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Content

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GENETIC MODIFICATION AND TRANSFORMATION STUDIES IN AROMATIC GRASSES: ADVANCES IN *CYMBOPOGON* AND *CHRYSOPOGON*

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Abstract: Aromatic grasses of the genera *Cymbopogon* and *Chrysopogon* (vetiver) represent economically important crops valued for their essential oils, phytoremediation capabilities, and diverse industrial applications. This manuscript provides a comprehensive review of genetic modification and transformation studies in these aromatic grasses, synthesizing recent advances in tissue culture, regeneration protocols, and genetic engineering approaches. The review examines in vitro regeneration systems, Agrobacterium-mediated transformation protocols, molecular characterization of essential oil biosynthesis pathways, and emerging biotechnological applications. Key findings reveal that while efficient regeneration systems have been established for multiple *Cymbopogon* species and vetiver, successful stable genetic transformation remains limited, with only a few reports of transgenic vetiver plants. The manuscript highlights critical bottlenecks in transformation efficiency, discusses the molecular basis of terpenoid biosynthesis, and identifies future directions for metabolic engineering and crop improvement in these valuable aromatic grasses.

Keywords: Aromatic grasses, *Chrysopogon zizanioides*, Genetic transformation, Essential oil biosynthesis

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MADHUCA LONGIFOLIA (MAHUA): A REVIEW OF TRADITIONAL USES, PHYTOCHEMISTRY, PHARMACOLOGICAL ACTIVITIES, TOXICOLOGY, BIOTECHNOLOGY AND THERAPEUTIC POTENTIAL

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Abstract: *Madhuca longifolia* (J.F. Gmel.) J.F. Macbr. (Sapotaceae), commonly known as Mahua or Indian Butter Tree, is a multipurpose indigenous tree widely distributed across the Indian subcontinent. It holds an important place in Ayurveda, Siddha, Unani, and tribal healthcare systems, where its flowers, leaves, bark, fruits, seeds, and seed oil have traditionally been used to treat diabetes, inflammatory disorders, respiratory and gastrointestinal ailments, skin diseases, wounds, ulcers, and rheumatism. Beyond its medicinal importance, Mahua contributes significantly to the livelihood and nutritional security of rural and tribal communities through its edible flowers, seed oil, timber, fermented products, and biodiesel potential. Growing scientific interest has highlighted *M. longifolia* as a valuable source of bioactive compounds with diverse therapeutic properties. This review summarizes together with classical Ayurvedic texts and earlier pharmacognostic studies, covering its taxonomy, botanical characteristics, distribution, ethnomedicinal importance, nutritional composition, phytochemistry, pharmacognosy, pharmacological activities, toxicology, biotechnology, and pharmaceutical applications. Phytochemical studies have identified numerous bioactive constituents, including triterpenoids, saponins, flavonoids, phenolic compounds, phytosterols, fatty acids, tannins, glycosides, and vitamins, which are responsible for its wide range of biological activities. Experimental studies have demonstrated significant antioxidant, anti-inflammatory, antimicrobial, antidiabetic, hepatoprotective, gastroprotective, wound-healing, analgesic, anticancer, and immunomodulatory properties. Recent advances in metabolomics, chromatographic fingerprinting, tissue culture, nanotechnology, and phytopharmaceutical research have further strengthened its medicinal and industrial potential. However, despite encouraging preclinical findings, standardized extracts, pharmacokinetic investigations, long-term safety assessments, and well-designed clinical trials remain limited. Future multidisciplinary research integrating phytochemistry, pharmacology, biotechnology, and clinical sciences is essential to develop safe, standardized, and evidence-based Mahua-derived phytopharmaceuticals for the management of chronic diseases.

Keywords: *Madhuca longifolia*, Mahua, Sapotaceae, Ethnomedicine, Phytochemistry, Medicinal plant

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OPTIMIZING CALLUS CULTURE FOR HIGH-PEROXIDASE PRODUCTION: A CASE STUDY OF *VITEX* WITH UNIQUE ENZYME CHARACTERISTICS

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Abstract: Efficient callus induction and proliferation protocols have been successfully established for several plant species known to be potent sources of peroxidases. Phenolic compounds, while inhibitory to callus formation, have been found to stimulate peroxidase production. The level of peroxidase activity in callus cultures varies significantly depending on both the type of plant growth regulator used and the morphological nature of the callus. Among the species studied, *Vitex* peroxidase is particularly unique, as callus cultures exhibit exceptionally high enzyme activity despite minimal or undetectable activity in the intact plant body. N-terminal sequencing of the *Vitex* peroxidase revealed a novel sequence distinct from all previously reported plant peroxidases, which likely accounts for its remarkably high specific activity. These findings highlight the potential of *Vitex* callus cultures as a valuable biotechnological system for peroxidase production.

Keywords: Callus culture, Peroxidase, *Vitex*, N-terminal sequencing

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BHANG ESSENTIAL OIL POSSESSES ANTIOXIDANT AND ANTIBACTERIAL ACTIVITY

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Abstract: The present study evaluated the antioxidant and antibacterial activity of essential oil extracted from fresh leaves of *Cannabis sativa.* Antioxidant potential was determined using DPPH radical scavenging, ferric reducing antioxidant power (FRAP) assay, while antibacterial efficacy was assessed by the agar well diffusion method against gram-positive and gram-negative bacterial strains. The essential oil of the plant exhibited significant antioxidant potential, as evidenced by its free radical scavenging ability and ferric ion reducing capacity and also inhibited the growth of all tested bacterial strains, with the highest antibacterial activity observed against *Escherichia coli*, followed by *Micrococcus luteus*. The findings indicate that *C. sativa* essential oil possesses promising antioxidant and antibacterial properties, which may be attributed to the synergistic action of its volatile phytoconstituents. The results highlight its potential for future applications as a natural bioactive ingredient in pharmaceutical, nutraceutical and food preservation systems.

Keywords: *Cannabis sativa*, Essential oil, DPPH, FRAP, Antibacterial

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FLORISTIC DIVERSITY AND SPECIES DISTRIBUTION IN DIFFERENT FOREST STANDS IN NORTHERN CHHATTISGARH, INDIA

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Abstract: The understory or vegetation beneath the forest canopy, or undergrowth, flourishes under the stratum of the forest stand and has significant distribution and impact on diversity, regeneration, nutrient cycling, and ecological functions. These are diverse life forms and have a substantial role in forest ecology, silvicultural aspects, and wildlife perspectives. Generally, the occurrence, distribution, and diversity of understory depend upon the canopy closure, light availability, site quality, and environmental conditions that can favor or limit it in a particular region. The present investigation was carried out in five forest land uses (i.e., degraded forest, moderately dense forest, regenerated forest, dense forest, and teak plantation) in the Duldula region of northern Chhattisgarh. Stratified simple random sampling techniques were used for data collection. A total of 89 species (28 tree species, 14 shrub species, 17 climber species, and 30 herb species) were recorded in different forest stands of the Duldula region of Jashpur (C.G.). In the overall floristic richness tree, shrub, climber, and herb contribute 31.46%, 15.73%, 19.10%, and 33.71%, respectively, in total. The frequency class distribution showed mostly species restricted to Classes A and B, reflecting their infrequent or moderate distribution. The origin of species or nativity analysis reflects that most of the species that occurred in different forest stands are native to India and South Asia. These floristic resources need to be preserved, conserved, and protected for future generations and to achieve sustainability.

Keywords: Distribution, Floristic, Flora, Diversity, Regeneration