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Desmostachya bipinnata: A FOCUSED REVIEW ON ETHNOBOTANY, PHYTOCONSTITUENTS AND BIOLOGICAL ACTIVITIES

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ABSTRACT

Traditionally *Desmostachya bipinnata (D. bipinnata*) known as darbh is commonly used in day-to-day life in various rituals. It is used for the treatment of cuts, wounds, and dysentery and used as a diuretic. The present study aimed in reviewing the botanical, phytoconstituents, biological activities, and some other activities of darbh. This study's findings are based on a review of the literature conducted using search engines such as BioMed Central, SpringerLink, Scopus, Google Scholar, PubMed, Web of Science, and Science Direct. The extracts prepared from the plant are reported with various biological activities like an antibiotic, antioxidant, cytotoxic, anti-inflammatory, analgesic, anti-ulcer, anti-diarrhea, antipyretic, analgesic, and antihistamine activities, etc. The plant contains multiple phytoconstituents which include carbohydrates, alkaloids, steroids, proteins, glycosides, flavonoids, saponins, coumarins, volatile oils, tannins, and phenolic compounds. Its phytoconstituents are used as a biosorbent for the removal of heavy metals from industrial waste and also have great potential as a herbal medicine in treating several diseases, but more research is proving the activities of *D. bipinnata* by animal models is needed to link its medicinal uses to its phytochemistry and pharmacological properties.

Keywords: Biological activity, *Desmostachya bipinnata*, Flavonoid compounds, Phytoconstituents, Quercetin.
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INTRODUCTION

For quite a long time, medicinal plants were utilized almost worldwide to treat numerous illnesses and diseases and increase physical health and profound prosperity. Medicinal plants were the only option available in ancient times; newly manufactured medications supplanted these with scientific advancements. Over the most recent decades, herbal medicines have started to edge out their synthetic counterpart in developed and developing nations.[1] Medicinal plants establish a fundamental part of the traditional medication rehearsed worldwide because of their practical suitability, openness, and hereditary experience. Notwithstanding the accessibility of a tremendous range of approaches for various ailments, the lion's share of the developing nation's individuals depends on herbal medications for different diseases. WHO has energized research for treating and counteracting various conditions relying upon traditional clinical practices.[2]

Religions also forged a strong bond between humans and nature by tying them to various natural systems and traditions. On certain occasions, Hindu families perform religious rituals. Any ritual does not necessitate using plants and their products.[3] Most of these plants are also helpful medicinally. Ex: *Ocimum tenuiflorum* is a sacred plant with various religious importance and ayurvedic medicine for treating colds and flu. Our forefathers used this spiritual plant in rituals to emphasize its significance as medicine.[4] We do not know the primary reasons for using these plants, but we continue to do so for ceremonial commitment. As their uses are restricted to rituals, an attempt has been made to uncover these plants' secret

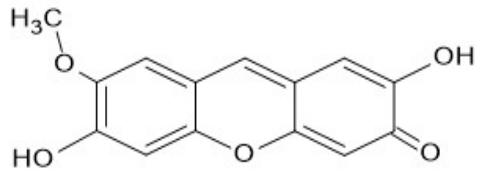
medicinal values by performing numerous experiments and research on them.[5] *Desmostachya bipinnata (D. bipinnata*) (*Poaceae*) is known as *kusha*[6], *darbh*[7], and *dab.*[8] Cuts and wounds are handled with leaf paste[9], rheumatism is dealt with roots[10], diuretic[6], carbuncles[7], and dysentery.[8] Its medicinal values are documented in various Ayurvedic texts.[11] This halo-phytic grass is native to Africa and Pak-Indo-China region.[12] Salt and drought-tolerant grass with long, vigorous rhizomes make it a great sand-binder.[13] The plant grows widely and abundantly on dry and sandy soils in neglected farming areas, alongside roads and the edges and bunds of rural fields. It creates a ruling patch of plants by forming dense tufts regularly. This plant is the hardest and most persistent weed in rural areas. It is hard to oversee or destroy the built-up populaces of *D. bipinnata.*[14]

Botanical Description

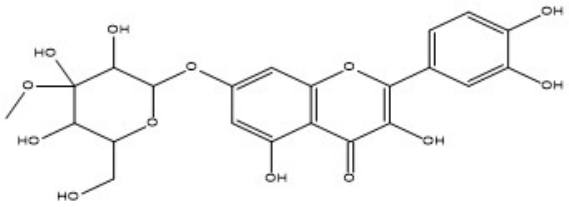
D. bipinnata is a rhizomatous perennial grass with a rough surface. Clumps can grow up to 1.2 meters in height. Unrolled, leaf blades can be as long as 65 cm and as thick as 3.8-10.5 mm. At the base of the clump, the lower leaf sheaths are leathery and thickly flabellate. The inflorescence can reach 60 cm long. 14 cm long and grouped or scattered spikes. 3-10 mm long, narrowly ovate to linear-oblong spikelet's with 3-17 flowers. The thickness of the lower glume ranges from 0.7 to 1.5 mm, whereas the upper glume ranges from 1.1 to 2.0 mm. Lemmas have straw-colored or violet-tinged flowers that are 1.8-2.7 mm long and bloom between July and November.[15]

Phytoconstituents

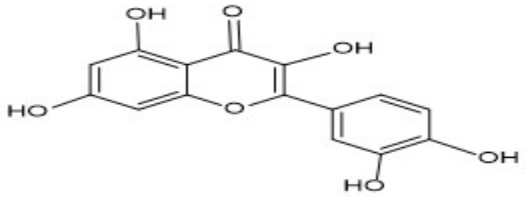
The weed contains various phytochemical constituents. It has many phytochemical constituents like carbohydrates, alkaloids, steroids, proteins, glycosides, flavonoids, saponins, coumarins, volatile oils, tannins, and phenolic compounds.[16] Different phytochemicals are isolated from the other plant parts by various isolation procedures (i.e., column chromatography, bio-guided fractionation, HPLC, GC-MS, and TLC procedures). The structures of important isolated compounds of this plant are depicted below:



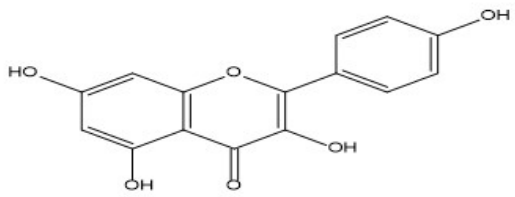
2,6-dihydroxy-7-methoxy-3H-xanthen-3-one[17]



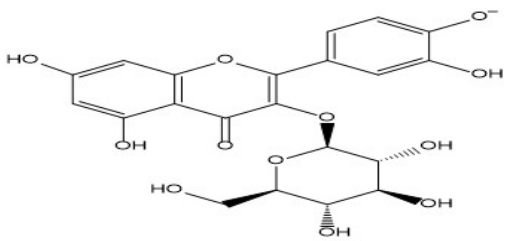
4`-methoxy quercetin-7-O-glucoside[18]



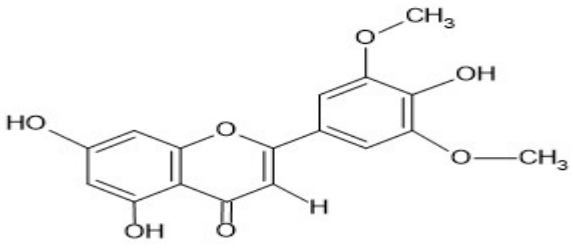
Quercetin[19]



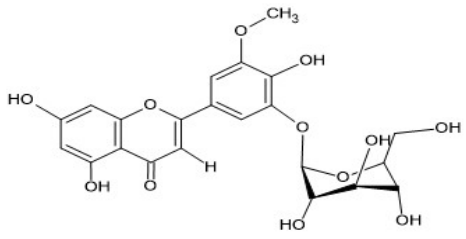
Kaempferol[19]



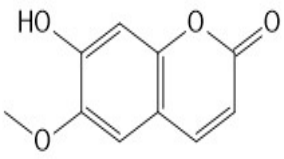
Quercetin-3-glucoside[19]



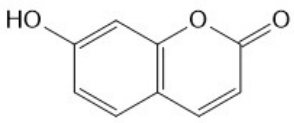
Trycin[19]



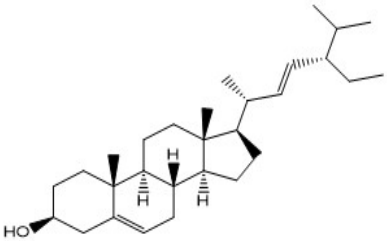
Trycin-7-glucoside[19]



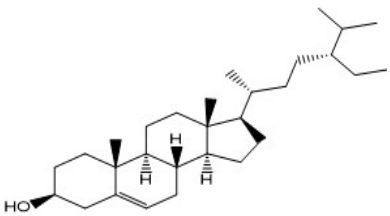
Scopoletin[20]



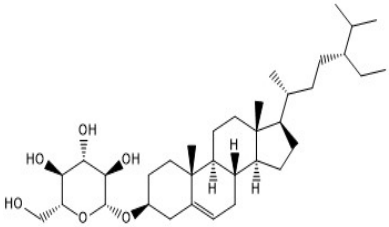
Umbelliferone[20]



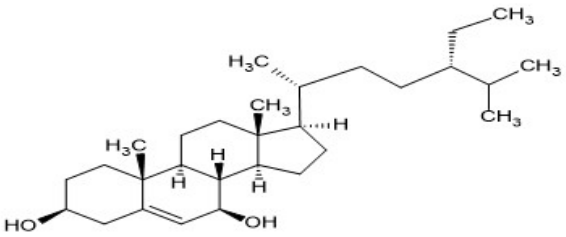
Stigmasterol[21]



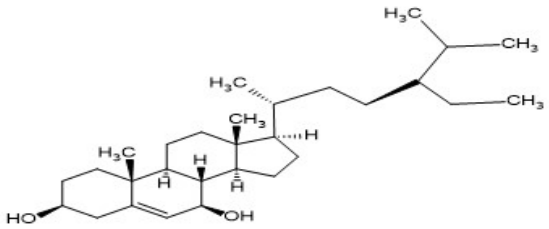
β-Sitosterol[21]



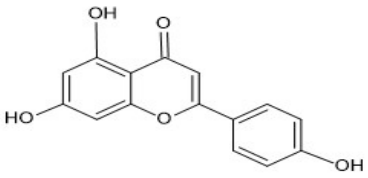
Daucosterol[21]



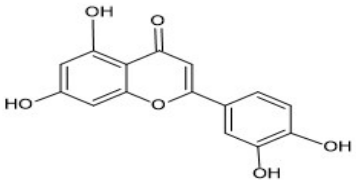
Stigmast-5-en-3β, 7β-diol[21]



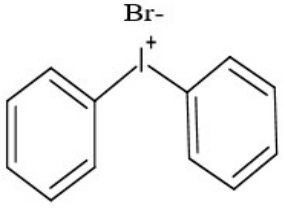
Stigmast-5-en-3β,7α-diol[21]



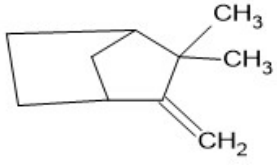
Apigenin[22]



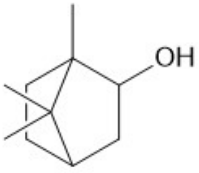
luteolin[22]



Diphenyliodinium bromide[23]

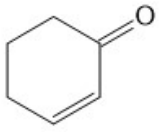


Camphene[23]

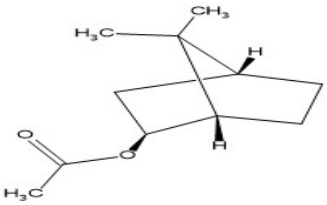


Endoborneol[23]

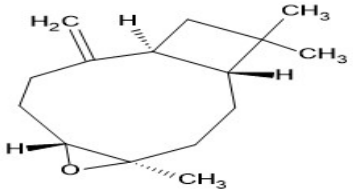
Tricyclene[23]



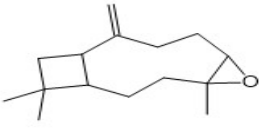
2-cyclohexene-1-one[23]



I sobornyl acetate[23]



Caryophyllene oxide[23]



Caryophyllene diepoxide[23]

Fig.-1: Structures of important isolated compounds

Biological Activities

Analgesic Activity

The *in vivo* analgesic potential of the hydroalcoholic extract was assessed by the hot plate method using analgin as a standard compound. The results have shown that the analgesic effect produced by the 300 mg/kg body weight is comparable with the results produced by 150 mg of analgin. The results concluded that the hydroalcoholic extracts of the plant possess excellent analgesic activity.[24] The *in vivo* analgesic potential of petroleum ether, ethanol, chloroform, benzene as well as aqueous plant extracts in albino rats was performed by tail immersion method using diclofenac sodium as a standard compound. The results have shown that all extracts showed significant analgesic activity, but chloroform extract has shown more analgesic activity when compared with the other extracts.[25]

Anti-diabetic Activity

The glycaemic balancing levels of the plant extract were assessed during the hypo and hyperglycaemic conditions in the non-diabetic rats. They induced hypoglycemia by allowing the animals to swim at room temperature for three minutes in a polypropylene container and giving an exogenous dextrose injection 20 minutes before the experiment. The blood was collected by puncturing the tail vein, and the glucose levels were measured using a glucometer. The findings showed that prophylactic induction of the plant extracts to experimental animals restored euglycemic levels. Combining the plant extract with anti-diabetic drugs yields more effective results than using only anti-diabetic medications.[26]

Anti-histaminic Activity

The *in vivo* antihistaminic potential of different extracts of the plant was evaluated by histamine-induced lethality in guinea pigs using cetirizine as a standard. The results have shown that the animals treated with standard drugs, hydroalcoholic extract, alcoholic extract, and ethyl acetate extracts were alive. The remaining animal's control, aqueous, and chloroform groups were dead because of difficulty breathing. Few animal groups were live and administered hydroalcoholic, alcoholic, and ethyl acetate extract because the extract's alkaloids, glycosides, and coumarins were responsible for anti-histaminic activity.[27]

Anti-ulcer Activity

Anti-ulcer activity of methanolic extract and its isolated flavonoid glycosides was performed by methanol-induced peptic ulcers using ranitidine as a standard drug. The results have shown that the extract and the isolated compounds possess more excellent anti-ulcer activity than the standard drug ranitidine. Ranitidine has not shown activity because it blocks the histamine receptors responsible for releasing gastric juices. Still, it has not shown any protective effect against ethanol-induced ulcers. But the extract and the isolated compounds have a protective action against ethanol-induced peptic ulcers.[19]

Anti-Hepatotoxicity

The *in vitro* as well as *in vivo* hepatoprotective effects were performed on polyphenolic fractions of this plant. They demonstrated *in vitro* hepatoprotective activity on BRL3A cells compared to ethanol-induced damage by calculating mitochondrial synthesis using tetrazolium assay. Cells that were exposed to ethanol had a percentage viability of 10.302%, whereas cells pre-treated with Polyphenolic fractions had an increase in percentage viability that is dose-dependent, with highly significant results. Maximum protection was given to the cells which were pre-treated with the fraction of the plant, i*n vivo* test by tamoxifen-induced hepatotoxicity in rats. The animals pre-treated with the polyphenolic fractions showed hepatoprotective activity against the tamoxifen by increasing the antioxidant properties in the hepatic region.[22]

Antibiotic Activity

The antibacterial potential of *H. pylori* strains was checked by using the cup diffusion technique with the extract. This study showed that *D. bipinnata* is exceptionally active against the test strain where its minimum inhibitory concentration (MIC) was low (40 μg/ml). This plant appears to contain profoundly active secondary metabolites of good anti-helicobacter action. To decide whether the active compound was liable for the anti-helicobacter activity of plant fractionation, purification of the rough extract was

performed. The fractionation procedure uncovered that the ethyl acetate and butanol fractions, which incorporate most of the plant's flavonoids, had excellent anti-helicobacter movement. Their MICs were 0.79 mg/ml and 1.3 mg/ml individually.[18]

Cytotoxic Activity

The *in vitro* cytotoxic study was carried out on human laryngeal epithelial carcinoma cells (Hep-2), human cervical cancer cell line (HeLa), and NIH 3T3 using a microculture tetrazolium assay. The results have shown that the percentage of growth inhibition was enhanced with increasing concentrations of *D. bipinnata* and standard compounds. At 400 µg/ml concentration, a maximum percentage of cell inhibition was observed. Among the three cell lines tested, the extract showed an IC_{50} value of 109.8 µg/ml for HeLa cell lines which was less than the other cell lines, 166.8 for Hep-2 cells, and 216 for NIH3T3.[28]

CONCLUSION

The present data provide a detailed description of the medicinal grass used in many traditional rituals in India. The therapeutic value of this plant has also been recorded in conventional medicinal texts. Although this study addresses different molecules, only a few molecules have been isolated from this plant, with many molecules previously reported from other plants. As a result, it is thought that more research work on this sacred plant is required, and it should be validated before its use in the market, particularly with a greater emphasis on the isolation of new, unreported molecules. Several pharmacological activities were summarised, from analgesic to cytotoxic potentiality. The chemical constituents and pharmacological activities of the plant have been reported. Still, it is not clear to what degree the different constituents are present in its preparations. Therefore, the author suggests that further studies such as preliminary toxicology studies on animal models and clinical studies should be performed to emphasize the activities of *D. bipinnata* plant isolates and other phytoconstituents.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS

All the authors contributed significantly to this manuscript, participated in reviewing/editing and approved the final draft for publication. The research profile of the authors can be verified from their ORCID ids, given below:

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