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FROM FOREST GUARDIAN TO FOLK MEDICINE: A REVIEW OF DIOSPYROS MELANOXYLON'S ECOLOGICAL AND ETHNOMEDICINAL SIGNIFICANCE

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ABSTRACT Tendu, tetul (in Bengali) or Kend is the common Indian trees in Diospyros melanoxylon aludoa. The present review presents an uptodate perspective of its unique characteristics, brief information on various ethnobotanical uses around the world and pharmacological properties in addition to conservation status. The cynometra is prized in the woodworking industry for its black heartwood, as well as their tough timber and used extensively to make traditional Indian bidis with some using biodiesel production fuel. Parts of the tree are used medicinally to treat a range of disorders. Diospyros melanoxylon: This tree plays a key role in supporting biodiversity and soil health of tropical forests. Due to overexploitation and deforestation, conservatory efforts are urgently needed.

KEYWORDS : Diospyros melanoxylon, tendu, Indian ebony, ethnobotanical uses, pharmacological properties, conservation, sustainable management, biodiversity, traditional medicine

INTRODUCTION:

Diospyros melanoxylon, the popularly known as tendu or Indian ebony, is an important tree species of family Ebenaceae. This tree is the bread and butter of a host of indigenous peoples in the Indian subcontinent, as well as certain parts of Southeast Asia. The blackwood is the dark, dense heartwood of then tall hardwood which extremely valuable commercially for its hardness and beauty. It is also important in Indian traditional culture, because of its leaves which are used with betel (areca) nuts for making bidis.

Botanically, Diospyros melanoxylon is a tree with potential to 25 meters and a trunk up to in diameter at breast height. Even pruning does neither harm nor damage to the tree it just adds beauty. Leaves are simple, alternate and elliptic to long obovate coriaceous. It usually blooms in late FebruaryApril producing small, relatively inconspicuous flowers that mature into globose fruits filled with seeds.

This tree beyond its economic and cultural value, plays a key role in the ecology of tropical and subtropical forest ecosystems. It is rich in biodiversity serving as a home and food source to different forms of wildlife. The tree also enhances soil health and nutrient cycling, which collectively results in increased resilience of forest environments.

Although these species have both ecological and economic value, Diospyros melanoxylon is heavily exploited for wood products and faces significant conservation threats. Because it has a high value as timber and for other commercial uses A. sinensis is at risk of overexploitation Habitat loss and fragmentation represents the greatest threat to their populations in all native range countries.

In this review, we have attempted to integrate and consolidate the present information available on Diospyros melanoxylon. It is a review of its botanical features, ethnobotanical roles, pharmacological attributes toxic levels and conservation standing. This review attempts to integrate such literature and perspectives that emphasize the necessity of sustainable management practices as well as conservation strategies for promoting stability in populations of Diospyros melanoxylon at these varied natural habitats.

Botanical Description and Distribution:

Diospyros melanoxylon, commonly known as tendu or Indian ebony, is a medium to large deciduous tree belonging to the family Ebenaceae. It is characterized by several distinctive botanical features that contribute to its significance and utility.

Morphological Characteristics:

Size and Growth: Diospyros melanoxylon typically grows to heights ranging from 15 to 25 meters, occasionally reaching up to 30 meters. It has a straight trunk with a diameter that can reach 1 meter or more.

Bark: The bark of the tree is smooth and dark brown to black in color, often becoming deeply fissured with age.

Leaves: The leaves are simple, alternate, and elliptical to ovateoblong in shape, with a leathery texture. They are typically 715 cm long and 37 cm wide, with entire margins and acute to acuminate tips.

Flowers: Diospyros melanoxylon produces small, greenishyellow flowers that are either solitary or in clusters. The flowers are bellshaped with four lobes and are inconspicuous but important for the tree's reproductive cycle.

Fruits: The fruit is a berrylike drupe, spherical in shape, and approximately 12.5 cm in diameter. It initially appears green and turns yellow when ripe. Each fruit typically contains 13 seeds.

Wood: The heartwood of Diospyros melanoxylon is dark brown to black, hence the common name "Indian ebony" or "blackwood." It is exceptionally dense and durable, making it highly prized for its use in fine furniture, musical instruments, and decorative items.

Distribution:

Diospyros melanoxylon is originally from the Indian subcontinent, mainly comes throughout tropical and subtropical India that includes Nepal to Myanmar. It also can be found in some parts of other Southeast Asia countries like Thailand. In India this species is distributed in a number of states including Madhya Pradesh, Maharashtra, Chhattisgarh Odisha and Karnataka.

It is commonly found in deciduous forests, dry evergreen or mixed decdious type of forest habitat and it grows best on welldrained soils with warm climate. It is frequently associated with other native tree species like Teak (Tectona grandis), Sal, and Mahua.

Habitat Diospyros melanoxylon serves ecological functions in the landscape: it rescues as well as provides shelter and food for a large number of wildlife species; along with improving nutrient cycling, energy flow, soil sustainability within its native surroundings. Nevertheless, as a result of its prized

timber and other anthropogenic threats this species is in conservation need and good management practices to ensure the continued survival.

Ethnobotanical Uses of Diospyros melanoxylon:

Diospyros melanoxylon, commonly known as tendu or Indian ebony, has been extensively utilized in various traditional and cultural practices across its native range in the Indian subcontinent and Southeast Asia. The tree offers a wide array of ethnobotanical uses, ranging from medicinal applications to cultural and commercial uses.

1. Medicinal Uses:

The different parts of Diospyros melanoxylon have long been employed in traditional medicine systems for their therapeutic properties. Here are some common medicinal uses:

Bark: The bark contains tannin and is dried and used in throat and tonsil irritation and sore throat. It has been also employed for management of diarrhoea, dysentery and other conditions affecting the gastrointestinal tract. Bark extract also has antimicrobial properties and the crushed mixture is used to treat wound infected by bacteria or any sort of skin infection.

Leaves: Stem bark of Diospyros melanoxylon has been employed in the treatment of chest complaints, fever and other respiratory diseases. There is also the knowledge of antiinflammatory effects of sorghum grains and they are also applied in poultice to manage swellings and inflammations.

Fruits: The fruits are consumed locally and are believed to have cooling properties, often used to alleviate thirst and as a mild laxative.

2. Commercial Uses:

Timber: The harvesting and use of Diospyros melanoxylon is considered due to its valuable characteristic such as high density, durability and black heartwood. It is employed in the manufacture of fine furniture, musical instruments like sitar, carving and ornamental work.

Bidis: Perhaps one of the greatest values of Diospyros melanoxylon in commerce is in the production of bidis, which are India's traditional cigarettes. The leaves are dried and Used with tobacco and rolled up to make bidis which are popular among some community of India.

3. Cultural Significance:

Rituals and Crafts: Diospyros melanoxylon also has some cultural importance aside the economic importance it has been mentioned. It is used in the carving of religious charovers, idols, and any other articles used in temples. The tree itself is considered sacred in some community and is involved in their religious practices and events.

4. Other Uses:

Fuel: The wood and fallen leaves of Diospyros melanoxylon functionary as the fuelwood in those rural areas where it grows in plenty.

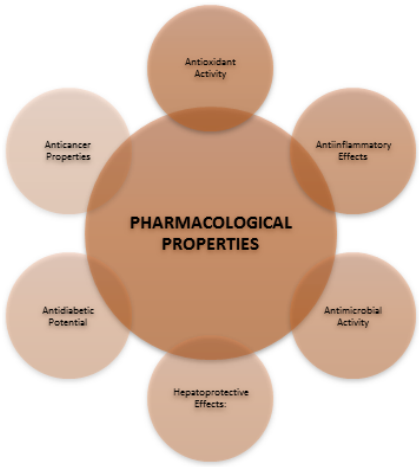
Soil Improvement: It has great Significance to the soil fertility since the leaves and organic matters from Diospyros melanoxylon are used in traditional agriculture.

Conservation Considerations:

Diospyros melanoxylon is widely used in diversified domains, however, the utilization of this species is threatened by current conservation factors such as habitat destruction, overexploitation for timber, and improper logging. There is therefore need to encourage the sustainable utilization, conserve on genetic stock and ensure the species favorable existence in its habitual range.

Pharmacological Properties of Diospyros melanoxylon:

Diospyros melanoxylon, locally known as tendu or Indian ebony has been found to exhibit many pharmacological actions and these have been recorded in different research publications. These characteristics are several of the grounds for its use in the conventional medicine and maybe other modern usages. Here, we explore the pharmacological aspects of various parts of the plant: Here, we explore the pharmacological aspects of various parts of the plant:



1. Antioxidant Activity:

Some of the studies on Diospyros melanoxylon have proven that extracts from this plant contains strong antioxidants activity. It is well known that antioxidants minimize the damage done by free radicals in cells, which are associated with many chronic diseases and the aging mechanism.

2. Antiinflammatory Effects:

An aqueous and ethanol/methanol extracts of the bark and leaves of Diospyros melanoxylon possess antiinflammatory activity. These properties are helpful in the treatment of inflammation that is caused by arthritis, skin inflammations, and gastrointestinal complications.

3. Antimicrobial Activity:

Lesser known and used part used: Diospyros melanoxylon extracts have demonstrated the presence of antimicrobial properties against the bacteria and fungi. For these reasons it is used in traditional medicine in the treatment of infections and for promotion of wound healing.

4. Hepatoprotective Effects:

This is documentation was gotten from research work that pointed to the effect of Diospyros melanoxylon extracts having the ability to prevent the liver from being damaged by toxins or disease. The protective effect of SP on the liver is considered to be due to the bio active constituents of the plant.

5. Antidiabetic Potential:

Studious show that Diospyros melanoxylon has the potential of reducing the high incidences of diabetes by controlling the blood glucose levels. This potential is of interest for developing natural therapies in the management of diabetes.

6. Anticancer Properties:

The enclosed manuscript is the first to systematically investigate the anticancer activities of Diospyros melanoxylon extracts. Some of the bioactive compounds in the plant might be cytotoxic to cancerous cells but additional study is called for in order to determine the viability of the plant for this application.

Mechanisms of Action:

The pharmacological activities of Diospyros melanoxylon are

attributed to its rich phytochemical composition, including flavonoids, tannins, phenolic compounds, and other secondary metabolites. These compounds interact with biological systems to exert therapeutic effects such as antioxidant, antiinflammatory, antimicrobial, and hepatoprotective actions.

Implications for Modern Medicine:
The pharmacological properties of Diospyros melanoxylon underscore its potential as a source of natural medicines and therapeutic agents. Research into its bioactive compounds and mechanisms of action could lead to the development of new pharmaceuticals or complementary treatments for various health conditions.

Ecological Significance and Conservation Status of Diospyros melanoxylon:
The plant Diospyros melanoxylon locally known as tendu or Indian ebony is an important species in the tropical and subtropical forest of the countries of its origin, including India and South Asia and some parts of southeastern Asia. Its ecological importance encompasses several key aspects: Its ecological importance encompasses several key aspects:

1. Biodiversity Support:
Diospyros melanoxylon is a native and a large tree species, which supports otherwise diverse fauna which includes birds, mammals, insects and fungi. The very existence of the tree in forest ecosystems helps in the promotion of species diversities which in essence improves the stability of the ecosystems.

2. Soil Health and Nutrient Cycling:Soil Health and Nutrient Cycling:
Therefore, the decomposition of the leaf litter and organic matter of Diospyros melanoxylon enhance nutrient cycling and soil fertility. The decay of the foliage helps in the addition of nutrients to the soil and hence the support of other vegetation growth thus contributing to the productivity of the ecosystem.

3. Carbon Sequestration:
Like other trees in the tropical forests, Diospyros melanoxylon is also involved in the carbon storage capability through the process of photosynthesis wherein the tree fixes CO2 from the atmosphere and stores the carbon in its biomass. This assists in avoiding climatic change since the levels of greenhouse gases shall have reduced.

Conservation Status and Threats:
Diospyros melanoxylon faces various threats that impact its conservation status:

1. Habitat Loss and Fragmentation:
This arise from habit loss through activities such as deforestation, land conversion to agriculture, urbanization and infrastructural development. Clearing and fragmentation of the area minimize bearing grounds of the species besides eradicating essential organic structures.

2. Overexploitation for Timber:
The Diospyros melanoxylon heartwood is extremely compact and hard, making it a popular choice in the timber market for purposes of furniture, carving and music instruments. Natural populations of the species have been depleted by unsustainable logging practices and through making them available in the market for commercial utilization.

3. Fire Incidents:
Catastrophic events such as fire which may be either natural or anthropogenic are a threat to Diospyros melanoxylon and its populations. Fire can girdle individual trees, prevent regeneration, and change ecosystem processes, all of which ramp up the species' precarious existence.

Conservation Efforts:
Efforts to conserve Diospyros melanoxylon and its habitats include:

Protected Areas: Creating new and widen protected area, national park, and wildlife corridors in which Diospyros melanoxylon is present and conserve its ecosystems as well as species.

Sustainable Management Practices: C) Encouraging responsible logging and proper forestry use for its revenue besides other uses that do not compromise with the conservation objectives. This encompasses the management of the timber production, the encouragement of afforestation and involving the locals in the conservation of the natural resources.

Awareness and Education: Thus, increasing the public awareness of Diospyros melanoxylon's ecological value and promoting its conservation to the policymakers, residents of the affected areas and the public.

Research and Monitoring: To conserve the species one requires to undertake scientific research to improve the existing knowledge on the species' ecology, population status and genetic stock. Evaluation of populations for the determination of their conservation status, and to determine where conservation effort is most needed.

Future Directions for Research and Conservation of Diospyros melanoxylon:
When planning for the future, a number of points should be of interest to improve the knowledge of Diospyros melanoxylon, to preserve it as well as to use it sustainably. Future research and conservation efforts should focus on the following aspects: Future research and conservation efforts should focus on the following aspects:

1. Genetic Diversity and Population Dynamics: Genetic Diversity and Population Dynamics: Complement this by undertaking detailed genetic analysis in order to understand the genitic variability of Diospyros melanoxylon in its geographical distribution. it is important in humandriven conservation management strategies and breeding for improved durability to shocks and changes.

2. Ecological Interactions and Ecosystem Services: Ecological Interactions and Ecosystem Services:
Study its role in maintaining the structure and function of forest ecosystems, in supporting other species, nutrients cycling, and carbon stocks. This assessment aimed at establishing quantities of the ecosystem services which will depict the ecological role of Diospyros melanoxylon.

3. Pharmacological Potential and Biomedical Applications: Pharmacological Potential and Biomedical Applications:
To examine the type of active compounds contain in Diospyros melanoxylon and the pharmaceutical uses of the bioactive. More studies about its pharmacological uses involving antioxidative, antiinflammatory, as well as antimicrobial effects, can make it possible to discover new medication.

4. Sustainable Management Practices:
Sensitise and encourage proper techniques for growing and cutting D. melanoxylon. This consists of the management of appropriate timber removal, encouraging policies on intercropping of Diospyros melanoxylon with other crops and community conservation.

5. Climate Change Resilience:

Determine whether Diospyros melanoxylon populations are susceptible to climate change factors such as rising temperatures and altered precipitation regimes, pest and disease pressure and burning. Stake out measures that will increase ability of the species to survive under new conditions as the environment changes.

6. Conservation Strategies and Policy Development: Conservation Strategies and Policy Development:

Enhance protection measures of Diospyros melanoxylon through enlarging the extent of protected lands, setting up connectivity for gene flow, and integrating conservation of biological diversity into the spatial planning and management of land and forests'. Campaign for laws that are friendly to the Congos use and conservation of the species.

7. Community Engagement and Socioeconomic Aspects: Community Engagement and Socioeconomic Aspects:

Identify and develop conservation programs that incorporate the concerns and concepts of indigenous populations of the regions through development of social relationships. Diospyros melanoxylon should therefore be managed to support sustainable livelihood activities that depend on this tree for their subsistence needs such as ecotourism, and harvesting of NTFPs as well as value addition of this trees resources.

8. Monitoring and Assessment:

The following strategies need to be adopted for Diospyros melanoxylon : Long term monitoring programs to monitor the population status and habitat conditions and changes as well as to evaluate the efficacy of conservation measures. Utilize set procedures and instrumentations, and spatial and orbital data and tools in collecting and measuring data.

CONCLUSION

In brief, Diospyros melanoxylon or tendu is characterized by its intricate ecological importance and rich cultural heritage as well as being a sustainable resource of forestry. In this review, the different facets of a multipurpose tree species Acacia nilotica have been brought out through its botanical characteristics, ethnobotanical uses and pharmacological attributes along with ecological importance.

Botanically, Diospyros melanoxylon is notable for its size and black heartwood that is hard to work; the wood of this species has been a mainstay in indigenous craftspeople as well as industrialists. It is ethno botanically significant in its native regions and has historical importance as well, for instance The ancient stem of the Nictates arbour tristis are using to make cigarettebrands locally known as "Bidis" which can serves tobacco cravings.

Various pharmacological investigations to the plant Diospyros melanoxylon has shown potent antioxidant, antiinflammatory and antimicrobial activity as well perhaps maybe even anticancer properties indicating a potential utilisation of pharmaceutical product development in health applications.

Globally, from an ecological perspective, it aids tropical and subtropical ecosystems in one or more of the following ways: supporting biodiversity (through high quality food source), promoting soil health by fixing nitrogen (a long term increase in fertility) 7 as well as carbon sequestration.

The species, however is under pressure from habitat loss (spurred by conservation agriculture), poaching for wood and other humancaused hardships. It is urgently required to manage Diospyros melanoxylon for sustainable extractive use particularly forms an integral part of culture among indigenous communities throughout the country.

Genetic research, ecosystem studies, Gene bank and breeding planning Climate resilience assessments community collaborations And future efforts Other crucial factors include: There is a need to combine scientific knowledge with traditional wisdom and to create synergistic partnerships among the major stakeholders in devising an effective strategy for conservation of Diospyros melanoxylon simultaneous promotion of sustainable development, which will deliver tangible benefits on local communities.

Ultimately, conserving Diospyros melanoxylon is about saving biodiversity but also acknowledging its inherent cultural and human importance. Adopting these principles can allow us to protect this precious species and make it available for ages to come, so that all of the contribution in our world remain without end.

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