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Review Article: A Study Of *Careya Arborea* Activities And Their Industrial Applications For Sustainable Economical Growth

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Abstract: Since the beginning of human history, plants have been used to diagnose, cure, and prevent a wide range of illnesses. One of the most commonly used species is *Careya arborea*, which belongs to the Lecythidaceae family. This tree is distinguished by its huge, eye-catching blooms, thick, dark grey bark, and scarlet winter foliage. The majority of plant parts employed in traditional medical systems are a result of the plant's high medicinal value. Antimicrobial, anticancer, antimicrobial, antioxidant, and antidiarrheal properties have all been employed. The chemical components that make up the plant determine its pharmacological activity. Because natural dyes are easily biodegradable and environmentally friendly, they can be disposed of without causing any problems. As a result, they are widely used in the textile industry to create surfaces that are antibacterial, deodorant, and insect repellent. One such tree species is *Careya arborea*, which is known to contain important biological activity in its many portions that are necessary for textile dyeing in addition to its capacity to produce dye. Because natural dyes are easily biodegradable and environmentally friendly, they can be disposed of without causing any problems. As a result, they are widely used in the textile industry to create surfaces that are antibacterial, deodorant, and insect-repellent. One such tree species is *Careya arborea*, which is known to contain important biological activity in its many portions that are necessary for textile dyeing in addition to its capacity to produce dye.

Index Terms - Pharmacology, textile dye, bark, secondary metabolite, fibers and inhibition.

I. INTRODUCTION

A species of tree belonging to the Lecythidaceae family, *Careya arborea* is found in the Chhattisgarh region of India [1] and in several genera in other countries, including Afghanistan, Indochina, Africa, and Asia. Common names for it include Patana oak, slow match tree, Pilu, wild guava, Kumbhi, Kumbha, Kampi, Khum, Kumari, Kumrega, Pani-bhela, Panibhela, Kum Kumari, Kumbi. Alasoo, Pezhu, and Aalam. [2] This plant belongs to the kingdom Plantae, which is divided into the Ericales order and the angiospermae. The

genus *Careya* has arborea species, and the family is Lectthidaceae. It is a medium-sized deciduous tree with thin, exfoliating bark strips and a dark grey color. There are 450 species and more than 20 genera known. This plant's stem bark can treat a variety of ailments, including bronchitis, skin conditions, epileptic episodes, ear ache, diarrhea, bloody stools, and tumors. [3–5] *Careya arborea* is classified as follows: Kingdom: Plantae; Clade: Angiosperms; Order: Ericales; Family: Lecythidaceae; Genus: Careya; Species: *Careya arborea*.

The cork cambium is one to two discontinuous layers thick, the outermost cork in the stem is three to four layers thick, and the cortex is collencymatous with cortical vascular groups scattered throughout. Cortical vascular groups of different sizes and shapes are surrounded and dispersed by a sclerenchymatous bundle sheath. The arrangement of vascular bundles is amphicrival. The endodermis is noticeable, pericyclic is seen in sclerenchyma patches, and most cortical cells are hollow. In addition to four to five layers of vascular cambium, phloem is composed of concentric groupings of phloem components, including companion cells, sieve channels, and phloem parenchyma. The stem bark of *Careya arborea* frequently contains cork cells, parenchymatous cells, secondary phloem components, and remnants of cortical tissue. [6] April to May is when the tree blooms. Fruiting: June through July is when the fruit ripens. Seed propagation is how the tree reproduces. As soon as the rain starts, seeds start to spread. [7] This plant contains a natural dye that is included in its bark and is also used as a natural dye in the textile industry.

Fig. 1. *Careya arborea* plant body with fruits parts

II. Pharmacological Studies of *Careya arborea*:

a. Anti-inflammatory activity:

Careya arborea methanol extract was tested for its effects on acute and chronic phases of inflammation using dextran, carrageenan, and inflammatory mediators such as serotonin & histamine mediated cotton pellet, granuloma, and paw oedema models. The extract's analgesic efficacy was evaluated in hot plate and acetic acid-induced writhing samples. The antiedema effects of *Careya arborea* methanolic extract and oral indomethacin 10 mg/kg were contrasted. Using the cotton pellet method, the formation of granuloma tissue was considerably reduced by administering 200 mg/kg b.w. of methanol extract and 10 mg/kg b.w. of indomethacin. The *Careya arborea* extract reduced peritoneal leukocyte migration in mice and produced analgesic effects in rat and mouse models. Coumaroyl lupendioic acid, one of the six lupine-type triterpenes

that were separated from *Careya arborea* bark, had more Cyclooxygenase-2 selectivity than the reference medication, celecoxib. Coumaroyl lupendioic acid significantly reduced inflammation caused by carrageenan at comparable dosages and had a stronger effect than betulinic acid. Additionally, pro-inflammatory mediators generated by carrageenan were suppressed. [8]

b. Antitumor activity:

A methanol extract of stem bark was evaluated for its anticancer properties in solid and ascetic tumors caused by Dalton's lymphoma ascites. When the bark extract was administered orally to mice for ten days at doses of 250 or 500 mg/kg, the tumorigenic index significantly decreased. The ethanolic leaf extract of *Careya arborea* was tested for cytotoxicity using the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay, which inhibits the Vero cell line. A lower inhibition in normal cells and anticancer and antiproliferative action against tumor cells at this dose were suggested by the extract's 63.47 percent antitumor activity against the Vero cell line. [9]

c. Antimicrobial and antioxidant activities:

Using disc diffusion techniques, the antibacterial activity of a methanol extract of *Careya arborea* bark against Gram positive, Gram negative, and fungal infections was evaluated. The extract's broad antibiotic action was effective against every tested bacterium. 2,2-diphenyl-1-picrylhydrazyl, superoxide anion radical, nitric oxide radical, and hydroxide radical scavenging experiments were used to assess the antioxidant and free radical scavenging capabilities of bark extract. *Careya arborea* extract worked better in a concentration-dependent process. The Folin-Ciocalteu method and the aluminum chloride method were used to measure the total phenolic, flavonoid content, and antioxidant activity of petroleum ether, aqueous, and alcoholic extracts of *Careya arborea* bark. Utilizing the 2,2-diphenyl-1-picrylhydrazyl method, the antioxidant activity was assessed. According to some theories, this plant is a potent antioxidant and can be used to treat a number of ailments. [10]

d. Antifertility effect:

Careya arborea Roxb's methanolic root extract possesses antifertility properties. was investigated with albino mice. Up to a dosage level of 5000 mg/kg bodyweight, the methanolic root extracts from the plant showed no acute toxicity in adult mice. Strong pregnancy-inhibiting effects were demonstrated by the root extracts at a dose level of 500 mg/kg body weight. A number of phenolic compounds, including 2-methoxy dibenzofuran, hydroquinone, resorcinol, synergic acid, vanillic acid, and gallic acid, were found by analyzing the methanolic extract using Gas Chromatography-Mass Spectrometry. These phenolic compounds may be responsible for the plant's anti-fertility effects. [11]

e. Central nervous system Activity:

The *Careya arborea* bark methanol extract's effects on central nervous system in Swis albino mice and Wistar albino rats. Muscle relaxant action, general behavior, exploratory behavior, and the amount of time that phenobarbitone sodium caused people to sleep were all examined. The results shown that the 100 and 200 mg/kg methanol extract of *Careya arborea* bark considerably reduced the spontaneous activity. notably longer sleep duration brought on by phenobarbitone sodium, a discernible reduction in exploratory behavior, and a decline in muscle relaxant activity as measured by traction and rota rod tests. The findings imply that in tested animal models, *Careya arborea* methanol extract possesses central nervous system S depressing qualities. The findings indicated that in investigated animal models, *Careya arborea* methanol extract exhibited central nervous system depressive action. [12]

III. Industrial application:

Natural dye from *Careya arborea* Bark:

The primary method used to add appealing colors to the white natural material is dyeing. A 15 × 15 cm dry white cotton cloth was treated with 10% Sodium hydroxide in a boiling water bath at 63˚C for 30 minutes in order to eliminate starch. The experiments included both mordant and no mordant. After being treated with 5% sodium sulfate for an hour at 105˚C in a boiling water bath, the processed cloth was washed and dried without the use of a mordant. Alum, a synthetic mordant, and chitharathai were used to dye textiles. Pre-mordanting, simultaneous mordanting, and post-mordanting were the three steps of mordanting. Pre-mordanting involved treating the scored fabrics with a mordant first, followed by extract dyeing. The fabrics were treated with a 1:10 ml solution of each of the previously described mordants for 30 minutes at 50˚C. The mordanted fabric was then colored. After being immersed for 30 minutes at 50˚C in an equal mixture of the mordant and dye extract, the dyed materials were cleaned and dried. The dyed cloth was post-mordanted for 30 minutes at 50˚C using mordants in a 1:10 ratio. [13]

Physio-mechanical properties:

Cellulose is a naturally occurring, renewable biopolymer that is necessary for the structure of many plants, including tree bark. In order to understand their characteristics and limitations, there is an increasing interest in identifying new plant fibers, such as those found in Furcraea foetida, *Cyperus platystylis*, *Carica papaya L*, and *Corypha taliera* fruit. Jute, hemp, sisal, and bananas are among the few lignocellulose-extracted materials that have perhaps been researched in the scientific literature. Raw cellulose fibers have poor strength, flexibility, and water resistance, which could prevent them from being widely used in practical applicationsA tree native to India and its subcontinent, *Careya arborea*, or Cary, is one of the new plant fibers found so far that has never been used in commercial composites.

A significant step toward the development of innovative lightweight composites, environmentally friendly materials, and renewable products is the use of bark from *Careya arborea*. By chemically changing cellulose fibers to take advantage of its natural properties, we can promote a more sustainable and ecologically conscious mentality in modern businesses and contribute to the development of a more

sustainable and greener future. Researching eco-friendly and sustainable alternatives to synthetic fibers can contribute to the development of greener materials and lower carbon emissions. [14] During the colonial era in India, the fibrous bark of this tree was found to be an ideal substitute for beech bark for matchlocks. [15]

Textile application:

Dyeing is the main technique used to give the white natural stuff attractive colors. A 15 × 15 cm. dry white cotton material was treated with 10% sodium hydroxide in a boiling water bath at 63˚C for 30 minutes in order to eliminate starch. The experiments included both mordant and no mordant. After being treated with 5% sodium sulfate for an hour at 105°C in a boiling water bath, the processed cloth was washed and dried without the use of a mordant. Alum, an artificial mordant, chitharathai, and masikai were used to dye linen. Pre-mordanting, simultaneous mordanting, and post-mordanting were the three steps of mordanting. [16]

IV. Mordant: [16]

a. Before mordanting-

Pre-mordanting involved treating the scored fabrics with a mordant first, followed by extract dyeing. Each of the aforementioned mordants was applied to the fabrics in a 1:10 ml ratio for 30 minutes at 50˚C. After then, the mordanted fabric was dyed.

b. In parallel, mordanting-

The dyed materials were washed and dried after being submerged in an equal mixture of the mordant and dye extract for 30 minutes at 50˚C.

c. After mordanting -

In post-mordanting, mordants in a 1:10 ratio were applied to the colored fabric for 30 minutes at 50˚C.

V. RESULTS AND DISCUSSION

In recent years, nutrition researchers have become increasingly interested in chemicals originating from plants. Consumers' growing desire for natural supplements fuels the market for natural components. Preliminary studies known as phytochemical screenings are used to find out whether a plant extract contains primary and secondary metabolites. The presence of flavonoids, tannins, quinines, sterol, phenol, anthocyanin, steroids, and terpenoids was demonstrated by the methanol extract of the bark of *Careya arborea*. Its exceptional hemicellulose concentration, which exceeds that of other widely used fibers in the world community, accounts for its special adaptability. Because of its high hemicellulose content, the fiber has remarkable strength and durability, making it a perfect choice for applications requiring high mechanical resilience. This beneficial characteristic results from the fiber's strong amorphous structure, which forms solid bonds with the cellulose and lignin components. The high amount of lignin found in Cary fibers is especially noteworthy; it exceeds the amounts found in other known fibers as reported in scholarly literature.

The presence of active chemical components linked to these activities is confirmed by the historic usage of *Careya arborea* in certain painful and inflammatory illnesses. The different therapeutic qualities of *Careya arborea* may be due to the individual or combination action of the bioactive phytochemicals found in its bark. The plant has a wide range of pharmacological actions, including diuretic, hepatoprotective, antioxidant, anticancer, analgesic, and antidiarrheal. However, to create more effective formulations, a thorough pharmacological examination is needed. Given that the bark extract was also tested for its ability to dye textiles in addition to its natural mordant qualities, *Careya arborea* may be a source of natural colorants for use in the cosmetics and textile industries. Ultimately, these findings validate the existence of active chemical components linked to these actions and justify the traditional usage of *Careya arborea* in certain inflammatory and painful disorders.

VI. CONCLUSION

One of the most significant benefits is the geographical richness of these fibers in the Indian subcontinent, which offers a significant opportunity to promote economic expansion and support a sustainable global balance. Thus, the development of novel fibers and the skillful application of bio-waste present a means to avoid dependence on petrochemicals. As *Careya arborea* has not yet been identified and utilized in any applications, our goal is to confirm whether they can be used in industries such as aerospace, naval, packaging, automotive, energy storage, textile, and biomedical. Additionally, we want to see if they can replace domestic products and petrochemicals used in the toys and petrochemical industries. [14]

Researchers can investigate the incorporation of cellulose natural fiber from *Careya arborea* linn into hybrid and polymeric composite formulations. This involves experimenting with various combinations of polymer matrices with reinforcing fibers, such as glass, carbon, or aramid fibers, in order to get better mechanical and thermal properties. As the demand for eco-friendly materials grows, future research can focus on developing hybrid and polymeric composites employing bio-based polymers and ecologically acceptable additives. This strategy tackles the environmental issues related to traditional composite materials and is in line with sustainable development goals. Because of their phytoconstituents, these herbal medicinal plants have been a unique part of our lives since the beginning of time and have given us information on how to employ plants or plant products as therapeutic agents to cure a variety of illnesses.

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