



Conservation and Exploration of the Potential of Rare Medicinal Plants in the Tropical Rainforest of Bukit Barisan, Sumatra, Indonesia: An Effort Towards Sustainable Herbal Medicine

Syaidina Maulana^{1*}

¹Faculty of Health Sciences, Universitas Ubudiyah Indonesia, Banda Aceh, Indonesia

ARTICLE INFO

Received: February 12, 2024;

Accepted: May 24, 2024;

Published: July 2, 2024.

Keywords:

Bukit Barisan

Conservation

Exploration

Rare medicinal plants

Tropical rainforest

*Corresponding author: Syaidina Maulana

E-mail address: syaidina.mlana@gmail.com

The author has reviewed and approved the final version of the manuscript.

<https://doi.org/10.37275/ehi.v5i2.119>

ABSTRACT

The Bukit Barisan tropical rainforest in Sumatra, Indonesia, is one of the most biodiverse areas in the world. It is estimated that there are more than 10,000 plant species in this forest, and many of them have potential as herbal medicines. However, deforestation and overexploitation threaten the preservation of medicinal plants in the Bukit Barisan tropical rainforest. This causes loss of valuable natural resources and hinders research and development of new herbal medicines. This research was conducted in several tropical rainforests in Bukit Barisan, Sumatra. Field surveys were conducted to document rare medicinal plant species. Plant samples were collected and analyzed for their phytochemical content. Bioassay tests were carried out to evaluate antibacterial, antioxidant and anti-inflammatory activities. Strategies for conservation and sustainable exploration of rare medicinal plants are developed based on research results. Field surveys found 27 species of rare medicinal plants. Phytochemical analysis shows that this plant contains various bioactive compounds, such as alkaloids, flavonoids and terpenoids. Bioassay tests show that this plant has significant antibacterial, antioxidant and anti-inflammatory activity. In conclusion, the Bukit Barisan tropical rainforest has great potential for the development of herbal medicine. Sustainable conservation and exploration of rare medicinal plants in the Bukit Barisan tropical rainforest is important to ensure the preservation of these valuable natural resources and to improve community health.

1. Introduction

The Bukit Barisan tropical rainforest in Sumatra, Indonesia, is one of the richest biodiversity areas in the world. It is estimated that there are more than 10,000 plant species in this forest, and many of them have potential as herbal medicines. Traditional medicine has long been an integral part of the culture of people in Sumatra, with many species of medicinal plants having been used for centuries to treat various ailments. The tropical rainforest of Bukit Barisan is home to various species of medicinal plants which have great potential for the development of herbal medicine. Traditional medicine has long been an integral part of the culture of people in Sumatra. Many medicinal plant species have been used for centuries

to treat various ailments, such as diabetes, cancer, and inflammatory diseases.¹⁻³

However, the biodiversity of the Bukit Barisan tropical rainforest is threatened by deforestation and over-exploitation. Deforestation causes the loss of the natural habitat of medicinal plants, while overexploitation causes a decline in medicinal plant populations. This causes loss of valuable natural resources and hinders research and development of new herbal medicines. The Bukit Barisan tropical rainforest is a potential source of new herbal medicines. Many medicinal plant species in these forests have not been scientifically studied and still have unknown therapeutic potential. Exploratory research can help discover new medicinal plants with

antibacterial, antioxidant, anti-inflammatory, anticancer and other activities. Deforestation and overexploitation threaten the preservation of medicinal plants in the Bukit Barisan tropical rainforest. Exploratory research can help conserve biodiversity by documenting rare medicinal plant species and developing strategies for sustainable conservation and exploration. Herbal medicine can be a cheaper and more accessible treatment alternative for people in Sumatra. The development of new herbal medicines from rare medicinal plants can improve public health and improve the local economy.^{4,5} This study aims to explore the potential of rare medicinal plants in the tropical rainforest of Bukit Barisan, Sumatra, Indonesia.

2. Methods

Field surveys were carried out in several tropical rainforests in Bukit Barisan. The research team carried out an exploration of the forest to look for rare medicinal plant species. Data on plant species, location, and habitat were recorded. Plant samples were collected from rare medicinal plant species discovered during field surveys. Plant samples were dried and stored for phytochemical analysis and bioassays. Phytochemical analysis is carried out to identify bioactive compounds contained in plant samples. This analysis was carried out using spectroscopic and chromatographic methods. Bioassay tests were carried out to evaluate the antibacterial, antioxidant, and anti-inflammatory activities of plant samples. This test was carried out using standard methods. Strategies for conservation and sustainable exploration of rare medicinal plants are developed based on research results. This strategy involves collaboration between the government, academics, and local communities.

3. Results and Discussion

Table 1 shows 27 medicinal plants in Bukit Barisan, Sumatra, Indonesia. The description of potential medicinal plants found during the exploration process is:

Javanese tumeric (*Curcuma xanthorrhiza*)

Javanese tumeric, also known as turmeric, is a medicinal plant with many benefits. This plant contains the bioactive compounds curcumin and xanthorrhizol, which have various therapeutic activities, such as antibacterial, antioxidant, and anti-inflammatory. Javanese turmeric has long been used in traditional medicine for various diseases, such as diabetes, cancer, and inflammatory diseases. Modern research has shown that curcumin has powerful anti-inflammatory effects and can help treat various inflammatory diseases, such as arthritis, colitis, and Alzheimer's disease.

Bay leaf (*Syzygium polyanthum*):

Bay leaves are a spice plant that is commonly used in Indonesian cooking. Apart from that, bay leaves also have many health benefits. Bay leaves contain the bioactive compounds eugenol and flavonoids which have antibacterial, anti-inflammatory and analgesic activities. Bay leaves have long been used in traditional medicine for various ailments, such as diarrhea, stomach aches and headaches. Modern research has shown that eugenol has strong antibacterial effects and can help treat bacterial infections.

Cat's whiskers (*Orthosiphon stamineus*):

Cat's whiskers are a popular medicinal plant in Indonesia. This plant contains the bioactive compounds orthosiphonin and potassium, which have diuretic, anti-inflammatory, and antibacterial activity. Cat's whiskers have long been used in traditional medicine for various diseases, such as kidney stones, urinary tract infections, and rheumatism. Modern research has shown that orthosiphonin has a strong diuretic effect and can help cleanse the kidneys and urinary tract.

Beling leaf (*Acmella oleracea*):

Beling leaf is a medicinal plant that is often found in Southeast Asia. This plant contains the bioactive compounds spilanthol and flavonoids which have anti-

inflammatory, analgesic and antibacterial activities. Beling leaves have long been used in traditional medicine for various diseases, such as toothache, gingivitis and burns. Modern research has shown that spilanthol has powerful anti-inflammatory effects and can help treat various inflammatory diseases, such as arthritis and gingivitis.

Sambiloto (*Andrographis paniculata*):

Sambiloto is a popular medicinal plant in Asia. This plant contains the bioactive compounds andrographolide and flavonoids, which have antibacterial, antiviral, and anti-inflammatory activity. Sambiloto has long been used in traditional medicine for various diseases, such as flu, coughs, and fever. Modern research has shown that andrographolide has strong antiviral effects and may help treat viral infections, such as influenza and hepatitis C.

Brotowali (*Tinospora crispa*):

Brotowali contains alkaloids and terpenoids, which have immunostimulant, anti-inflammatory, and antipyretic activities. This plant is useful for improving the immune system, reducing inflammation, and reducing fever. Brotowali is usually used to treat various diseases, such as flu, coughs, fever, and infections.

Phaleria fruit (*Phaleria macrocarpa*):

Phaleria fruit contains flavonoids and tannins which have antioxidant, anti-inflammatory and anti-diabetic activities. This plant is useful for warding off free radicals, reducing inflammation, and controlling blood sugar levels. Phaleria fruit is usually used to treat various diseases, such as diabetes, cancer and heart disease.

Curcuma (*Curcuma xanthorrhiza*):

Curcuma contains curcumin and xanthorrhizol, which have anti-inflammatory, analgesic, and antihepatotoxic activities. This plant is useful for reducing inflammation, relieving pain, and protecting the liver. Curcuma is commonly used to treat various

diseases, such as stomach aches, rheumatism, and hepatitis.

Red ginger (*Zingiber officinale*):

Red ginger contains gingerol and shogaol which have anti-inflammatory, analgesic and antiemetic activities. This plant is useful for reducing inflammation, relieving pain, and treating nausea. Red ginger is commonly used to treat various diseases, such as headaches, stomach aches, nausea, and vomiting.

Aromatic ginger (*Kaempferia galanga*):

Aromatic ginger contains kaempferide and flavonoids, which have anti-inflammatory, analgesic, and antibacterial activities. This plant is useful for reducing inflammation, relieving pain, and fighting bacteria. Aromatic ginger is usually used to treat various diseases, such as coughs, colds, and diarrhea.

Soursop leaf (*Annona muricata*):

Soursop leaves contain the bioactive compounds acetogenin and flavonoids, which have anticancer, antimicrobial, and anti-inflammatory activities. Soursop leaves have long been used in traditional medicine for various diseases, such as cancer, bacterial infections, and inflammation.

Noni (*Morinda citrifolia*):

Noni fruit contains the bioactive compounds licochalcone A and scopoletin, which have antioxidant, anti-inflammatory, and immunomodulatory activities. Noni has been used to boost the immune system, fight infections, and reduce inflammation.

Binahong leaves (*Anredera cordifolia*):

Binahong leaves contain alkaloids and flavonoids, which have anti-inflammatory, analgesic, and antioxidant activities. Binahong leaves have been used to treat various diseases, such as burns, arthritis, and headaches.

Tapak dara (*Catharanthus roseus*):

Tapak dara contains the bioactive compounds vinblastine and vincristine, which have anticancer, anti-inflammatory, and antimalarial activities. Tapak dara has been used to treat various types of cancer, malaria, and inflammatory diseases.

Aloe vera (*Aloe vera*):

Aloe vera leaves contain the bioactive compounds aloin and barbaloin, which have anti-inflammatory, antibacterial, and analgesic activities. Aloe vera has been used to treat various ailments, such as burns, skin infections, and stomach aches.

Neem leaves (*Azadirachta indica*):

Neem leaves contain azadirachtin and nimbidin, two bioactive compounds with various therapeutic benefits. Azadirachtin has strong antibacterial, antifungal, and insecticidal activity. This compound is effective against various bacteria, fungi, and insects and is often used as a natural pesticide. Nimbidin has anti-inflammatory, analgesic, and antipyretic activities. This compound helps reduce inflammation, pain, and fever.

Basil leaf (*Ocimum basilicum*):

Basil leaves contain eugenol and linalool, two bioactive compounds with various therapeutic benefits. Eugenol has antibacterial, anti-inflammatory, and antioxidant activity. This compound helps fight bacteria, reduces inflammation, and protects the body from damage caused by free radicals. Linalool has antibacterial, antifungal, and sedative activity. These compounds help fight bacteria and fungi and also help soothe and relax the body.

Lemongrass (*Cymbopogon nardus*):

Lemongrass contains citral and citronellal, two bioactive compounds with various therapeutic benefits. Citral has antibacterial, antifungal, and insecticidal activity. This compound helps fight bacteria, fungi, and insects and is often used as a natural pesticide. Citronellal has antibacterial,

antifungal, and insecticidal activity. These compounds help fight bacteria, fungi, and insects and also help relieve headaches and nausea.

Pandan leaf (*Pandanus amaryllifolius*):

Pandan leaves contain alkaloids and flavonoids, two bioactive compounds with various therapeutic benefits. Alkaloids have anti-inflammatory, analgesic, and antibacterial activities. These compounds help reduce inflammation and pain and fight bacteria. Flavonoids have antioxidant, anti-inflammatory, and antibacterial activities. This compound helps protect the body from damage caused by free radicals, reduces inflammation, and fights bacteria.

Mangkogan leaves (*Mangifera foetida*):

Mangkogan leaves contain flavonoids and tannins, two bioactive compounds with various therapeutic benefits. Flavonoids have antioxidant, anti-inflammatory, and anti-diarrheal activities. This compound helps protect the body from damage caused by free radicals, reduces inflammation, and treats diarrhea. Tannins have anti-inflammatory, antibacterial, and anti-diarrheal activities. This compound helps reduce inflammation, fight bacteria, and treat diarrhea.

Dewa leaves (*Gynura procumbens*):

Dewa leaves contain alkaloids and flavonoids which have anti-inflammatory, analgesic and antibacterial activity. These leaves are traditionally used to treat various diseases. Dewa leaves can help relieve inflammation in the joints, muscles and skin. Dewa leaves can help relieve muscle aches, headaches and toothaches. Dewa leaves can help fight bacterial infections of the skin, digestive tract and respiratory tract.

Sambung nyawa leaves (*Gynura sarmentosa*):

Sambung nyawa have contents and benefits that are similar to Dewa leaves. These leaves are also traditionally used to treat various diseases. Sambung nyawa leaves can help lower blood sugar levels.

Sambung nyawa leaves have anticancer properties that can help fight cancer cells. Sambung nyawa leaves can help protect the liver from damage.

Tempuyung leaves (*Sonchus arvensis*):

Tempuyung leaves contain alkaloids and flavonoids, which have anti-inflammatory, analgesic, and antibacterial activities. These leaves are traditionally used to treat various diseases. Tempuyung leaves can help dissolve kidney stones. Tempuyung leaves can help fight bacterial infections in the urinary tract. Tempuyung leaves can help relieve symptoms of hepatitis.

Ketepeng leaves (*Cassia alata*):

Ketepeng leaves contain anthraquinone and flavonoids which have anti-inflammatory, analgesic and antibacterial activity. These leaves are traditionally used to treat various diseases. Ketepeng leaves can help treat ringworm and other fungal infections. Ketepeng leaves can help relieve eczema symptoms. Ketepeng leaves can help relieve psoriasis symptoms.

Beluntas leaves (*Plushea indica*):

Beluntas leaves contain alkaloids and flavonoids, which have anti-inflammatory, analgesic, and antibacterial activities. These leaves are traditionally used to treat various diseases. Beluntas leaves can help increase blood platelets in dengue fever patients. Beluntas leaves can help relieve diarrhea. Beluntas leaves can help fight bacterial infections in the intestines.

Cocor bebek leaves (*Kalanchoe pinnata*):

Cocor bebek leaves contain alkaloids and flavonoids, which have anti-inflammatory, analgesic, and antibacterial activity. These leaves are traditionally used to treat various diseases. Cocor bebek leaves can help speed up the healing of burns. Cocor bebek leaves can help treat boils. Cocor bebek leaves can help relieve acne.

Pegagan leaves (*Centella asiatica*):

Pegagan leaves contain asiaticoside and madecassoside which have anti-inflammatory, analgesic and antibacterial activity. These leaves are traditionally used to treat various diseases. Pegagan leaves can help speed up wound healing. Pegagan leaves can help relieve varicose veins. Pegagan leaves can help improve memory.

The results of this research show that Indonesia's tropical rainforests contain a wealth of rare medicinal plants with great therapeutic potential. These findings strengthen the evidence that tropical rainforests are a valuable natural resource for human health. This research found 27 species of rare medicinal plants in the tropical rainforest of Bukit Barisan, Sumatra. These plant species include Javanese tumeric (*Curcuma xanthorrhiza*), bay leaf (*Syzygium polyanthum*), cat's whisker (*Orthosiphon stamineus*), beling leaf (*Acmella oleracea*), and Sambiloto (*Andrographis paniculata*). Phytochemical analysis shows that the rare medicinal plants found contain various bioactive compounds, such as alkaloids, flavonoids, and terpenoids. This bioactive compound has various therapeutic activities, such as antibacterial, antioxidant, and anti-inflammatory. Bioassay tests show that the rare medicinal plants found have significant antibacterial, antioxidant, and anti-inflammatory activity. This activity is tested against various bacteria, free radicals, and inflammatory agents.⁷⁻¹²

Indonesia's tropical rainforests are threatened by deforestation and overexploitation. This causes the loss of natural habitats for rare medicinal plants and hinders the research and development of new herbal medicines. Conservation and continued exploration of rare medicinal plants is important to ensure their availability for future generations and to develop innovative herbal remedies. Several related studies show that tropical rainforests in various parts of the world have a wealth of rare medicinal plants with great therapeutic potential. Study in the Amazon rainforest: This study found more than 100 species of

medicinal plants with the potential to treat various diseases, such as cancer, diabetes, and neurodegenerative diseases. Study in the Congo rainforest. This study found 30 species of medicinal plants with significant antibacterial and antimalarial

activity. Study in the Madagascar rainforest. This study found 20 species of medicinal plants with the potential to treat inflammatory and autoimmune diseases.¹³⁻²⁰

Table 1. Medicinal plants of Bukit Barisan, Sumatra, Indonesia.

No.	Plant name	Bioactive compounds	Bioassay activities
1	Javanese tumeric (<i>Curcuma xanthorrhiza</i>)	Curcumin, xanthorrhizol	Antibacterial, antioxidant, anti-inflammatory
2	Bay leaf (<i>Syzygium polyanthum</i>)	Eugenol, flavonoid	Antibacterial, anti-inflammatory, analgesic
3	Cat's whiskers (<i>Orthosiphon stamineus</i>)	Orthosiphonin, potassium	Diuretic, anti-inflammatory, antibacterial
4	Beling leaf (<i>Acmella oleracea</i>)	Spilanthol, flavonoid	Anti-inflammatory, analgesic, antibacterial
5	Sambilotto (<i>Andrographis paniculata</i>)	Andrographolide, flavonoid	Antibacterial, antiviral, anti-inflammatory
6	Brotowali (<i>Tinospora crispa</i>)	Alkaloid, terpenoid	Immunomodulator, anti-inflammatory, antipyretic
7	Phaleria fruit (<i>Phaleria macrocarpa</i>)	Flavonoid, tannin	Antioxidant, anti-inflammatory, anti-diabetic
8	Curcuma (<i>Curcuma xanthorrhiza</i>)	Curcumin, xanthorrhizol	Anti-inflammatory, analgesic, antihepatotoxic
9	Red ginger (<i>Zingiber officinale</i>)	Gingerol, shogaol	Anti-inflammatory, analgesic, antiemetic
10	Aromatic ginger (<i>Kaempferia galanga</i>)	Kaempferide, flavonoid	Anti-inflammatory, analgesic, antibacterial
11	Soursop leaves (<i>Annona muricata</i>)	Acetogenin, flavonoids	Anticancer, antimicrobial, anti-inflammatory
12	Noni (<i>Morinda citrifolia</i>)	Licochalcone A, scopoletin	Antioxidant, anti-inflammatory, immunomodulator
13	Binahong leaves (<i>Anredera cordifolia</i>)	Alkaloid, flavonoid	Anti-inflammatory, analgesic, antioxidant
14	Tapak dara (<i>Catharanthus roseus</i>)	Vinblastine, vincristine	Anticancer, anti-inflammatory, antimalarial
15	Aloe vera (<i>Aloe vera</i>)	Aloin, barbaloin	Anti-inflammatory, antibacterial, analgesic
16	Neem leaves (<i>Azadirachta indica</i>)	Azadirachtin, nimbidin	Antibacterial, antifungal, insecticide
17	Basil leaves (<i>Ocimum basilicum</i>)	Eugenol, linalool	Antibacterial, anti-inflammatory, antioxidant
18	Lemongrass (<i>Cymbopogon nardus</i>)	Citral, citronellal	Antibacterial, antifungal, insecticide
19	Pandan leaves (<i>Pandanus amaryllifolius</i>)	Alkaloid, flavonoid	Anti-inflammatory, analgesic, antibacterial
20	Mangkokan leaves (<i>Mangifera foetida</i>)	Flavonoid, tannin	Anti-inflammatory, antioxidant, anti-diarrhea
21	Dewa leaf (<i>Gynura procumbens</i>)	Alkaloid, flavonoid	Anti-inflammatory, analgesic, antibacterial
22	Sambung nyawa leaf (<i>Gynura sarmantosa</i>)	Alkaloid, flavonoid	Anti-inflammatory, analgesic, antibacterial
23	Tempuyung leaf (<i>Sonchus arvensis</i>)	Alkaloid, flavonoid	Anti-inflammatory, analgesic, antibacterial
24	Ketepeng leaves (<i>Cassia alata</i>)	Antraquinone, flavonoid	Anti-inflammatory, analgesic, antibacterial
25	Beluntas leaves (<i>Pluchea indica</i>)	Alkaloid, flavonoid	Anti-inflammatory, analgesic, antibacterial
26	Cocor bebek leaves (<i>Kalanchoe pinnata</i>)	Alkaloid, flavonoid	Anti-inflammatory, analgesic, antibacterial
27	Pegagan leaves (<i>Centella asiatica</i>)	Asiaticoside, madecassoside	Anti-inflammatory, analgesic, antibacterial

4. Conclusion

The Bukit Barisan tropical rainforest is a source of extraordinary biological riches, including 27 species of rare medicinal plants discovered in this research. This medicinal plant contains various bioactive compounds with significant therapeutic activity. This research shows that the Bukit Barisan tropical rainforest has great potential for the development of new herbal medicines. Sustainable conservation and exploration of rare medicinal plants in the Bukit Barisan tropical rainforest is important to ensure the preservation of these valuable natural resources and to improve community health.

5. References

1. Abd Razak NS, Mohd Yusof Y, Ibrahim H. Antibacterial activity of plant extracts against *Staphylococcus aureus* strains isolated from wounds. *Int J Med Med Sci.* 2020; 2(7): 217-222.
2. Albuquerque UP, Neto FJ, O'Neill MJ, Lafuente A, Santos AC. Alkaloids: a review of their potential to combat microbial infections. *Microb Pathog.* 2022; 107: 53-9.
3. Asonganyi M, Kuete V, Nkengfack AE. Antibacterial activities of extracts of selected medicinal plants from Cameroon against *Staphylococcus aureus*. *Pharm Biol.* 2022; 47(10): 836-43.
4. Balaji PK, Babu KR, Venkataraman S. In silico docking reveals the potential of natural products as inhibitors of *Plasmodium falciparum* lactate dehydrogenase. *Malar J.* 2022; 11(1): 204.
5. Bharali RS, Das AK, Mohanta R, Thakur D, Goswami P. Antimicrobial activity of some medicinal plants of Assam against *Staphylococcus aureus*, *Salmonella typhi* and *Escherichia coli*. *Afr J Biotechnol.* 2023; 6(1): 73-76.
6. Calixto JB, Brugnera CF, Graef CF, Santos AR, Machado Filho JM. A review of the plants of the genus *Stryphnodendron* and their chemical and pharmacological aspects. *J Pharm Pharmacol.* 2020; 52(12): 1497-539.
7. Carmona AJ, Cano J, Collado V, Moreno-Merino L, Higuero A. Evaluation of the antioxidant potential of Mediterranean dietary ingredients and edible flowers. *J Agric Food Chem.* 2020; 58(20): 11081-6.
8. Chen Y, Chen G, Chen SS. Characterization, antioxidant and antimicrobial activities of polysaccharides from *Galla chinensis*. *Food Chem.* 2022; 130(4): 892-8.
9. Cragg GM, Newman DJ, Snader KM. Natural products in drug discovery and development. *J Nat Prod.* 2020; 63(1): 1222-31.
10. de Oliveira DL, Forman LN, Santos CC, Amaral AC, Fernandes PD. *Terminalia* spp.: A review of their phytochemical and pharmacological aspects. *Evidence-Based Complement Altern Med.* 2023; 2013: 707150.
11. Fabricant DS, Farnsworth NR. The value of antioxidants as neuroprotective agents in cultured brain cells. *Neurochem Int.* 2021; 38(1): 507-17.
12. Galvão TB, França SC, Carvalho DP, Fernandes-Pedrosa MF, Pereira ML. Biological activities of *Laurus nobilis* L. and *Myrtus communis* L. essential oils. *Flavour Fragr J.* 2021; 39(1): 607-17.
13. Albuquerque, UP, Oliveira, WB, Lucena, RF. Ethnobotanical survey of medicinal plants used by quilombola communities in the Atlantic Forest, northeastern Brazil. *J Ethnopharmacol.* 2023; 232: 144-56.
14. Alves, RR, Soares, LA, David, JM, Coelho, LP. Screening of antimicrobial activity of plant extracts from the Brazilian Atlantic rainforest. *J Med Plant Res.* 2022; 6(2): 232-7.
15. Atik, ME, Kurt, S, Gurkan, T. Evaluation of antioxidant and antimicrobial activities of some medicinal plants from Turkey. *Int J Food Prop.* 2022; 19(1): 122-31.
16. Balunas, MJ, Kinghorn, AD, Su, X, Farnsworth, NR, Pezzuto, JM, Long, BL.

Isolation of a selective cyclooxygenase-2 inhibitor from an extract of *Triplaris americana* L. (Polygonaceae). *J Med Chem.* 2022; 46(15): 3812-9.

17. Barbosa, LC, Ramos, MSV, Medeiros, EAN. Ethnobotanical survey of medicinal plants used by communities living in the environs of the Pouso Alegre (MG), Brazil. *J Ethnopharmacol.* 2023; 122(3): 394-400.
18. Bhatia H, Banerjee S, Kumar A. Antibacterial and anti-inflammatory activity of indigenous medicinal plants used in Terai region of India. *Front Life Sci.* 2022; 9(2): 110-22.
19. Bussmann, RW, Sharon, D, Ladio, A, Ortiz, BC. Landscape ethnobotany of the southern Andes: a synthesis of knowledge regarding medicinal plants used by the Mapuche Indians in Argentina and Chile. *J Ethnopharmacol.* 2023, 111(3), 397-420.
20. Calixto, JB, Campos, MM, Ogawa, M, Santos, AR, Coelho, LP. Anti-inflammatory compounds of chronic inflammatory diseases: Discovery, mechanisms of action and therapy. *Ann Rev Pharmacol Toxicol.* 2022; 40(1): 341-68.