



Blumea Lacera (Burm f.) DC: A review on its pharmacognosy, phytochemistry and pharmacological activities

¹Harshala Shirose, ²Pradnya Patil, ³Rohit Aghane, ⁴Harsh Suroshe, ⁵Kaveri Pawar

Research Scholar, Assistant Professor
Siddhi's Institute of Pharmacy Nandgaon

Abstract : *Blumea lacera* (Burm. F.) DC, a medicinal plant belonging to the family Asteraceae. It has been recognized in traditional medicine for its various therapeutic applications. This review provides an analysis of the pharmacognosy, phytochemistry and pharmacological activities of *B. lacera*. The pharmacognostic study including taxonomical classification, microscopic characteristics and phytochemical composition of this herb are examined. That supports the identification of this traditional plant. The phytochemical profile reveals the presence of various bioactive compounds such as flavonoids, terpenoids and phenolic acids. These chemical compounds are responsible for its anti-inflammatory, antimicrobial, antioxidant and anti-diabetic activities. This review also highlights the potential of *B. lacera* as a source of novel therapeutic agent and underlines the need for further research to explore its possible medicinal applications.

Index Terms - *Blumea lacera*, traditional medicine, pharmacognosy, phytochemistry, novel therapeutic agent.

INTRODUCTION

Blumea lacera is a member of the Asteraceae family and commonly known by names such as Janglimulli, Kakaronda, Siyalmutra and Susksampatra. (1) This perennial herb has a distinct camphor-like smell and tall stems with corymbose branching. It is covered in long silky hairs and has obovate, deeply serrated leaves along with yellow, daisy-like flowers. *Blumea lacera* often grows wild in wastelands, roadsides and drying ponds near rivers and drains.

In Ayurveda, this plant is valued for its various medicinal properties. It is believed to be bitter, astringent and acrid and is used as a thermogenic, anti-inflammatory, digestive aid, liver tonic, and many more. (2)

Blumea lacera has also been recognized in West Africa for its anti-scorbutic properties. Its essential oils have shown analgesic (pain-relieving), hypothermic (cooling) and calming effects. Chemical compounds identified in the leaves include flavones such as 5-hydroxy-3,6,7,3',4'-pentamethoxy flavone and 5,3',4'-trihydroxy flavone. (3) Additionally its leaves are known for their stomachic, antispasmodic and sweat-inducing properties.

Blumea lacera, also known as *Burm. f. DC.*, is a plant from the Asteraceae family that grows as an annual herb. It reaches a height of 40 to 90 cm. The plant has obovate leaves that smell like camphor and bright yellow flowers that grow in clusters at plant's axils. The flowers have sharp points. This plant typically bears fruit from December to March.

This plant is common in tropical areas, including Africa, Malaya, Australia, China, and India. For a long time, *Blumea lacera* herb has been used in traditional medicine. People have used it as a diuretic, to treat blood dysentery, piles and gout. (4) The knowledge about how to use this plant for healing has been passed down through generations to generations, making it a vital part of traditional medicine in many cultures. Besides its medicinal uses, some communities also use the plant in cooking. Also researchers have become interested in *Blumea lacera* because it contains several useful compounds such as terpenoids and fatty acids.



Fig. 1: Blumea Lacera plant



Fig. 2: Flower of blumea lacera

Synonyms: (5)

English: Blumea, Malay Blumea
 Hindi: Kukaraundha
 Gujarati: Kolhar
 Telgu: Advimulangi, Karupogaku
 Tamil: Kattumullangi, Narakkandai
 Bengali: Kukurmata
 Marathi: Bhamurda
 Malayalam: Kukkravriksham and Rakkila

Plant Taxonomy: (6)

Kingdom: Plantae
 Subkingdom: Tracheobionta
 Super division: Spermatophyta
 Division: Magnoliophyta
 Class: Magnoliopsida
 Subclass: Asteridae
 Order: Asterales
 Family: Asteraceae
 Genus: Blumea
 Species: Blumea lacera.

Biological source:

The biological source of *Blumea lacera* (Burm. f.) DC. is dried aerial parts of the plant. This includes its leaves, stems and flowers, which are typically harvested when the plant is in full bloom and then dried for use in traditional medicine. The plant belongs to the Asteraceae family which is known for its aromatic properties and medicinal applications.

Morphology: (7) (8)

Blumea lacera is a gregarious, annual herb and known for its strong odour. The plant has a sticky, glandular stem covered with fine hairs. Its leaves are sessile, sharply serrated with the lower leaves being lobed or lyrate, measuring about 5-12 cm in length and 2-6 cm in width. The plant has yellow flowers arranged in short, axillary cymes. The involucre bracts are silky and hairy while the receptacle are smooth and hairless. The pappus is white and the stigma is hairy.

The inner florets are hermaphroditic with only few being fertile. The involucre are either ovoid or campanulate with numerous, narrow and sharp bracts that are soft and herbaceous. The outer bracts are smaller and the receptacle is flat and bare. The calyx limb is bristly. The female florets have petals fused into slender corollas that are shorter than its styles ending in a minutely toothed apex. The stamens are syngenesious with anthers that are sagittate at the base featuring small and slender tails.

The plant produces small, subterete or angled fruits known as cypsela. Which typically appear from December to March. The flowering and fruiting period extends from December to May. *Blumea lacera* is very abundant in its natural habitats and is classified as "Least Concern" on the IUCN Red List.

Microscopic characters: (9)

In a microscopic study of its root's transverse section, the outline is irregularly circular with a central area almost entirely filled by wood, making up about two-thirds portion of the section. Surrounding this central wood there is a narrow layer of bark.

Examining the root's transverse section in detail, its outer layer consists of 2-5 rows of cork which can become irregular and incomplete in some areas. Beneath this is a layer of 2 to 5 rows of parenchyma cells and the endodermis is clearly visible. Just inside the endodermis there is a narrow band of pericycle cells which includes a row of oil cells. Then phloem is next, featuring a broad zone of parenchyma with small groups of fibers scattered throughout. The cambium is distinct and the xylem is composed of isolated or grouped xylem vessels.

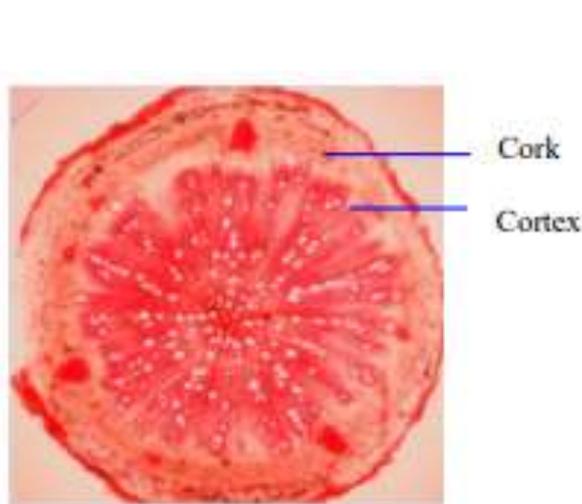


Fig. 3: Diagrammatic TS of Blumea lacera root

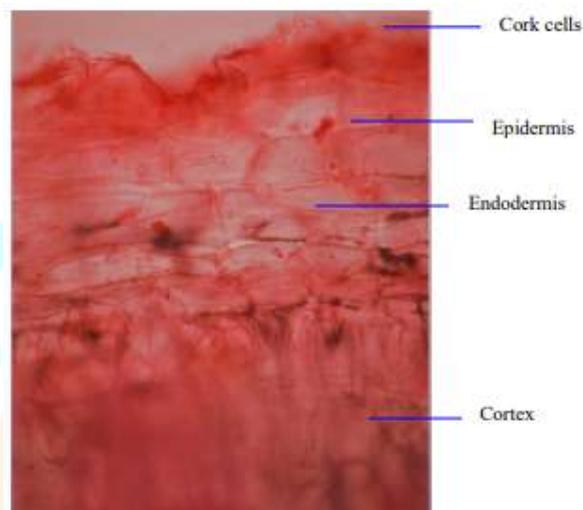


Fig. 4: TS of Blumea lacera root

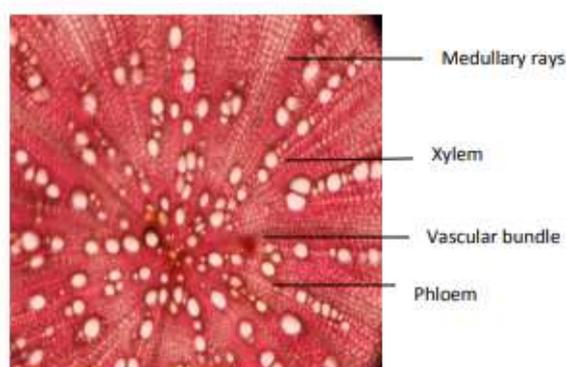


Fig. 5: Detailed TS of Blumea lacera root

Ethnomedicinal Uses:

Blumea lacera is an herb with significant importance in traditional medicine across many cultures. It has a long history in Ayurvedic practices and it is known for its wide range of medicinal properties. These include its astringent, anti-inflammatory, digestive, anti-microbial and many other beneficial effects. (10)

One common use is its fresh juice of leaves, which is often given to children to treat threadworm infections. The leaves are also applied in various regions to heal cuts, wounds, and burns. (11) (12) This highlights its role in treating injuries. Additionally, Blumea lacera herb is used to manage conditions like swelling, piles, general weakness, cholera, and

infections. It is also used topically to help with anal fissures and piles. (13) Overall, *Blumea lacera* herb is a vital part of traditional healing in many different communities.

Extraction : (14)

Dried powdered material (25 gm) of sample was extracted with methanol, distilled water and chloroform separately in soxhlet apparatus. The temperature of heating mantle was adjusted to 65°C for methanolic extraction while 100°C for aqueous extraction and 55°C for chloroform extraction. The extracts were concentrated by gradually evaporating the respective solvent on hot water bath. The concentrated extract was collected in sterile bottles and refrigerated until use (Sharma et al., 2013),

Phytochemical composition:

Phytochemical research is important for ensuring the quality control of traditional medicines, particularly those who are derived from bioactive substances found in medicinal plants. Investigating the chemical components found in and pharmacological activities of *B. lacera* is important, as it could become a valuable new drug in medicine.

B. lacera is a perennial, branching herb found in India, Bangladesh, Sri Lanka, and Nepal. This 1-2 meter tall plant, part of the Asteraceae family. It has various therapeutic properties with its leaves being particularly well-known for their healing potential. The essential oils extracted from the leaves contain several beneficial compounds, including phenol, flavones, monoterpene, triterpenes, stigmasterol, cineol, campesterol, lupeol, and artemisinin. (15) (16)

Research has shown that (Z)-Lachnophyllum ester found in *B. lacera*, has multiple biological properties such as cytotoxic effects against human cancer cells as well as antifungal and antibacterial activities.^[17] (17) The seeds of the plant have shown antibacterial properties and Linalool, another compound found in this plant has been reported to have larvicidal activity with an LC50 value of 46.86 mg/L¹ (18)

The key phytochemicals identified in *B. lacera* include camphor, (Z)-lachnophyllum ester, (Z)-lachnophyllic acid, nerolidol, gernacrene, monoterpene glycosides, flavonoids, β -farnesene, dihydroxy-trimethoxy flavone, diacetylglucopyranoside, β -caryophyllene, campesterol, α -humulene, amyirin, amyirin acetate, lupeol acetate, hentriacontane, hentriacontanol, β -sitosterol, cineol, and others are detailed in following Table Fig. 5. Illustrates the molecular structures of some of these compounds found in *Blumea lacera* herb.



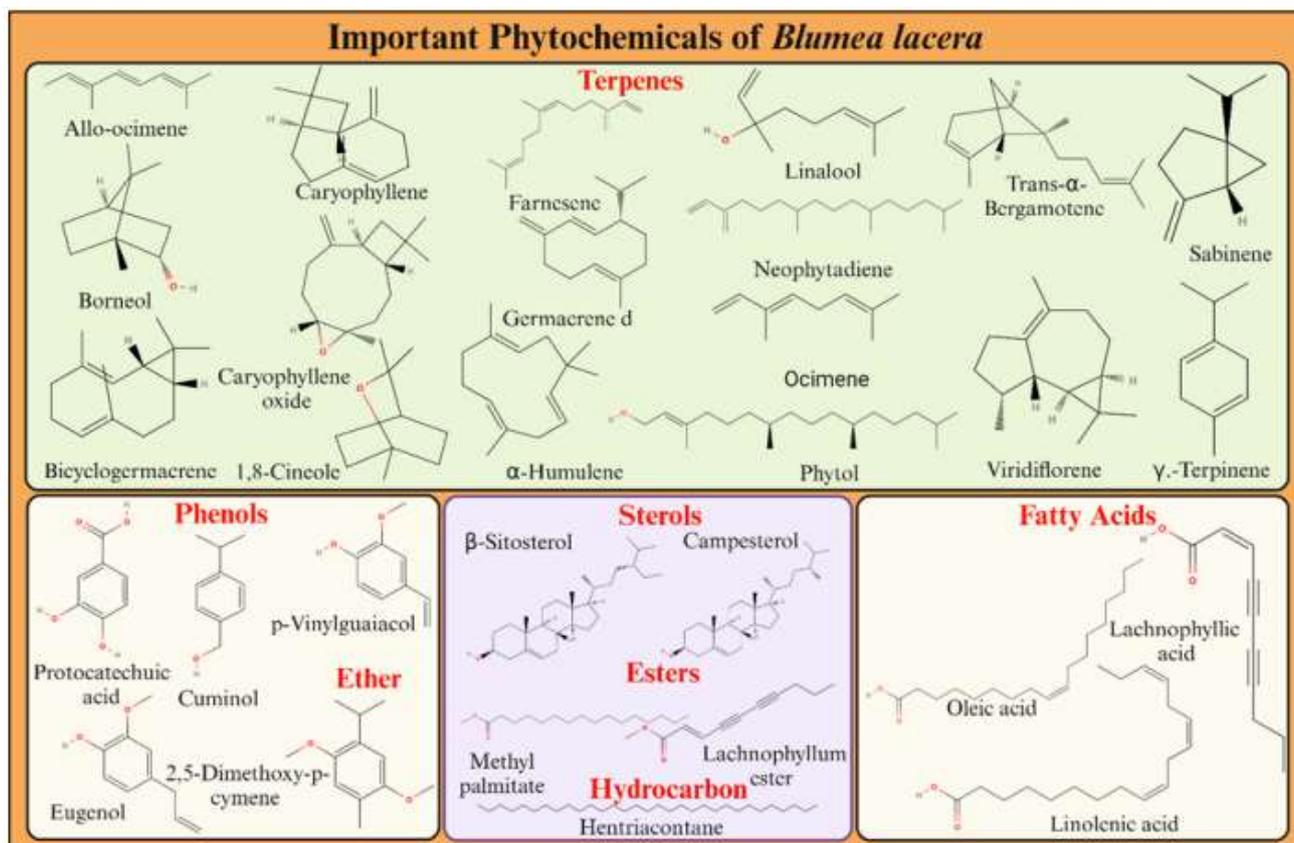


Fig.6: Important phytochemicals of *Blumea lacera*

Phytochemical tests : (19)

1. Alkaloids Test (Mayer's Test)

Procedure: Add a few drops of Mayer's reagent (potassium mercuric iodide) to the extract.

Observation: A creamy white precipitate indicates the presence of alkaloids.

2. Flavonoids Test (Alkaline Reagent Test)

Procedure: Add a few drops of sodium hydroxide solution to the extract.

Observation: An intense yellow color, which turns colorless upon addition of dilute acid, indicates the presence of flavonoids.

3. Tannins Test (Ferric Chloride Test)

Procedure: Add a few drops of ferric chloride solution to the extract.

Observation: A blue-black or greenish-black coloration indicates the presence of tannins.

4. Saponins Test (Froth Test)

Procedure: Shake the extract with distilled water in a test tube.

Observation: Persistent froth formation indicates the presence of saponins.

5. Terpenoids Test (Salkowski Test)

Procedure: Mix the extract with chloroform, and then add a few drops of concentrated sulfuric acid.

Observation: A reddish-brown color at the interface indicates the presence of terpenoids.

6. Glycosides Test (Keller-Kiliani Test)

Procedure: Mix the extract with glacial acetic acid, a drop of ferric chloride, and concentrated sulfuric acid.

Observation: A brown ring at the junction of the two layers and a violet ring below the brown ring indicates the presence of glycosides.

7. Steroids Test (Liebermann-Burchard Test)

Procedure: Add a few drops of acetic anhydride and concentrated sulfuric acid to the extract.

Observation: A greenish color indicates the presence of steroids.

8. Phenols Test (Ferric Chloride Test)

Procedure: Add a few drops of ferric chloride solution to the extract.

Observation: A deep blue or green color indicates the presence of phenolic compounds.

9. Anthraquinones Test (Borntrager's Test)

Procedure: Add dilute sulfuric acid to the extract and shake. Then add ammonia.

Observation: A pink, red, or violet color in the ammoniacal phase indicates the presence of anthraquinones.

10. Proteins and Amino Acids Test (Ninhydrin Test)

Procedure: Add a few drops of Ninhydrin solution to the extract and heat.

Observation: A purple or blue color indicates the presence of proteins and free amino acids.

High Performance Thin Layer Chromatography (HPTLC) : (20)

HPTLC studies were carried for the better isolation and identification of the different components of ethanolic extract of *Blumea lacera*. The report of HPTLC indicates the presence of eleven spots in the solvent system - Chloroform: Benzene: Formic acid (3: 1: 12 drops), carried out at NBRI, Lucknow.

HPTLC Parameters

- Sample preparation: 10 mg/ml
- Sample application: Linomat 5 applicator (Camag).
- Volume applied: 10 μ l
- Solvent system: Chloroform: Benzene: Formic acid (3: 1: 12 drops).
- TLC plate development: Presaturated Camag Twin Trough Chamber.



Fig 6. TLC Chromatogram of Ethanolic Extract of *Blumea lacera* in Solvent system Chloroform: Benzene: Formic acid (3:1:12 drops), performed in lab.

Table 1: Rf values and color of the TLC spots in solvent system - Chloroform: Benzene: Formic Acid (3:1:12 drops).

S. No.	Rf value	Color
1	0.03	Dark green
2	0.05	Light green
3	0.13	Light Brown
4	0.18	Green
5	0.23	Light yellow
6	0.28	Light green
7	0.33	Yellow
8	0.40	Light Brown
9	0.47	Dark green

Pharmacological activity:**Anthelmintic activity:**

The anthelmintic properties of *B. lacera* were evaluated by testing its ethanolic and water extracts against *Ascaris lumbricoides* and *Pheretima posthuma* in vitro studies, using Piperazine Citrate as a standard agent for comparison. The results demonstrated that both extracts of *Blumea lacera* exhibits significant anti-parasitic effects that were dependent on the dosage. In this study the alcoholic extract being slightly more effective than the water extract. (21)

Antimicrobial activity:

In the search for new antimicrobial treatments to combat bacterial resistance researchers have tested the antibacterial properties of various extracts from *Blumea lacera*. These extracts include ethyl acetate extract, methanol extract, petroleum ether extract, dichloromethane, 95% ethanolic, and water extract.

The ethyl acetate extract from dried leaves of *B. lacera* showed antibacterial activity against six bacterial strains: *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Propionibacterium acnes* and *Salmonella typhi*. Notably, *Pseudomonas aeruginosa* was inhibited the most with an inhibition zone of 12 mm. (22)

The methanol extract from the leaves was effective against *Salmonella typhi*, with a 20 mm inhibition zone. (23) Petroleum ether extracts from the whole plant also showed an antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*. (24) Various extracts, including such as from petroleum-ether, dichloromethane, ethyl acetate, 95% ethanol, methanol and water exhibited antibacterial effects against different bacterial species. (25)

Additionally the ethyl acetate fraction from *B. lacera* showed dose-dependent effectiveness against gram-positive bacterium *Bacillus cereus*.

Antidiabetic activity:

The study concluded that the methanolic extract of *B. lacera* herb has strong anti-diabetic effects. In this study 400 mg/kg dose of the methanol extract (MEBL) showed significant dose-dependent antidiabetic activity which effectively restoring the liver and pancreas structure in hyperglycemic rats without causing any damage to liver. (26)

Antiviral activity:

A recent study showed that hot water extracts from *B. lacera* can stop the growth of herpes simplex viruses HSV-1 and HSV-2. The effectiveness of these extracts was measured using IC₅₀ values, which indicate the concentration needed to inhibit the virus by half. For HSV-1 the IC₅₀ was 83.2 µg/ml and for HSV-2 it was 43.3 µg/ml. Both values are below 100 µg/ml indicating that the *B. lacera* extracts are effective for inhibiting these herpes viruses at relatively low concentrations.

Antioxidant activity:

Various factors can affect the antioxidant activity of plant extracts, making it difficult to fully understand their potential using just one method. The antioxidant abilities of plant extracts are likely influenced by their phenolic content which can act as reducing agents, electron donors and oxygen scavengers due to their oxidation-reduction properties. Therefore, multiple tests are needed to analyze the different mechanisms of antioxidant activity.

In this study, the antioxidant properties of *B. lacera* extract were evaluated using three different assays:

- 1) DPPH (2, 2-diphenyl-1-picrylhydrazyl)
- 2) FRAP (Ferric Reducing Ability of Plasma)
- 3) TEAC (Trolox Equivalent Antioxidant Capacity)

This was the first time for antioxidant properties of *B. lacera* were measured, so there were no previous data for comparison. (27)

Anti-inflammatory activity:

A previous study investigated that the medicinal effects of an ethanolic extract from the aerial parts of *B. lacera* on indomethacin-induced enterocolitis. Male Wistar rats were divided into six groups (with 5 rats in each group) and were given different doses of the ethanolic extract (100 and 200 mg/kg) and sulphasalazine (100 mg/kg) for 7 days. On the seventh and eighth days, enterocolitis was induced with two additional doses of indomethacin (7.5 mg/kg). The study found that the plant's antioxidant, anti-inflammatory, antibacterial and membrane-stabilizing properties helps to prevent indomethacin-induced enterocolitis in the rats. (28)

Antipyretic activity:

Antipyretics work by preventing the production of PGE-1, competing with arachidonic acid at the COX enzyme's active site. *Blumea lacera* herb has been traditionally used to reduce fever and pain and this study supports this uses. The leaves of *Blumea lacera* herb contain substances like flavonoids, β -sitosterol and triterpenes which are known to inhibit the prostaglandin synthetase enzyme leading to significant antipyretic effects.

In this anti-pyretic study the Brewer's yeast was used to induce fever in order to test the antipyretic effectiveness of *Blumea lacera* extract (BLE). The acute oral LD50 for BLE in female rats was found to be over 2000 mg/kg. To examine its antipyretic effects three doses of BLE—100 mg/kg (1/20 of the LD50), 200 mg/kg (1/10 of the LD50) and 400 mg/kg (1/5 of the LD50)—were selected. Extract reduced yeast-induced fever in rats at doses of 200 and 400 mg/kg demonstrating its antipyretic action. (29)

Conclusion:

Blumea lacera (Burm f.) DC. is a medicinal plant having ethnopharmacological background, with a diverse range of therapeutic potentials. Through this review, it is evident that its pharmacognosy reveals unique botanical characteristics, while its phytochemical profile includes significant compounds such as flavonoids, terpenoids, and glycosides that contribute to its pharmacological efficacy. The pharmacological studies demonstrate its wide range of bioactivities including antimicrobial, antipyretic, antidiabetic, antioxidant and anthelmintic effects. Highlighting its potential as a natural remedy for various ailments. So further research is necessary to explore its full therapeutic potential, ensuring its safe and effective integration into modern medicine.

REFERENCES :

1. Phytochemical investigation and spectral studies of isolated flavonoid from ethanolic extract of whole plant *Blumea lacera* DC. **Mishra, P., Irchhiya, R., & Mishra, S. K.** 2015, *Journal of Pharmacognosy and Phytochemistry*, p. 4(2).
2. Sacred Groves: Repositories of Medicinal Plants. *Medicinal Plants.* **Warrier, K. C., & Warrier, R. R.** 2019, p. 113.
3. Rideout JA. Monoterpene glycoside and flavonoids from *Blumea lacera*. *J. Nat. Med.* **Ragasa CY, Wong J.** 2007, p. 61: 474-475.
4. *L. Blumea balsamifera*—A phytochemical and pharmacological review. *Molecules.* **Pang, Y., Wang, D., Fan, Z., Chen, X., Yu, F., Hu, X., & Yuan.** 2014, pp. 19(7): 9453-9477.
5. Antifungal activity of various extracts of *Blumea lacera* against different *Aspergillus* species. **Kagne RM, Jamdhade VC, Surwase BS.** 2012, *Online Int Interdiscip Res J* , pp. 2:22-7.
6. Anti pyretic activity of *Blumea lacera* leaves in Albino rats. *Anim Med Res.* **Verma LK, Singh AK, Pachade VR, Koley KM, Vadlamudi VP.** 2012, pp. 2:56-9.
7. Phytochemical investigation and spectral studies of isolated flavonoid from ethanolic extract of whole plant *Blumea lacera* DC. *J Pharmacogn Phytochem.* **Mishra P, Irchhiya R, Mishra SK.** 2015, pp. 4(2):1-4.
8. Comparative pharmacognostical, preliminary phytochemical and acute toxicological evaluation of *Blumea lacera* var. *lacera* and *Blumea eriantha* DC. *Res J Pharm Technol.* **Singh UP, Parthasarathy R.** 2012, pp. 5(6):834-41.

9. PHARMACOGNOSTIC STUDY AND QUANTIFICATION OF MARKER COMPOUND THROUGH HPTLC TECHNIQUE IN KUKRONDHA (BLUMEA LACERA (BURM. F.) DC.- ROOT. **Asmita Soni, & Rashmi Singh & Manoj Tripathi.** 2024, IJARR, pp. 32-41.
10. Ethno-medicinal plants used by Bantar of Bhaudaha, Morang, Nepal. Our Nature. **Acharya E, Pokhrel B.** 2006, pp. 4:96-103.
11. Ethnomedicinal composition depends on floristic composition: A case studied in Sal forests of Jhar khand. Int J Pharm Life Sci. **Kumar K, Abbas SG.** 2012, pp. 3(5):1710-19.
12. Aromatic plants of Gorakhpur division: Their antimycotic properties and medicinal value. **Pandey AK, Tripathi NN.** 2011, Int J Pharm Sci Rev Res., pp. 7(2):142-47.
13. Rationale behind ethnopharmacological uses of Blumea lacera (Burm.f.) DC., (Asteraceae) for piles/haemorrhoids and anal fissures by Madia-Gond tribe of Gadchiroli district of Maharashtra state. **VJ., Tiwari.** 2016, India. Research Journal of Pharmacognosy and Phytochemistry., pp. 8(4):235-41.
14. Investigation on antioxidant, antimicrobial and phytochemical profile of Blumea Lacera leaf. **Umesh Khandekar, Sachin Tippat, Rahul Ghongade.** International Journal of Biological & Pharmaceutical Research.
15. Chemical composition of Blumea lacera essential oil from Nepal. Biological activities of the essential oil and (Z) Lachnophyllum Ester. Nat Prod Commun. **Research., International Journal of Biological & Pharmaceutical.** 2015, pp. 10(10):1749-50.
16. Isolation and structural characterization of compounds from Blumea lacera. **Pham XP, Nhung TTT, Trinh HN, Trung DM, Giang DT, Vu BD et al.** 2021 : s.n., Pharmacogn J. , pp. 13(4):999-1004.
17. Indigenous traditional medicinal plant resources from Ahmednagar district, Maharashtra. **Gayake DN, Awasarkar UD, Sharma PP.** 2013, Asian J Biomed Pharm Sci., pp. 3(22):1-5.
18. Chemical composition and larvicidal effects of essential oil of Blumea martiniana against Anopheles anthro pophagus. **Zhu L, Tian Y juan.** 2011, Asian Pac J Trop Med., pp. 4(5):371-74.
19. INVESTIGATION ON ANTIOXIDANT, ANTIMICROBIAL AND PHYTOCHEMICAL PROFILE OF BLUMEA LACERA LEAF. **Umesh Khandekar*, Sachin Tippat, Rahul Ghongade.** 2013, International Journal of Biological, pp. 4(11): 756-761.
20. Phytochemical investigation and spectral studies of isolated flavonoid from ethanolic extract of whole plant Blumea Lacera D.C. **Pratibha Mishra, Raghuveer Irchhiaya, Sunil Kumar Mishra.** Journal of Pharmacognosy and Phytochemistry.
21. Investigation of in-vitro antioxidant and cytotoxic activity of Blumea lacera leaf extract (Doctoral dissertation, Brac University). **Khan, M. A.** 2019.
22. Investigation on antioxi dant, anti-microbial and phytochemical profile of Blumea lacera leaf. Int J Biol Pharm Res. **Khandekar U, Tippat S, Hongade R.** 2013, pp. 4(11):756-61.
23. Screening of Indian plant extracts for antibacterial activity. Pharm Biol. **Mahida Y, Mohan JSS.** 2006, pp. 44(8):627-31.
24. Evaluation of antimicrobial and cytotoxic activities of the mehanolic and petroleum ether ex tract of Blumea lacera Burm.f. in Bangladesh. **Jahan K, Kundu SK, Bake MdA.** 2014, J Pharmacogn Phytochem. , pp. 2(6):104-08.
25. Screening of phytochemicals, anti oxidant and antimicrobial activities of Blumea lacera (Burm. f.) DC. leaf and root. **Myint PP, Sann AN, Soe NM.** 2017, J Med Plants Stud. , pp. 5(4):3-35.
26. Antidiabetic effect of extracts of Blumea lacera dc. in streptozotocin induced hyperglycemic rats. **Rath, D., Panigrahy, S. R., Panigrahi, S. K., Kar, D. M., & Maharana, L.** 2017, International Journal of Pharmacy and Pharmaceutical Sciences, pp. 218 - 223.
27. Comparative assessment of nutritional composition, polyphenol profile, antidiabetic and antioxidative properties of selected edible wild plant species of Bangladesh. Food chemistry., **Alam, M. K., Rana, Z. H., Islam, S. N., & Akhtaruzzaman, M.** 2020, p. 320: 126646.
28. Protective effect of Blumea lacera DC aerial parts in indomethacin-induced enterocolitis in rats. Inflammopharmacology., **Basnet, S., Adhikari, A., Sachidananda, V. K., Thippeswamy, B. S., & Veerapur, V. P.** 2015, pp. 23(6): 355-363.
29. Antipyretic activity of Blumea lacera leaves in albino rats. **Verma, L. K., Singh, A. K., Pachade, V. R., Koley, K. M., & Vadlamudi, V. P.** 2012, Explor Anim Med Res., pp. 2(1): 56-59.