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REVIEW ARTICLE **OPEN ACCESS**

Study on Structural and Pharmaceutical Constituents of *Cyathocline purpurea* - (Buch-Ham ex D. Don.) Kuntze "A Specified Medicinal Plant"

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ABSTRACT
Intervention between plants and human beings has been practiced and executed since the ancient era. This has acknowledged the fact that plants have been uttermost important for the existence of human beings. Interestingly, the past studies done on genus Cyathocline emphasizes its need to be studied with the perspectives of extracting drugs out of it. Subsequently, the instrumentation and techniques needs to be explored and developed. Considering all the above aspects, an attempt has been made to generate the accumulative data in the form of review for Cyathocline purpurea O. Kuntze as a specified medicinal plant. The review states the active structural constituents and their pharmacological properties concluding the future research trends on Cyathocline purpurea O. Kuntze.
Keywords: *Cyathocline, Sesquiterpenes Lactones, Santamarine, Eudesmonolide*

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INTRODUCTION

Plants make the basics of life forms on earth and are significant to the people's livelihood. India is considered to be the country with the geographical diversity which helps the sustainable vegetation of various life forms. Plants have been studied widely since ancient times for the benefit of mankind. The study of *Cyathocline purpurea* was also a step to reveal its significance and benefits to the mankind.

Scientific Classification:

Kingdom	-	Plantae
(unranked)	-	Angiosperms
(unranked)	-	Eudicots
(unranked)	-	Asterids
Order	-	Asterales
Family	-	Asteraceae
Genus	-	*Cyathocline*
Species	-	*purpurea.*(Buch-Ham ex D. Don.)Kuntze.

Geographical Distribution:

"Cyathocline purpurea (Buch-Ham ex D. Don.)Kuntze. belong to Asteraceae family. It is a seasonal Indian medicinal plant generally found in soggy habitats such as along watercourses and in rice fields throughout most of peninsular and northern India at an elevation of 1300m. This plant is widely distributed in widespread in Himalaya (Kashmir to Bhutan), Assam, India, Burma, Thailand, Indo- China and China" [3, 4, 5, 6].

Plant Description:

"Cyathocline purpurea (Buch-Ham ex D. Don.) Kuntze is an erect annual herb, growing in the range of 20-50 cm of height. Branched, grooved stem has soft hair covering it. The whole plant is strongly aromatic. It has alternately arranged stalk, less leaves are toothed, covered with soft hair, and 3-12 cm long. Flowers are purple in color, develop corymbs at the top of branches and the head of the flower is across 5-8 cm"[3, 4, 5, 6].

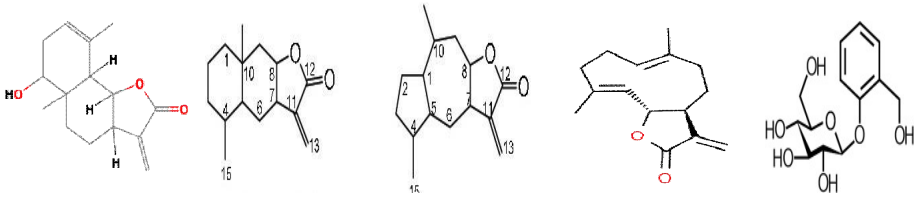
TRADITIONAL USES

Cyathocline purpurea has been used to treat a variety of ailments in the past. *Cyathocline purpurea* is an herbal treatment used in Chinese medicine to treat human TB, malaria, haemorrhage, rheumatism,

swelling, inflammatory, and anthelmintic disorders. Anticancer, antibacterial, anthelmintic, and hypotensive characteristics are all present in it. The herbal formulation of *Cyathocline purpurea* was applied traditionally for the control for different types of cancer [9, 10].*Cyathocline purpurea &Cyathocline lyrata*have a well-known drug. It is Uses as bitter tonic by Indigenous system of medicine. It's also a germicide and a tasty appetizer. It has antibacterial, antiprotozoal, antiviral, antifungal, antifungal, antifertility, and other pharmacological properties. *Cyathocline purpurea* has been specified as one of the useful medicinal and edible plant amongst the wetland plants of India [33]. Due to the abundance of essential oils, *Cyathocline has been studied chemically* for the presence volatile components in it [17].Genus *Cyathocline* has also got history of extensive research of having worked upon it from various perspectives. Attempt has been made in current review to focus and enlist various structural constituents and pharmaceutical properties in *Cyathocline purpurea*, to realize the future trend of research in this plant.

PHYTOCHEMISTRY

The analysis of the plants from medicinal perspectives has had a long history including the organoleptic techniques used initially to assess the plant's quality. It's clear that several aspects of analytics, particularly chromatographic and spectroscopic approaches, have progressed. The era of bioinformatics has opened the door to metabolomics giving us enhanced ability not just to speculate but also to practically find the gist of plants chemical constituents and so it's profiling of secondary metabolites. This has made the world of clinical research more sustainable and promising for the scientists to work up to their research trends [14].



A *B* *C* *D* *E*

Fig:1Basic Chemical structure of some sesquiterpene lactones: A: Santamarine, B: Eudesmonolide, C: Guianolid, D: Costunolide, E: Glycosides

From C. lyrata, two novel sesquiterpene lactones, Eudesmanolide and Isoivangustin, as well as the guaianolide – 6- hydroxy- 4,10- guaianadien- 8, 12-olide, have been isolated. The H NMR spectrum data of Isoivangustin and its hydrogenated derivative were found to be comparable to the signals of Alantolactone, Ivangustin, and lactone that were epimeric at C-8. The presence of Eudesmanolides was confirmed by this. Furthermore, the H NMR spectrum data of Alantolactone, a hydrogenated derivative, were identical to those of the corresponding 1-deoxy molecule. Spin decoupling was used to confirm the existence of the 1 - hydroxy1 groups. When the H NMR spectrum data were compared to those of invangustin, it was discovered that, the position of the double bond isomer of invangustin differs from that of the latter, which has an olefinic bond at C-3.The plant's aerial section has a strong antimicrobial effect. The yield of essential oil recovered by hydro-distillation was 0.28 percent. The antibacterial and antifungal properties of the oil were investigated by screening it in its purest form and at dilutions of 1:10, 1:100, and 1:1000 in ethylene glycol [17].Carbohydrates are found in the stem and root of *Tridax procumbens*, with 232.5 g/100g and 402.8 g/100g, respectively. The protein content of *Tridax procumbens* stem and root was found to be 121.6 g/100g and 11.61.9 g/100g, respectively. The vitamin C content of *Tridax procumbens* stem and root was determined to be 0.03680.87 g/100g and 0.00750.48 g/100g, respectively [35].Abubakar. *et. al.,* [1] reported the phytochemicals analysis of *Vernonia ambigua, Vernonia blumeoides* and *Vernonia ocephala*were shows that the alkaloid, saponins, steroids, flavonoids, tannins, and glycosides present in *Vernonia*plant extract and absence of tannins, glycosides and saponins in chloroform extract of all species of *Vernonia*.

Standardizing the *C. lyrata*&*C. purpurea*,according to different morphological, Microscopic, Organoleptic characters and also on the basis of Chemical test, Chromatographic techniques like TLC & HPLC, Physicochemical & UV Studies. Study revealed that *Cyathocline purpurea*) have different chemical compounds that are having a biological activity. Formulations of this plant contain different types of chemical & minerals. They standardized every individual drug on the basis of Pharmacognostic, physicochemical & anatomical properties (TLC & HPLC). In this study after analysis, it was seen that every molecule has its own specific function. Different organic solvents are used to extract phytochemicals from *Cyathocline purpurea* and *Cyathocline lyrata*, including ethanol, methanol, hexane, ethyl acetate,

chloroform, diethyl ether, toluene, petroleum ether, acetone, ammonia, n butanol, diethyl amine, formic acid. & different compounds identified by TLC, HPLC & U.V. Spectroscopy. Results indicate that Aqueous and Ethanolic extract of *Cyathocline purpurea* shows presence of Glycosides & flavonoids. Aqueous extract of *Cyathocline lyrata* shows presence of alkaloids, Tannins & phenol. HPLC Shows Presence of sesquiterpene lactones in both the species of Cyathocline in 50Mm KH_2PO_4 Buffer (pH-3 with OPA): Acetonitrile in the ratio of (30**:**70 v/v) solvent system [15].Ahmed et. al., 2016 reported the aerial parts of *Pulicaria somalensis* were shows presence of alkaloid, glycosides, carbohydrates, saponin, Tri terpenoids, flavonoids, Tannin, Phenolic compounds, proteins and amino acids[2], agreements with *Cyathocline purpurea* agreement withBharathiet. al., 2019.Bharathiet. al.,2019 were reported the presence of Alkaloids, flavonoids, Terpenoids, Phenolic compounds Triterpenoids, Quinones and Tannins in *Tridaxprocumbens* [35]. The leaves and stem bark extract of *Vernonia cinerea* were shows presence of steroids, ester, glycosides, and triterpenoids [25].Twenty five different compounds of essential oil were isolated from *Cyathocline purpurea*(Buch-Ham ex D. Don.) Kuntze, & the entire compound were identified by GC-MS. Phenyl derivative (58.0%) & Thymohydroquinone dimethyl ether (57.4%) are most abundantly identified from essential oil of root extract. Sesquiterpene (11.4%) & β-selinene (14.0%) were identified as the other largest constituents from essential oil root extract of *Cyathocline purpurea*. They also reported that oil extract of *Cyathocline purpurea* have an oxygenated monoterpens (2.4%) and oxygenated sesquiterpene (11.4%). In antibacterial assay *Micrococcus flavus* was more susceptible &*Micrococcus lites*& *Staphylococcus aureus* were moderately susceptible. Some organisms like *Escherichia coli, Klebsiella pneumonia, Salmonella typhimurium& Enterobacter aerogenes* showed resistance to essential oil of *Cyathocline purpurea*[18].

Table 2. Contains list of phytochemicals, Solvent systems with Mode of Detection and Medicinal properties.

S. n	Phytochemicals	Mode of Detection	Extract	Pharmacological Properties	References
1.	Cyathoclol	H- NMR	Aqueous extract	Antitumor, Antifidant& Anti-viral Activity	[17]
2.	Eudesmonolide & Guianolid	H- NMR	Ethanolic extract	Antitumor, Antifidant& Anti-viral Activity	[17]
3.	Sesquiterpene alcohol	H- NMR	_	Ant feeding activity against Larva	[17]
4.	Glycosides & flavonoids	TLC, HPLC & U.V. Spectroscopy	Aqueous and Ethanolic extract	Antibacterial activity	[15]
5.	alkaloids	TLC, HPLC & U.V. Spectroscopy	Ethanolic extract	Antibacterial activity	[15]
6.	Tannins	TLC, HPLC & U.V. Spectroscopy	Ethanolic extract	Antibacterial activity	[15]
7.	phenol	TLC, HPLC & U.V. Spectroscopy	Aqueous extract	Antibacterial activity	[15]
8.	Sesquiterpene lactones	HPLC	50Mm KH_2PO_4 Buffer (pH-3 with OPA): Acetonitrile in the ratio of (30**:**70 v/v) solvent system	Anti-Cancer activity	[15,17]
9.	Phenyl derivative	GC-MS	essential oil of root extract	Antibacterial activity	[18]
10.	Thymohydroquinone dimethyl ether	GC-MqS	essential oil of root extract	antibacterial activity	[18]
11.	Sesuiterpene lactones	Apoptosis & Caspases activity	_	Anti-Cancer activity	[23]
12.	Santamarine and 9β - Acetoxycostunolide	G2/M phase of the cell cycle	_	Anti-Cancer activity	[11]
13.	6 α- hydroxy-4, guanidine - 8β, 12-olide	UV- VIS, IR, TLC, ^{1}HNMR, HPLC,^{13}CNMR & Mass Spectrum	Pet ether extract	Anti-Cancer activity	[16]
14.	Isoivangustin	IR, MS, 1H-NMR, 13C-NMR and DEPT	30% acetone in pet. ether	Anti-inflammatory activity	[8]

Sesquiterpene lactones were isolated from *Cyathocline purpurea*(Asteraceae) tested against cancer cell line, where they were seen inhibiting the growth of cancerous cell [23].A 9- Acetoxycostunolide is a sesquiterpene lactone derivative that is structurally related to santamarine. Both chemicals were discovered in the Chinese herb *Cyathocline purpurea*, which belongs to the Asteraceae family. Santamarine and 9-acetoxycostunolide inhibit the G2/M phase of the cell cycle in L1210 murine leukaemia cells in a concentration and time-dependent manner, resulting in a decrease in cells in the G1 phase and eventual cell death [11],agreement with Ohhini *et. al*., they were reported the costunolide anticancer properties were first discovered in a rat intestinal carcinogenesis model produced by azoxymethane, and were later confirmed in a DMBA-induced carcinogenesis model, Carcinogenesis in the induced buccal pouch of hamsters [27]. Costunolide is a sesquiterpene lactone counterpart of parthenolide found in *Magnolia grandiflora* and *Tanacetum parthenium*, among other plants. Costunolide reduced LPS-induced NF-kB activation in a dose-dependent manner, according to Koo et al. Costunolide had even more potent inhibitory effect than parthenolide in this test method [20].Active constituents isolated from *Cyathocline purpurea* and analyzed by UV- VIS, IR, TLC, ^{1}HNMR, ^{13}CNMR & Mass Spectrum, then quantification of different compounds like 6 α- hydroxy-4, guanidine - 8β, 12- olide was done by using HPLC. All these compounds show more anticancer activity than pet ether extract of *Cyathocline purpurea* [16].

PHARMACOLOGICAL PROPERTIES

Cyathoclol has interestingly been discovered as a new sesquiterpene isolated from *Cyathocline purpurea.* Similar kind of sesquiterpene has been found to possess antihelmintic, anti- inflammatory, antioxidant and antibacterial activity[16].Ahmed et. al., 2016 reported the aerial parts of *Pulicaria somalensis* were shows antimircibial activity. Methanolic extract of *Pulicaria somalensis* were shows antimicrobial activity against *K. pneumonia, B. subtilis, and E. coli* with zone of inhibition 23mm, 16mm, 25mm respectively, slightly less effective as compare to standard, this antimicrobial activity matching with *Cyathocline purpurea*. They were also reported the antioxidant activity of *Pulicariasomalensis* DPPH assay. Ascorbic acid was shows better antioxidant activity than the methanolic extract of plants. Ascorbic acid were shows 48.65, 71.90, 84.62, 92.56, and 96.51% scavenging activity at 10, 50, 100, 500,and 1000 µg/ml concentration and methanolic extract were shows 19.57, 41.40, 76.78, 81.23, 79.84% at the activity at 10, 50, 100, 500,and 1000 µg/ml [2].The sesquiterpenes chosen have anticancer and anti-inflammatory properties, working on a variety of targets. Antifungal, anxiolytic, analgesic, and anti-trypanosomal properties are also present [26].Antimicrobial activity has been shown in a variety of Asteraceae plants in vitro. Ethanol extracts from Ageratum conyzoides and *Tagetes erecta* were discovered to have antibacterial activities against a wide range of Gram-positive and Gram-negative bacteria in an antimicrobial screening experiment. *P. aeruginosa* was similarly found to be inhibited by T. erecta [30]. Kappers *et. al.,* [19] reported the alkaloids, which are present in medicinal plants, are utilised as anaesthetics[19]. Terpenoids can have anticarcinogenic, antimalarial, antibacterial, and diuretic effects, among other things. Terpenoids are also crucial in attracting and consuming beneficial mites and herbivorous insects. Thymohydroquinone dimethylether has been analyzed by spectroscopic methods and has been screened as effective antimicrobial components which can certainly be utilized in the antimicrobial drug [21].Phyto-pharmacokinetics could be a new area where new models for the evaluation of veterinary medications in edible plants could be developed. With more specific information than previously accessible, it is now possible to pharmacokinetically monitor the flow of antibiotics and their fate in plants [12].*Cyathocline purpurea* is aromatic plant, used in medicine against headache[24,13].Essential oil isolated from *Cyathocline lyrata* showed cardiac depressant action on isolated guinea pig auricle & a hypotensive effect in anesthetized cat. It produced spasmo genic effect on isolated ileum and had an oxytocic action when tested on rat uterus. The essential oil isolated from *Cyathocline lyrata* increased the appetite when tested on mice but did not show a significant action on CNS. Death was observed in approx. 50 % of the animals with a dose of 400 mg/kg [32].The essential oils extracted from C. lyrata shows insecticidal activities against houseflies, mosquito larvae, Dysdercus similis and cockroaches [28].Plant extract isolated from C. lyrata shows antifungal activity against *Fusarium, Helinthosporium rostratum, and crystococcus neofarmans*[31]. Scientist also gave the treatment of different sesquiterpene to different cancer cell line. According to study, santamarine, 9-*β*-acetoxycostunolide and 9-*β*-acetoxyparthenolide significantly inhibited the growth of different cancer cell lines like Wve cell lines, that is L1210 murine leukaemia, CCRF-CEMl human leukaemia, KB human nasopharyngeal cancer, LS174T human colon adenocarcinoma and MCF-7 human breast cancer in concentration dependent manner. In this study they found that Santamarine, 9-*β*-acetoxycostunolide and 9-*β*-acetoxy-parthenolide are more effective against growth and & colonization of L1210 cell line in

concentration & Time dependent manner. They also found that Santamarine promotes the Caspases -3 activities in L1210 cell culture & caspase-3 reduces the growth of cancerous cell [24, 22].Aerial part of *Cyathocline purpurea* shows antimicrobial activity. Essential oil isolated from *Cyathocline purpurea* were tested against bacteria & Fungus. Essential oil with 1 % dilution shows antimicrobial activity, Gram positive bacteria are sensitive to essential oil [17].*Cyathocline purpurea* having an Analgesic, Antioxidant and Anti-inflammatory activity; 200 and 400mg/kg concentration of MECP is highly effective & also shows that action of MECP is more similar like NSAIDS than steroid drugs. Abubakar *et. al.,* 2011 reported the antibacterial activity of Vernonia a*mbigua, Vernonia blumeoides* And *Vernonia oocephala* were shows that the zone of inhibition from 14 to27 against the *C. ulcerans, K. pneumonia, Staphylococcus aureus, P. mirabilis, S. typhi*, *S. dysentriae,* MRSA and *P. aeruginosa*[1].When compared to the arthritic control group, MECP dosage has anti-arthritic efficacy in a concentration-dependent manner, as evidenced by decreased paw volume, joint diameter, and increased pain threshold, paw withdrawal latency, and paw withdrawal latency, body weight, and mechanical nociceptive threshold. MECP (400 and 200 mg/kg) has anti-arthritic efficacy by boosting Hb and RBC levels while lowering platelets, WBC, Rheumatoid factor (RF), and serum C-reactive protein (CRP) doses ($P<0.001$ and $P<0.01$, respectively)[10].Present study indicates various fractions of methanol extract of *Cyathocline purpurea* were showed anti-inflammatory activity and Isoivangustin, a sesquiterpene lactone isolated was the most active component contributing to its anti-inflammatory activity[8]. Entophytic cladosporium fungal species having an anticancer activity was isolated from crude extract of *Cyathocline purpurea* [29].The 6α-hydroxy-4 [14], 10 [15]-guainadien-8α, 12- olide (HGN) shows in- vitro & in-vivo Antioxidant & Anti-inflammatory activity with IC_{50} Values at 76 µg/mL concentration. HGN, antioxidant & ascorbic acid activity was analyzed with the help of radical scavenging effect the DPPH free Radical. In this study HGN has significant affinity towards active side of the COX-2. The mode of HGN binding to COX-2 are predicted by molecular docking that established link between affinity of binding & observed biological activity providing specific Non-bonded and Bonded interaction governing the activity[34].

CONCLUSION

With all the above literature, it can be undoubtedly and promisingly declare to have scopes for *Cyathocline purpurea* to explore from medicinal and pharmacological perspectives. The preceding plant research has sparked a novel pharmacological and pharmacokinetic perspective, in which absorption, distribution, metabolism, and elimination processes may be evaluated and modeled for risk assessment. Further clinical investigation can also be initiated for the above mentioned structural constituents to test the effects of nutritional achievable doses for human studies.

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CONFLICT OF INTEREST

Authors declare no conflict of interest.

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