the primary chemicals found in *C. elatior* leaf oil (5.2 %). Germacone was considered to be the dominant ingredient with variety of biological functions, including anti-ulcer, anti-bacterial, anti-fungal, and anti-tumor, anti-inflammatory, hepatoprotector and choleric effects.<sup>[40]</sup> In this oil, there are 28 chemicals, some examples like 3Z-Hexenol;  $\alpha$ -Pinene; Sabinene;  $\beta$ -Pinene; Myrcene;  $\alpha$ -Terpinene; (Z)- $\beta$ -Ocimene; (E)- $\beta$ -Ocimene; Linalool; Neo-alloocimene; Geraniol;  $\alpha$ -Copaene;  $\beta$ -Elemene;  $\beta$ -Longipinene;  $\alpha$ -Gurjunene;  $\gamma$ -Elemene;  $\alpha$ -Humulene; Alloaromadendrene;  $\gamma$ -Muurolole; Germacrene D; Amorpha-4,7(11)-diene; Bicyclogermacrene;  $\delta$ -Amorphene; Germacrene B; (E)-Nerolidol Spathulenol; cis- $\beta$ -Elemene; Germacrene; cis-Thujopsenal.<sup>[39]</sup>

### Pharmacological Properties

Despite the fact as *C. elatior* has an ancient legacy of use, there are not too many biological investigations on it. In earlier study, the antipyretic effect of a methanol leaf extract was evaluated using a Brewer's yeast-induced pyrexia albino rat model and the effect of the methanol extract compared to that of a renowned antipyretic medication, paracetamol.<sup>[41]</sup> In acute, sub-acute, and chronic inflammatory mouse models, the methanol leaf extract displayed significant anti-inflammatory action in model Carrageenan-induced rat hind paw edema, histamine- and serotonin-induced sub-acute model had all been evaluated. For comparison, Phenylbutazone was applied as a standard, according to preliminary research.<sup>[27,42-44]</sup> Using the modified agar-disk diffusion method, the antibacterial activity of a methanol leaf extract of *C. elatior* was tested against *Staphylococcus aureus*, *Bacillus subtilis*, *B. subtilis* DWI strain, *Escherichia coli*, *Klebsiella pneumonia*, *Ralstonia eutropha*, *Pseudomonas aeruginosa*, and *Salmonella typhimurium* and obtained remarkable activity against them.<sup>[41]</sup> From an Investigation of *Listiana Oktavia* has been known that *C. elatior* combined with Endophytic fungi extract and staurogyne elongata kuntze showed antibacterial effectiveness against *Staphylococcus aureus* and was less active against *Escherichia coli*.<sup>[45]</sup> From the Inventory of poisonous medicinal plants recorded in the Dai, Lahu, Miao, Tujia, and Wa ethnic groups in south and southwest China, the entire plants of *C. elatior* were found to be low toxicity plants.<sup>[46]</sup>

### DISCUSSION

The chemical basis of medicinal plants clinically curative effects is secondary metabolites (SMs). There have been a number of secondary metabolites found in *C. elatior*. The metabolites are also essential markers for assessing the quality of medicinal products. Accompanying future studies plus the synthesis and accumulation of SMs can enhance the therapeutic medicinal properties of *C. elatior* plants. There also seem to be numerous C- atoms skeleton as well as bioactive chemical components in *C. elatior* which including sesquiterpenoids; 8,12-guaianolides; Sesquiterpene polymers; Lindenane sesquiterpenes; dimeric sesquiterpenoids; Germacone etc. Those compounds have a wide range of pharmacological effects, including anti-inflammatory, antimalarial, anticancer, antiviral, immunosuppressive, and neurotropic properties. Many commercially available medications are based on indigenous plant knowledge and folklore.

### CONCLUSION

Despite having such bioactive compound and long traditional use of *C. elatior* there have been so limited investigation done on it. In underdeveloped countries, medicinal plant diversity is a key source of medication. The combination of indigenous medicinal plant knowledge with current research efforts can be create a new and more dependable strategy to drug discovery.

### REFERENCES

1. Kong, H. Z., Chen, Z. D., & Lu, A. M. Phylogeny of *Chloranthus* (Chloranthaceae) based on nuclear ribosomal ITS and plastid trnL-F sequence data. *American Journal of Botany*, 2002; 89(6): 940–946. <https://doi.org/10.3732/ajb.89.6.940>
2. Zhang, M., Liu, D., Fan, G., Wang, R., Lu, X., Gu, Y., & Shi, Q. W. (2016). *Constituents from Chloranthaceae plants and their biological activities*. Heterocyclic Communications. <https://doi.org/10.1515/hc-2016-0084>
3. *Advance in on chemical constituent and bioactivity research of genus Chloranthus*. (n.d.). [https://www.researchgate.net/publication/23301798\\_Advance\\_in\\_on\\_chemical\\_constituent\\_and\\_bioactivity\\_research\\_of\\_genus\\_Chloranthus](https://www.researchgate.net/publication/23301798_Advance_in_on_chemical_constituent_and_bioactivity_research_of_genus_Chloranthus)
4. Wang, A. R., Song, H. C., An, H. M., Huang, Q., Luo, X., & Dong, J. Y. Secondary metabolites of plants from the genus *Chloranthus*: Chemistry and biological activities. *Chemistry and Biodiversity*, 2015; 12(4): 451–473. <https://doi.org/10.1002/cbdv.201300376>
5. Fay, D. L. *Chloranthus erectus*. *Angewandte Chemie International Edition*, 1967; 6(11): 951–952. <https://www.mybis.gov.my/sp/10743>
6. Ahmad Aldrie Amir (Dr.). (n.d.). *Comparative study on structural composition and community association of Nambor Wildlife Sanctuary and its South-Westward extended Borneowria forest, Assam, India*. <https://www.mybis.gov.my/sp/10743>



7. Columbus, J. T., Wu, Z., Raven, P. H., Hong, D., Wu, Z., Raven, P. H., & Hong, D. Flora of China. In *Taxon*, 2008; 57(2): 682. <https://doi.org/10.2307/25066062>
8. Alt., E. H. B. (n.d.). *Chloranthus elatior* Link.
9. Nidhan Singh. (n.d.). *Tall Chloranthus*.
10. Monlai, S. (2013). *Ethno-Medicinal Plants in Lohit and Anjaw Districts of*.
11. Arseniuk, A. (n.d.). *Herbs from Distant Lands: Chloranthus erectus - Yasinha, Yu Zi Lan, Harostulang, Barau Barau, Kraduk Kai*.
12. Van Der Vossen, H. A. M., & Wessel, M. (n.d.). *Stimulants /H.A.M. van der Vossen and M. Wessel, editors. - National Library*.
13. Liu, J. (n.d.). *VIRBOGA - Chloranthus elatior*.
14. Alt., E. H. B. (n.d.). *Chloranthus elatior* Link / *Plants of the World Online | Kew Science*.
15. Sangat, H. M. (n.d.). *Chloranthus erectus (PROSEA) - PlantUse English*.
16. Haque, A. K. M. K., Khan, S. A., Uddin, S. N., & Shetu, S. S. An annotated checklist of the angiospermic flora of Rajkandi Reserve Forest of Moulvibazar, Bangladesh. *Bangladesh Journal of Plant Taxonomy*, 2018; 25(2): 187–207. <https://doi.org/10.3329/bjpt.v25i2.39525>
17. Publishers, B. *jEtur* v\$,2000; 16.
18. *Plants of the World: An Illustrated Encyclopedia of Vascular Plants - Maarten J. M. Christenhusz, Michael F. Fay, Mark W. Chase - Google Books*. (n.d.).
19. H.sangat. (n.d.). *Chloranthus erectus - Useful Tropical Plants*. <http://tropical.theferns.info/viewtropical.php?id=Chloranthus+erectus>
20. Creta-, E. (n.d.). *Chloranthaceae B. Verdcourt Kew* *jointed usually petiolate ; fairly conspicuous, sheath, sionally pectinate. Flowers much reduced, capitata axillary Hedyosmum consisting forming edges, stigma style subcapitate (or horseshoe-shaped solitary, ortho*, 123–144.
21. DeFilippis, R. A., & Krupnick, G. A. The medicinal plants of Myanmar. *PhytoKeys*, 2018; 341(102): 1–341. <https://doi.org/10.3897/phytokeys.102.24380>
22. Roosita, K., Kusharto, C. M., Sekiyama, M., Fachrurozi, Y., & Ohtsuka, R. Medicinal plants used by the villagers of a Sundanese community in West Java, Indonesia. *Journal of Ethnopharmacology*, 2008; 115(1): 72–81. <https://doi.org/10.1016/j.jep.2007.09.010>
23. Nursery, P. D. (n.d.). *Learn about Chloranthus erectus | Upright Chloranthus | Perennial Encyclopedia by Plant Delights Nursery*.
24. Yu xi lun. (n.d.). *Barau-barau, Lagrimas, Chloranthus elatior, TALL CHLORANTHUS: Philippine Medicinal Herbs / Alternative Medicine*. <http://stuartxchange.ph/Barau-barau.html>
25. Kantasrila, R., Pandith, H., Balslev, H., Wangpakapattanawong, P., Panyadee, P., & Inta, A. Medicinal plants for treating musculoskeletal disorders among karen in thailand. *Plants*, 2020; 9(7): 1–28. <https://doi.org/10.3390/plants9070811>
26. Panyaphu, K., Van On, T., Sirisa-Ard, P., Srisa-Nga, P., Chansakaow, S., & Nathakarnkitkul, S. Medicinal plants of the Mien (Yao) in Northern Thailand and their potential value in the primary healthcare of postpartum women. *Journal of Ethnopharmacology*, 2011; 135(2): 226–237. <https://doi.org/10.1016/j.jep.2011.03.050>
27. Tag, H., Namsa, N. D., Das, A. K., Kalita, P., & Mandal, S. C. Evaluation of anti-inflammatory potential of *Chloranthus erectus* (Buch.-Ham.) Verd. leaf extract in rats. *Journal of Ethnopharmacology*, 2009; 126(2): 371–374. <https://doi.org/10.1016/j.jep.2009.08.015>
28. Phumthum, M., & Balslev, H. Thai Ethnomedicinal Plants Used for Diabetes Treatment. *OBM Integrative and Complementary Medicine*, 2018; 3(3): 1–1. <https://doi.org/10.21926/obm.icm.1803020>
29. Nurraihana, H., Norfarizan-Hanoon, N. A., Hasmah, A., Norsuhana, A. H., & Fatan, H. Y. Ethnomedicinal survey of aborigines medicinal plants in Gua Musang, Kelantan. *Health and the Environment Journal*, 2016; 7(1): 59–76.
30. Datu Ansag Mansimoy-at. (n.d.). *Philippine Traditional Knowledge Digital Library on Health*. Philippine Traditional Knowledge Digital Library on Health.
31. Quattrocchi, U. (n.d.). *CRC World Dictionary of Medicinal and Poisonous Plants: Common Names... - Umberto Quattrocchi - Google Books*.
32. 逢坂悟郎, 原泰久, 来栖昌朗, 高田正三, 澤村誠志, & 越智隆弘. 4. 頸髄損傷患者に対するメチル硫酸アメリジニウムの効果: 自律神経系の多様な反応について(自律神経1). *The Japanese Journal of Rehabilitation Medicine*, 1995; 32(11): 772–773.
33. Iskandar, J. (2021). Pandemics and Sustainable Human Nature Relations: A Case study in Baduy Community, South Banten, Indonesia. *E3S Web of Conferences*, 249. <https://doi.org/10.1051/e3sconf/202124901001>
34. Das, A., & Tag, H. Ethnomedicinal studies of the Khamti tribe of Arunachal Pradesh. *Indian Journal of Traditional Knowledge (IJTK)*, 2006; 05(3): 317–322.
35. Liu, S., Xiong, J., Tang, Y., Wang, W., & Bui, V. *Chloranthes A – D: Minor and Unprecedented Dinor-Eudesmanes from Chloranthus elatior Introduction. - Within our studies directed toward the discovery of novel bioactive sesquiterpenoids from higher plants [1] [2], the EtOH extract of the aerial*, 2014; 11: 904–909.
36. Wang, F., Zhou, D. S., Wei, G. Z., Ren, F. C., & Liu, J. K. Chlorantholides A-F, eudesmane-type sesquiterpene lactones from *Chloranthus elatior*. *Phytochemistry*, 2012; 77: 312–317. <https://doi.org/10.1016/j.phytochem.2012.02.008>
37. Xiong, J., Liu, S. T., Tang, Y., Wang, W. X., Bui, V.

- B., Zhao, Y., Fan, H., Yang, G. X., & Hu, J. F. Sesquiterpenoids from the aerial parts of *Chloranthus elatior*. *Phytochemistry Letters*, 2013; 6(4): 586–589. <https://doi.org/10.1016/j.phytol.2013.07.015>
38. Liao, S. G., & Yue, J. M. Dimeric Sesquiterpenoids. In *Progress in the chemistry of organic natural products*, 2016; 101. [https://doi.org/10.1007/978-3-319-22692-7\\_1](https://doi.org/10.1007/978-3-319-22692-7_1)
39. Chee, B., Krishnasamy, G., & Jamil, M. (2018). *Unravelling Nature 's Treasures & Secrets: Current Species of Interest*, March 2020.
40. Thang, T. D., Dai, D. N., & Ogunwande, I. A. Composition of essential oils from *Chloranthus elatior* and *Ch. Spicatus* from Vietnam. *Chemistry of Natural Compounds*, 2016; 52(1): 149–151. <https://doi.org/10.1007/s10600-016-1575-x>
41. Tag, H., Namsa, N. D., Mandal, M., Kalita, P., Das, A. K., & Mandal, S. C. Antipyretic and antibacterial activity of *Chloranthus erectus* (Buch.-Ham.) Verdcourt leaf extract: A popular folk medicine of Arunachal Pradesh. *Indian Journal of Pharmacology*, 2010; 42(5): 273–276. <https://doi.org/10.4103/0253-7613.70083>
42. Kazemi, S., Shirzad, H., & Rafeian-Kopaei, M. Recent Findings in Molecular Basis of Inflammation and Anti-inflammatory Plants. *Current Pharmaceutical Design*, 2018; 24(14): 1551–1562. <https://doi.org/10.2174/1381612824666180403122003>
43. Murugesan, D., & Deviponnuswamy, R. Innovare Academic Sciences POTENTIAL ANTI-INFLAMMATORY MEDICINAL PLANTS - A REVIEW. *International Journal of Pharmacy and Pharmaceutical Sciences*, 2014; 6(4): 43-49.
44. Tag, H., Jeri, L., & Tsering, J. Higher Plant Diversity in Pakke Wildlife Sanctuary and Tiger Reserve in East Kameng District of Arunachal Pradesh: Checklist -I. *Pleione*, 2012; 6(1): 149-162.
45. Oktavia, L., Ilyas, M., & Agusta, A. the Antimicrobial and Antioxidant Activity of Endophytic Fungi Extract Associated With *Chloranthus Officinalis* Blume and *Staurogyne Elongata* Kuntze, 2020; 5(1): 131-140.
46. Huai, H., Dong, Q., & Liu, A. Ethnomedicinal analysis of toxic plants from five ethnic groups in China. *Ethnobotany Research and Applications*, 2010; 8: 169-179. <https://doi.org/10.17348/era.8.0.169-179>