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## Medicinal plants diversity in bhadra tiger reserve, muthodi, chikkamagaluru, Karnataka state

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#### Abstract

The objective of this work is a survey of the species of medicinal plants and their pharmacological properties. The area of this study is well known for its rich diversity of plant species. The Bhadra Tiger Reserve (BTR), Muthodi, is situated in the Western Ghats region of Karnataka. The herbal plant samples were collected, identified, and prepared as Herbarium, and data gathering was conducted based on the questionnaire method with well-known traditional herbalists. In this study 20 plant species have been identified in which 19 genera were identified as being used for various treatments. A total number of 20 plant species identified and studied in different growth forms were identified herbs, shrubs, small trees, and trees. Among them some of the plant's fruits are edible like *Ficus auriculata*, *Phyllanthus emblica*, *Syzygium cumini*, *Tamilnadia uliginosa*, *Bimbusa arundinaceae*, *Hemidesmus indicus*, *Centella asiatica*. Some of the plants identified in the sanctuary have been listed in the IUCN Red Data Book. According to IUCN Red Data Book, *Dalbergia latifolia* vulnerable, *Cinnamomum wightii*, *Hemidesmus indicus*, and *Tectona grandis* were reported endangered among 20 plants of this study. Information was collected from Forest Officers, local people, Vaidya, physicians, and literature about plants' scientific names, family, vernacular names, habits, species, parts used, pharmacological properties, and uses to cure various health-related problems. This study aims to emphasize the greatest importance of investigating those species of plants that have not been documented, although their popular uses have been reported.

**Keywords:** Medicinal plants, pharmacological, western ghats, vulnerable, endangered, vaidya, physician.

#### Introduction

Any plants that provide health-promoting characteristics, temporary relief, or curative properties are known as Medicinal plants. The history of medicinal plant use for treating diseases probably dates back to the beginning of human civilization. Medicinal plants are used by different nations to increase the immune system, relieve pain, and cure or provide relief from ailments. They serve as an important therapeutic agent and valuable raw material for manufacturing numerous traditional and modern medicines. In many developing countries, traditional medicine is still the backbone of health care. Even in developed countries, the raw materials for manufacturing essential drugs are extracted from medicinal plants, using their natural properties of healing. Increasingly, more people are turning to herbal remedies, especially for treating minor ailments<sup>[19]</sup>.

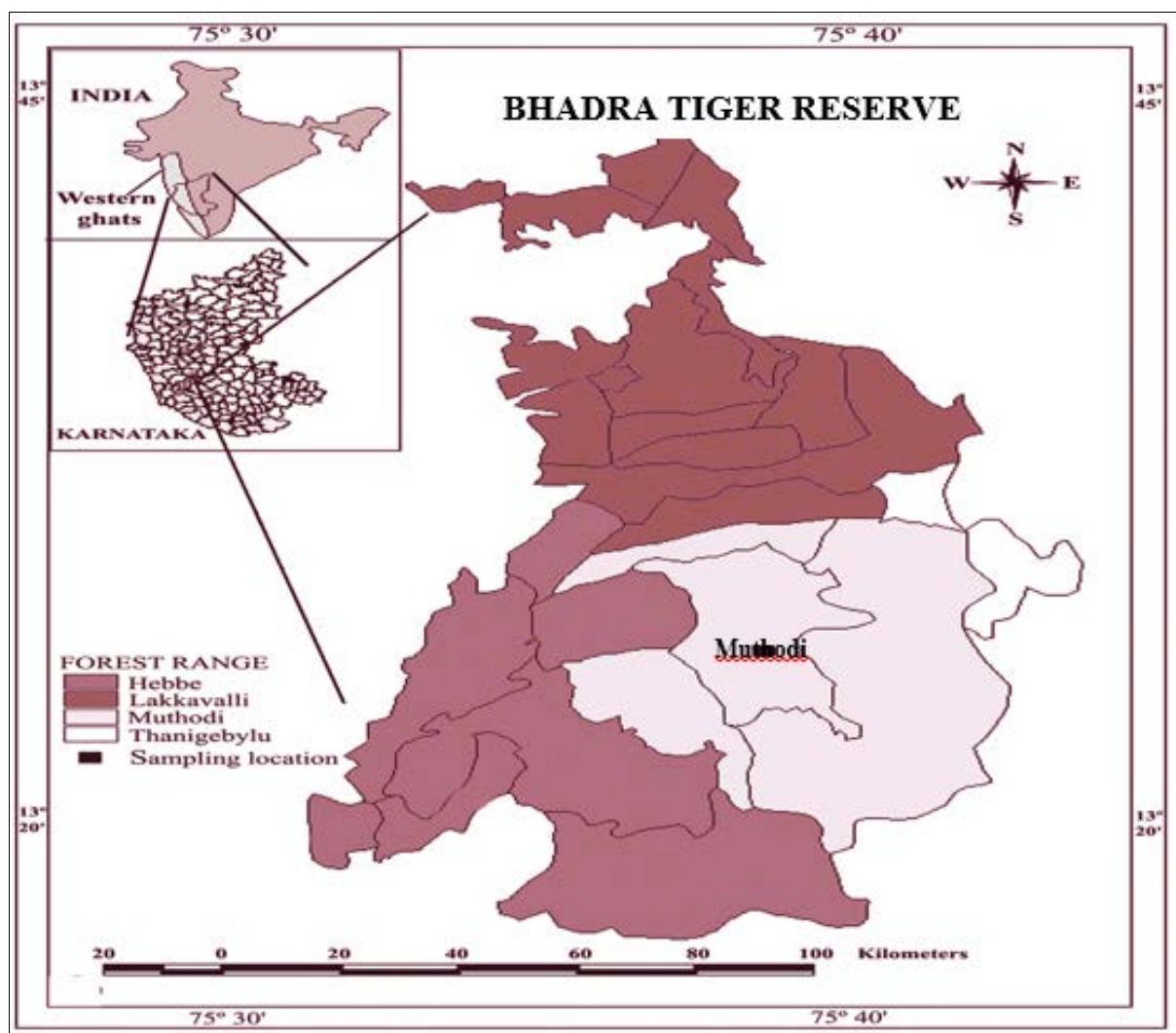
India has a rich heritage of using medicinal plants. The knowledge of medicinal plants has been accumulated for many centuries. The earliest documentation of 67 medicinal plants in Hindu culture is found in the "Rigveda," which is thought to have been written between 4,500 and 1,600 BC<sup>[10]</sup>. The collection and trade of medicinal plants in India is a historical fact<sup>[17]</sup>. The trade of non-timber forest products is mentioned in the 3,000-year-old Ramayan<sup>[4]</sup>. Similarly, the Vrikshayurveda provides excellent information about plants and their medicinal properties<sup>[16]</sup>. The Charak and the Sushrut Samhitas were written between 700-200 BC, and include accounts of the discovery of medicinal plants<sup>[11]</sup>.

The state of Karnataka boasts an unparalleled diversity of medicinal plants. Karnataka is estimated to be home to about 4800 species of flowering plants, of which about 2000 species are medicinal<sup>[18]</sup>. This is remarkable, as this number accounts for about 27% of the country's flora, with just 10% of the geographical area. Karnataka with its unique wild habitats spread across the Western Ghats and the Deccan Peninsula is also the home to several endemic species of commercial importance<sup>[15]</sup>.

Some of the studies related to ethnobotany and floristic diversity have been reported from Karnataka state [12, 13]. Medicinal plants have been an integral part of human healthcare for centuries, providing a rich source of bioactive compounds with therapeutic properties. The Western Ghats, one of the best biodiversity hotspots of the world, is home to a vast array of medicinal plants. Bhadra Tiger Reserve, Muthodi located in Chikkamagaluru district of Karnataka, India is a part of this biodiversity hotspot. Despite their importance, many medicinal plants remain undocumented, and their traditional uses are slowly disappearing. The sanctuary's rich flora, coupled with the local communities' traditional knowledge, presents an opportunity to document and evaluate the medicinal plants of the region. This research article aims to document the medicinal plants of Bhadra Tiger Reserve, explore their ethnobotanical significance, and evaluate their pharmacological potential. The study will contribute to the conservation of medicinal plants, promote sustainable use and provide a scientific basis for their traditional uses.

### Materials and Methods

The study was conducted in Bhadra Tiger Reserve (BTR), Muthodi located in Chikkamagaluru district of Karnataka. Bhadra Tiger Reserve is situated in the Malnad Region of Karnataka about 50km east of the Western Ghat Region, surrounded by parts of the Chikkamagaluru, Narasimharaja Pura, and Tarikere Taluks of Chikkamagaluru District and Bhadravathi Taluk of Shimoga District. The area comprises one of the best forests of the Western Ghats and its fringes. The sanctuary is important both due to its unique location and its biological diversity. The Sanctuary covering an area of 492.46 sq.km is situated between 13°25' to 13°50' Northern latitude and 75°15' to 75°50' Eastern longitude. Bhadra Tiger Reserve area is divided into mainly four division. They are the following: 1. Lakkavalli 2. Muthodi 3. Hebhe 4. Thanigebylu. Lakkavalli division is the first largest division of Bhadra Tiger Reserve and the second is the Muthodi division. Bhadra Tiger Reserve, Muthodi, Chikkamagaluru, (Fig.1) is the study area from the above four divisions.



**Fig 1:** Regions of Bhadra Tiger Reserve- study area Muthodi

The area was first declared as 'Jagara Valley Wildlife Sanctuary' in 1951 by the then government of its surroundings, the area was extended to its present extent and renamed to 'Bhadra Wildlife Sanctuary' in 1974 [1]. The Wildlife Sanctuary was declared as a 'Project Tiger Reserve' in 1998. Bhadra is the first tiger reserve in the country to complete a successful village relocation program. The original relocation plan was introduced in 1974 and was implemented

completely by 2002 when the 11 villages in the sanctuary were successfully relocated to M C Halli which is about 50 km (31 mi) from the Sanctuary [7]. There are no tribal communities in this area. Ethno-botanical was collected from the people of these communities who practice herbal medicine. A questionnaire was prepared based on the WHO format. The questionnaire consisted of information highlighting the social status, educational qualification,

occupation, expertise to cure diseases, plant product recommended as medicine, parts used, adjuvant in a recipe, mode of application, dosage and duration, precaution, and the local names of plants. The people in the study area who were aware of the knowledge about medicinal plants were also interviewed and information was documented.

The medicinal plants were identified, photographed, and collected for preparing the Herbarium. The information that is obtained from the survey was compared with already existing literature on ethnobotany. Medicinal Plants which are collected during the study area identified with the help of floras and other medicinal plant reference books. Therefore, the present study is proposed to document the area.

## Results and Discussion

The study on Medicinal Plants Diversity in BTR, Muthodi, revealed a rich diversity of medicinal plants in the region. A total of 20 species of 19 genera medicinal plants belonging to 15 families were documented. The most representative family was 4 Fabaceae species followed by 2 Rubiaceae, 2 Combretaceae, and the other families had 1 species each associated with treatment (Fig-3). Among them, some of the plant's fruits are edible like *Ficus auriculata*, *Phyllanthus emblica*, *Syzygium cumini*, *Tamilnadia uliginosa*, *Bimbusa arundinaceae*, *Hemidesmus indicus*, *Centella asiatica*. Communities living in and around forests in the sanctuary area had been practicing herbal medicine to cure diseases of local communities for a long time before the rehabilitation of villages in 2002. Many medicinal plants of the sanctuary are endemic to the Western Ghats. Some of the plants identified in the refuge have been listed in the IUCN Red Data Book (Table 2). According to the IUCN Red Data Book, *Dalbergia latifolia* vulnerable, *Cinnamomum wightii*, *Hemidesmus indicus*, and *Tectona grandis* were reported endangered among the 20 plants of this study. Herbal potential in India facilitated the rapid growth of phytopharmaceuticals, perfumery, and allied industries. Destructive harvesting has brought about the depletion and scarcity of medicinal plants. The habitat loss by the export of medicinal plants collected from wild sources finally leads to severe and irreplaceable loss of genetic stock of many of these species. For medicinal plants with limited abundance and slow growth, destructive harvesting generally results in resource exhaustion and even species extinction <sup>[2]</sup> <sup>[6]</sup>. Hence identified species were classified into different categories of red list (Table 2, 3).

Most of the medicinal plants were Trees (13), Shrubs (5) and Herbs (2) (Fig-2). Medicinal plants to alleviate ailments such as antiseptic, asthma, cold, fever, cough, diabetes, digestion, eye infection, headache, piles, jaundice, menstrual disorders, cancer, migraine, snake bite etc.,. Communities living around forests in the sanctuary area had been practicing herbal medicine to cure diseases of local communities for long time. In the present scenario, only a few herbal healers practice herbal medicine around the sanctuary, due to successful rehabilitation when Project Tiger was introduced in this sanctuary.

The herbal practitioner had regulation of knowledge of traditional medicine from his ancestors and was also a spiritual herbal healer. Quite often, the medicine men were reluctant to disclose the ethnobotanical information. Medicinal formations like powder, decoction, or infusion were prescribed for the treatment of various ailments along

with spiritual chanting. The majority of the herbal drug recipes were prescribed by medicine men as a single plant drug or in combination. Generally, fresh leaves, bark, fruit, flowers, seeds, and roots (Fig-4) were preferred and in the absence of fresh materials, dried ones were also prescribed.

The common ailments, Scientific and vernacular names of medicinal plants and their pharmacological properties, varieties of species, parts used, and their use are detailed in Table 1. The authenticity of reveals, therapeutical practices, and types of treatment were confirmed by discussion with residents and also referring to authentic literature.

When Bhadra Wildlife Sanctuary was declared a protected area in the year 1974. Under the Protected Area Act, local communities were forbidden from residing there. In 2002, residents living in the heart of the sanctuary were being rehabilitated to nearby urban areas. The rehabilitation implies that these people will be forced to live in the urban areas and they might depend on the popular allopathic medicine. This might result in the non-application of their local medicinal knowledge and deviation from their ethnic knowledge of medicine which they followed for generations. In this study, an attempt has been made to document the traditional medicinal knowledge of the local communities of BTR, Muthodi, which otherwise, would have been lost.

To preserve the medicinal plant diversity in Bhadra Tiger Reserve, conservation efforts should focus on sustainable harvesting practices and community engagement. This would ensure the long-term availability of medicinal plants and promote the well-being of local communities. Overall, the medicinal plant diversity in Bhadra Tiger Reserve is significant, and conservation efforts are necessary to protect this valuable resource.

Herbal medicine is not just a collection of plants, but a testament to the ancient wisdom of our ancestors, who recognized the intricate web of relationships between humans, plants, and the natural world. As we continue to explore the healing properties of plants, let us also honor the traditional knowledge and cultural heritage that has been passed down through generations, and strive to preserve the biodiversity that sustains us all.

The Bhadra Tiger Reserve in Muthodi is home to a diverse range of medicinal plants. While I couldn't find specific information on the reserve, studies on nearby areas provide valuable insights. A study on the Muthathi Wildlife Sanctuary, which shares similarities with Bhadra Tiger Reserve, documented a wide range of medicinal plants <sup>[20]</sup>. Similarly, research on the Yadahalli Chinkara Wildlife Sanctuary found 128 species of medicinal plants belonging to 57 genera <sup>[9]</sup>. A study on the Kalakad Mundanthurai Tiger Reserve found that over 350 species of ethnomedicinal plants were recorded, with 46 species being endemic. This emphasizes the importance of conserving medicinal plant diversity in protected areas like Bhadra Tiger Reserve.

To preserve the medicinal plant diversity in Bhadra Tiger Reserve, conservation efforts should focus on sustainable harvesting practices and community engagement. This would ensure the long-term availability of medicinal plants and promote the well-being of local communities. Overall, the medicinal plant diversity in Bhadra Tiger Reserve is significant, and conservation efforts are necessary to protect this valuable resource.

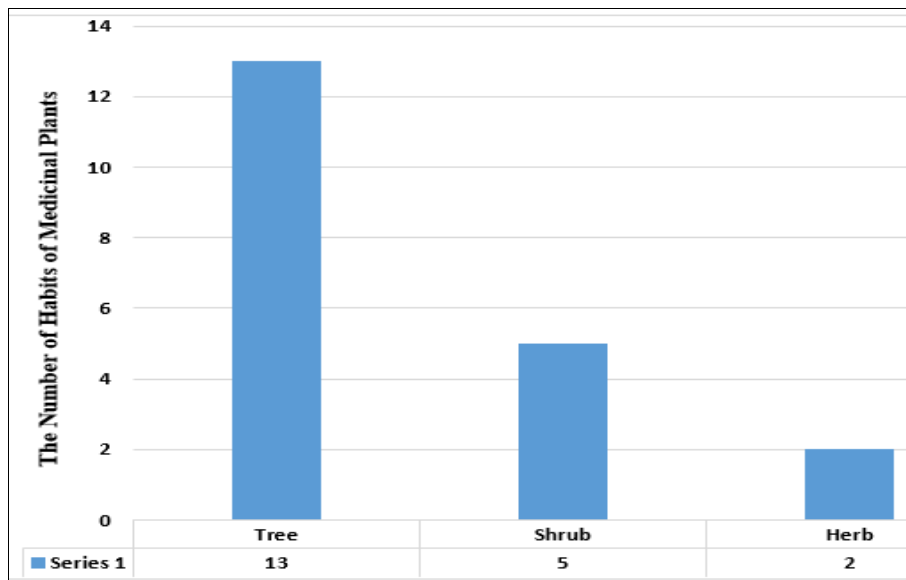


Fig 1: Habits of Medicinal Plants

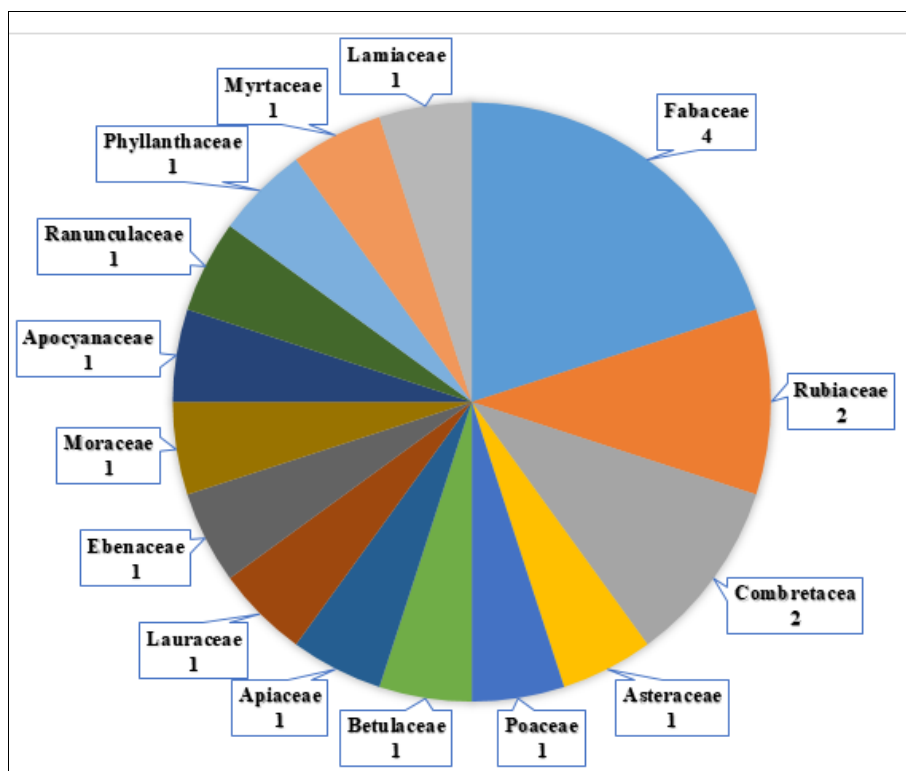


Fig 3: Plant Family in Number

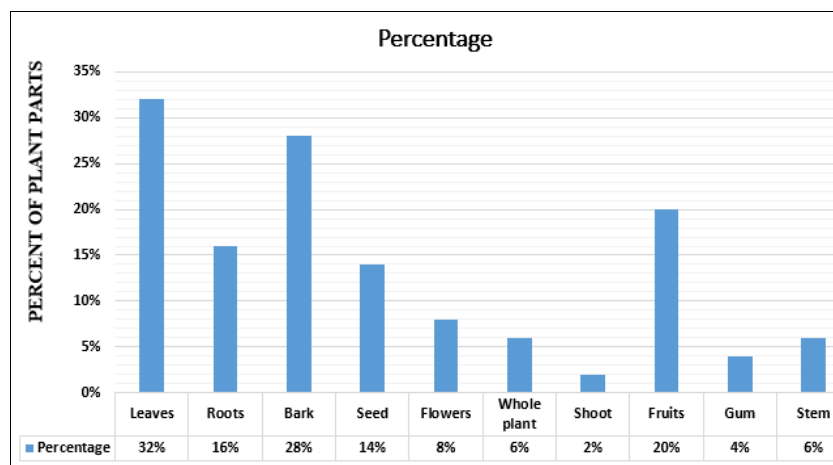


Fig 4: Percent of Plants parts used for Ethno-medicine Preparation



**Table 1:** Medicinal Plants in Bhadra Tiger Reserve, Muthodi, Chikkamagalur.

Sl. NO.	Botanical Name	Family	Habit	Vernacular/ Kannada Name	Part Used	Medicinal Uses
1	<i>Acmella oleracea</i> (L.)	Asteraceae	Herb	Toothache plant/Hemmugalu	Flower, root, leaf	To chew the roots, the leaves, and the flower heads for tooth ache, the decoctions of leaves and flowers are remedies for constipation, toothache, or stomatitis.
2	<i>Bambusa arundinacea</i> (Retz.) Wild.	Poaceae	Tree	Bamboo Bidiru	Seed, leaves, shoot, root and bark	The decoction of bark is used for 2-3 times a day for psoriasis and skin disorders and root burnt and ground into a paste apply for ringworm and bleeding gum.
3	<i>Betula fruticosa</i>	Betulaceae	Shrub	Dwarf dog birch/ Kubja birch	Bark, leaves	Decoction of the bark is given to the patient in the day to cure the jaundice for 10 to 12 days, decoction of the leaves given to heal pain.
4	<i>Butea monosperma</i> (Lam.)	Fabaceae	Tree	Palash tree / Muttugada mara	Bark, leaves, flowers and seed	Leaves fried with ghee and intake with yoghurt cream to cure piles, seed powder mixed with ghee and applying for the knee to heal arthritis pain and seed powder mixed with lemon extract and applied for skin allergy.
5	<i>Centella asiatica</i> L.	Apiaceae	Herb	Indian Pennywort/ Brahmi/ Vondelaga	Whole plant and leaves	Take 2-3 raw leaves and chew it to boost memory power, make a paste of whole plant and add grinded jaggery, cardamom powder, dates, almonds and boiled, after cooling store in air tight container to use as lehya.
6	<i>Cassia fistula</i> L.	Fabaceae	Tree	Indian laburnum/ Kakkemara	Root, bark, leaves, seed and fruit	Root kashaya for fever, grinding root and applying paste for the skin diseases, soak the gum or mucilage of the fruit with coriander seeds overnight and drink in empty stomach in the morning to get rid of acidity and constipation and bark paste apply for the leprosy and skin diseases.
7	<i>Catunaregam spinosa</i> (Thung.) Tirveng	Rubiaceae	Small tree or shrub	False guava / Kaarekaai gida	Leaves, fruits, bark, seeds and flowers	Taken in a paste of stem bark to prevent growth of cancer, fruit juice for ulcer, paste of leaves applied for the skin diseases. Taken in the form juice and paste.
8	<i>Cinnamomum wightii</i> Meisn.	Lauraceae	Tree	Jungle cinnamon / Kaadu dachinni	Bark and leaves	The powder of the bark used as tooth powder, powder of the bark is mixed with honey in a dose of 3-5g for cough and asthma, the paste of the bark applied over the affected area to cure swelling and pain, bark powder, patra, blackpepper, cardamom should be inhaled for running nose.
9	<i>Dalbergia latifolia</i> Roxb.	Fabaceae	Tree	Indian rosewood / Beete mara	Bark and leaves	Seed oil is used in the treatment of blue itching, burning on the skin, and scabies, powdered bark and leaf decoction used to treat gonorrhoea, Leprosy can be treat by bark decoction and Leaf juice are used in eye ailment
10	<i>Diospyros Montana</i> Roxb.	Ebenaceae	Tree	Bombay ebony / Jagalaganti mara	Leaves, fruit, bark and stem	Bark decoction used for cancer and gastric, chew raw leaf for mouth cancer
11	<i>Ficus auriculata</i> Lour.	Moraceae	Tree	Roxborough fig / Anjoora mara	Leaves, roots, bark and fruits	Leaves crushed and the paste is applied to the wounds, stem bark juice is effective for cuts, wounds and diarrhoea., Roasted figs are taken for diarrhoea and dysentery. Latex of roots is used in diarrhea, cholera mumps and vomiting. Mixture of root powder of <i>Ficus auriculata</i> and bark of <i>Oroxylum indicum</i> is taken in jaundice, the paste of leaves is applied on the wounds for curing.
12	<i>Hemidesmus indicus</i> L.	Apocyanaceae	Shrub	Indians arsaparilla/ Sogadeberu	Root	Two spoon of <i>Hemidesmus indicus</i> powder add into a glass of water and bring it boil, then allow it for cool and drink in the morning for empty stomach to get rid of hyperacidity, heat reduction stomach pain, blood purifier, appetite stimulator. It used as Kashaya.
13	<i>Mimosa pudica</i> L.	Fabaceae	Shrub	Touch-me-not plant / Muttidare muni	Root, leaf and whole plant	Whole plant paste is applied on the forehead to provide relief from migraine due to its pitta balancing, Crush leaves, prepare juice and use this 15 ml twice a day for high blood pressure, decoction made from roots used in bleeding piles and grind the leaves and stem of this plant on affected area twice a day for insect bite.
14	<i>Naravelia zeylanicz</i>	Ranunculaceae	Shrub	Neendamalli/ Dhanavalli	Root, stem, leaves and	The leaves when crushed give a pungent odour which is inhaled through nostrils to cure cold, all type of headaches including migraine, the leaf and stem juices or root and stem paste applying for treating psoriasis and dermatitis, chew the

						raw stem for tooth-ache, for treating wounds and worm infections, whole plant paste is applied externally on affected part for 2-3 days, for rhinitis, the stem is dried, powdered tied in a clean cloth and the aroma from the cloth bag is gently inhaled, for treating rheumatism leaves are boiled in water and used for bathing.
15	<i>Phyllanthus emblica</i> Linn..	Phyllanthaceae	Tree	Hill gooseberry / Bettada nellikaai	Fruits	Decoction of Triphala Churna powder, a teaspoon of Phyllanthus emblica juice or powder can be added to a glass of warm milk and if we drink this thrice a day will clear an unpleasant throat, adding some ghee to this decoction can clear cough. Phyllanthus emblica powder can be mixed with honey and if we intake this mixture twice a day can cure chronic dry cough, juice are a good supplement which can improve near-sightedness, cataract and glaucoma, the dried fruits can be boiled in coconut oil and then ground to form an oil. This is a very effective conditioner and can prevent balding and greying of hair. For oily hair, need to mix half a cup of amla juice,
16	<i>Syzygium cumini</i> (L.) Skeels.	Myrtaceae	Tree	Java plum wild   Kaadu nerale	Seed, leaves, bark and fruit	Powdered seeds are mixed with sugar are given orally 2-3 times daily in the treatment of dysentery, decoction of stem bark is taken orally three times a day for 2-3 weeks to treat diabetes, two teaspoon of juice extracted from the leaf is mixed with honey or cow's milk and taken orally taken twice a day after food for 3 months to treat diabetes, fresh fruits are also taken orally to get relief from stomachache and to treat diabetes, the juice obtained from the stem bark is mixed with butter milk and taken orally every day before going to bed to treat constipation, the tender leaves are taken orally to treat jaundice.
17	<i>Tamilnadia uliginosa</i> (Retz.)	Rubiaceae	Tree	Gray emetic nut/ Kare mara	Fruit, root and bark	Fruit is boiled and cooked into vegetables, the stem bark of Pendhra is sometimes used for bone fractures - ground with a white layer of desi egg, turmeric and calcium.
18	<i>Tectona grandis</i> (Linn.)	Lamiaceae	Tree	Teak wood \ Tegada, ara	bark, fruits, flowers and leaves	Teak leaf tree to reduce weight, extract oil from leaves and apply for hair growth, apply leaf paste on the affected area of wound, leaf decoction for constipation.
19	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	Tree	Bedda nut tree / Taare mara	Fruits, kernel and bark	Decoction of the green fruit is used for cough, fruit powder mix with warm water and paste applied for the skin diseases, equal amount of bark and kernel add into two glasses of water and decoction to cure cough, respiratory problems.
20	<i>Terminalia elliptica</i> Wild.	Combretaceae	Tree	Indian laurel / Karimatti	Bark, leaves, root and stem	Bark powder is helpful in vertigo and piles, Bark decoction is used for the treatment of rheumatism, diabetes, fever and urinary diseases, Leaf powder is effective in fast healing of cuts and wounds, Tender leaves are effective in migraine

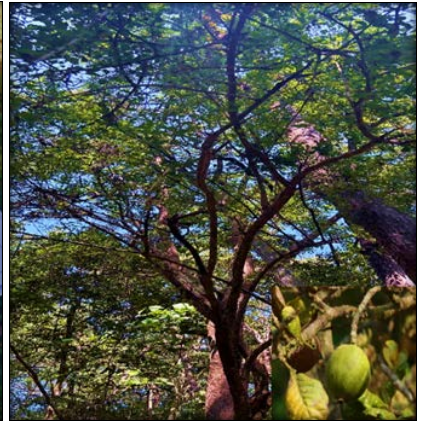
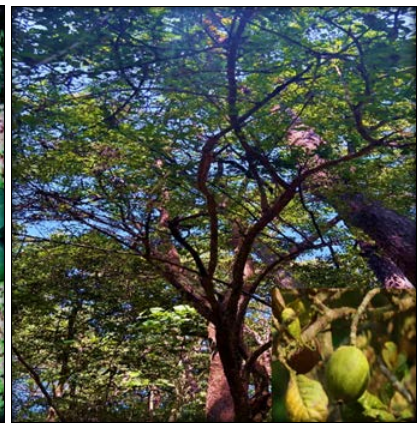
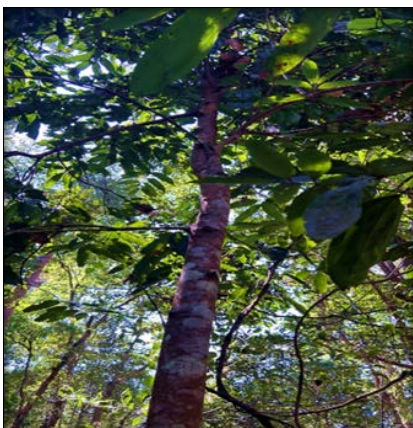
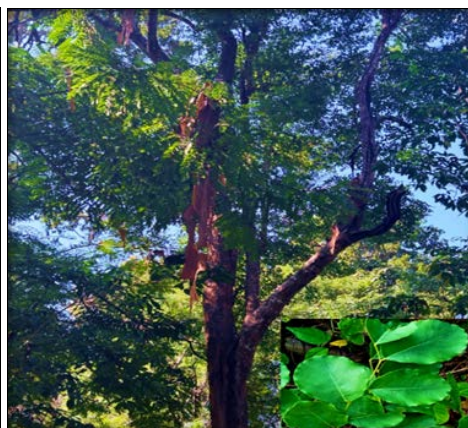
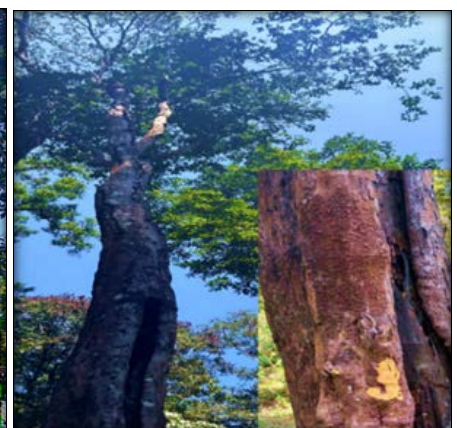
**Table 2:** The IUCN Status of Medicinal Plants of Bhadra Tiger Reserve, Muthodi

Botanical Name	Red List Category
<i>Acmella oleracea</i> (L.)	NE
<i>Bambusa arundinacea</i> (Retz.) Wild.	NE
<i>Betula fruticosa</i>	LC
<i>Butea monosperma</i> (Lam.)	LC
<i>Centella asiatica</i> L.	LC
<i>Cassia fistula</i> L.	LC
<i>Catunaregam spinosa</i> (Thunb.) Tirveng	LC
<i>Cinnamomum wightii</i> Meisn.	EN
<i>Dalbergia latifolia</i> Roxb.	VU
<i>Diospyros 68ontana</i> Roxb.	LC
<i>Ficus auriculata</i> Lour.	LC
<i>Hemidesmus indicus</i> L.	EN
<i>Mimosa pudica</i> L.	LC
<i>Naravelia zeylanica</i> DC	NE
<i>Phyllanthus emblica</i> Linn.	LC
<i>Syzygium cumini</i> (L.) Skeels	LC
<i>Tamilnadia uliginosa</i> (Retz.)	LC
<i>Tectona grandis</i> Linn.	EN
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	LC
<i>Terminalia elliptica</i> Wild.	LC



**Table 3:** Total number of species encountered in Bhadra Tiger Reserve, Muthodi

Total Encountered	Number of Plants
LC - Least Concern	13
VU - Vulnerable	01
EN - Endangered	03
NE - Not Evaluated	03
Total	20

*Acmella oleracea (L.)**Betula fruticosa B**utea monosperma (Lam.)**Centella asiatica L.**Cassia fistula L.**Catunaregam spinosa (Thunb.) Tirveng**Cinnamomum wightii Meisn.**Dalbergia latifolia Roxb.**Diospyros montana Roxb.*





*Ficus auriculata* Lour.



*Hemidesmus indicus* L.



*Mimosa pudica* L.



*Naravelia zeylanica*



*Phyllanthus emblica* L.



*Syzygium cumini* (L.) Skeels



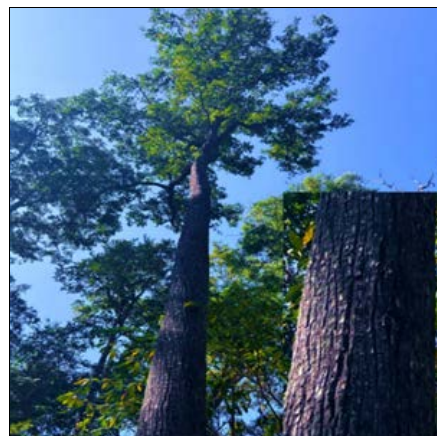
*Tamilnadia uliginosa* (Retz.)



*Tectona grandis* Linn.



*Terminalia bellirica* (Gaertn.) Roxb.



*Terminalia elliptica* Wild.



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