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PHARMACOLOGICAL AND THERAPEUTIC IMPORTANCE OF *DESMOSTACHYA BIPINNATA*- A REVIEW

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Abstract:
Phytochemical analysis of Desmostachya bipinnata resulted in isolation of coumarins (scopoletine and umbelliferone), carbohydrates, sugars, proteins, alkaloids, tannins, phenolics, flavonoids, triterpenoids, amino acids and glycosides. Pharmacological studies revealed that the plant possessed antimicrobial, antiinflammatory, analgesic, antipyretic, gastrointestinal, anticancer, diuretic, anti-urolithiatic, antioxidant, hepatoprotective, antidiabetic, bronchodilitation and antihistaminic effects. The current review will highlight the chemical constituents and pharmacological effects of Desmostachya bipinnata.

Keywords: *chemical constituents, pharmacology, Desmostachya bipinnata.*

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INTRODUCTION:

Medicinal plants are the Nature's gift to human beings to help them pursue a disease-free healthy life. Plants have been used as drugs by humans since thousands of years ago. Plant showed wide range of pharmacological activities including antimicrobial, antioxidant, anticancer, hypolipidemic, cardiovascular, central nervous, respiratory, immunological, anti-inflammatory, analgesic antipyretic and many other pharmacological effects [1-20]. Phytochemical analysis of *Desmostachya bipinnata* resulted in isolation of coumarins (scopoletine and umbelliferone), carbohydrates, sugars, proteins, alkaloids, tannins, phenolics, flavonoids, triterpenoids, amino acids and glycosides. Pharmacological studies revealed that the plant possessed antimicrobial, antiinflammatory, analgesic, antipyretic, gastrointestinal, anticancer, diuretic, anti-urolithiatic, antioxidant, hepatoprotective, antidiabetic, bronchodilitation and antihistaminic effects. The current review will highlight the chemical constituents and pharmacological effects of *Desmostachya bipinnata*.

Synonyms:

Briza bipinnata L., *Eragrostis cynosuroides* (Retz.) P. Beauv., *Poa cynosuroides* Retz., *Stapfiola bipinnata* (L.) Kuntze and *Uniola bipinnata* (L.) [21].

Taxonomic classification:

Kingdom: Plantae; **Phylum**: Spermatophyta; **Subphylum**: Angiospermae; **Class**: Monocotyledonae; **Order**: Cyperales; **Family**: Poaceae; **Genus**: *Desmostachya*; **Species**: *Desmostachya bipinnata* [22].

Common names

Arabic: Halfa, Jilda; **English**: sacrificial grass, Tail Grass, Halfa grass, big cordgrass, salt reed-grass; **Sanskkrit:** Darbha.

Distribution:

The plant is distributed from North Africa to South Asia. In Africa, it was recorded in (Chad, Eritrea, Ethiopia, Somalia, Sudan, Algeria, Egypt, Libya, Tunisia and Mauritania) and, in Asia it was distributed in (Saudi Arabia, Yemen, China, Iran, Iraq, Syria, Palestine, India, Nepal, Pakistan, Afghanistan, Burma, Myanmar, Thailand and Vietnam). It could introduced to USA for its soil-binding qualities along with its medicinal uses [21,23-25].

Description:

Coarse perennial forming large leafy tussocks, also with widely spreading scaly rhizomes. Culms rigid, branched at base and covered with leathery yellowish sheaths, 80–100 cm tall, ca. 7 mm in diam. Leaf sheaths glabrous; leaf blades flat or inrolled, tough, 18–30 × 0.4–1 cm, adaxial surface and margins scabrid, abaxial surface rather smooth, apex long acuminate; ligule ca. 0.3 mm. Inflorescence 20–60 × 2–3 cm; racemes ascending or spreading, crowded or spaced, 0.5–3.5 cm; main axis and rachis hispidulous. Spikelets elliptic or elliptic-oblong, 2–10 mm, stramineous or purplish, florets 3–10; glumes ovate-lanceolate; lower glume 0.7–1.5 mm; upper glume 1.1–2 mm; lemmas ovate-lanceolate, 1.8–2.7 mm; palea keels scabrid [23,26-27].

Traditional uses:

The plant was used as cattle fodder. Decoction made from leaves was used to treat fever [28]. Root was used as astringent, diuretic, galactogouge , litholytic and for the treatment of dysentery, diarrheoa, thirst, urinary calculi, dysuria and other disease of bladder, menorrhagia and skin diseases [29]. It was also used for the treatment of wounds and abdominal pain [30].

Chemical constituents:

Phytochemical analysis of the plant resulted in isolation of coumarins (scopoletine and umbelliferone), carbohydrates, sugars, proteins, amino acids, alkaloids, tannins, phenolics, flavonoids, triterpenoids and glycosides [25,31-33].

Five flavonoid glycosides were isolated from the ethanol extract of *Desmostachya bipinnata*. They were identified as kaempferol, quercetin, quercetin-3-glucoside, trycin and trycin-7-glucoside [34]. A new xanthenes (2,6-dihydroxy-7-methoxy-3H-xanthen-3-one) was isolated from the methanolic extract of *Desmostachya bipinnata*[35]. Stigmasterol, β-sitosterol, daucosterol, stigmast-5-en-3β, 7β-diol and stigmast-5-en-3 β, 7 β –diol were isolated from the leafy culms of *Desmostachya bipinnata* [36].

The essential oils of the aerial parts of *Desmostachya bipinnata* was analyzed by GC-MS, it appeared that they consisted of camphene (16.79%), isobornyl acetate (9.92%), tricyclene (4.30%), (+,-) trans-2,6-gamma-Irone (2.21%), caryophyllene diepoxide (12.29%) , I²-eudesmol (11.16%), eseroline (25.15%) and calarene (3.48%) as the main components. The oil also contained smaller percentages of diphenyliodinium bromide, 1-limenone, 2-cyclohexene-1-one and 8-nitro-12-tridecanolide [37].

Linoleic acid ethyl ester, palmitic acid ethyl ester, oleic acid ethyl ester, linoleic acid, palmitic acid, oleic acid, ρ- hydroxycinnamic acid ethyl ester, 2-methoxy-4-formylphenol (vanillin) and stearic acid ethyl ester were the most important lipid compounds isolated from the total alcohol extract of the rootstock of *Desmostachya bipinnata*. However, the isolated compounds from the early benzene fractions, were included: Tetradecene, Tetradecane, Octylcyclohexane, Octadecene, Phthalic acid, Hexadecane, Nonylhexane, Myristic acid, Octadecane, 6,10,14-Trimethyl-2-pentadecanone, Phthalic acid, Pentadecanoic acid, Nonadecane, Ethyl

9-hexadecanoate, Palmitic acid, Palmitoleic acid, Octadecanol, Heptadecanoic acid, Heneicosane, Linoleic acid, Oleic acid, Pentacosane, Hexatriacontane, Triacontane, Tetracosanoic acid, Tetracontane, Docosanoic acid, Triacontanediol and n-Tetratriacontane. While, the compounds isolated from the early benzene fractions were included: 2-Methoxy-4-formylphenol (Vanillin), Elemicin, Phthalic acid, n-Hexadecane, Zierone, Myristic acid, Benzyl benzoate, Myristic acid, Octadecane, ρ-Hydroxycinnamic acid, Phthalic acid, Palmitic acid, Eicosane, Octadecanol, Heptadecanoic acid, Linoleic acid, Oleic acid, Stearic acid, n-Pentacosane, 9-Tricosene, 1,2-Benzenedicarboxylic acid mono (2-ethylhexyl) ester, n-Hexacosane, n-Tetracosane, n-Pentatriacontane and Docosanoic acid [38].

Pharmacological effects:

Antimicrobial effect:

In studying the antimicrobial effect of *Desmostachya bipinnata*, it appeared that β-Sitosterol-D-glucopyranoside was the bioactive compound which possessed the best antimicrobial activity (MIC 6-50 µg/ml) and it works synergistically with most antibiotics, especially with ciprofloxacin. Time kill curves showed that β-Sitosterol-D-glucopyranoside killed most of the pathogens within 5-10 h [39].

The antimicrobial effect of the ethanolic extract of *Desmostachya bipinnata* rootstock was investigated against *Aeromonas hydrophila, Bacillus cereus, Bacillus subtilis, Enterobacter aerogens, Escherichia coli, Klebsiela pneumoniae, Proteus vulgaris, Pseudomonas aeruginosa, Salmonella typhimurium, Staphylococcus aureus, Streptococcus pyrogens, Vibrio fischeri* and *Candida albicans.* The ethanolic extract (15.652, 31.25, 62.5, 125. 250 and 500 mg/ml) was found to inhibit *K. pneumonia* (16-25 mm), *E. coli* (12-22), *B. cereus* (9-18mm), *S. typhimurium* (13-17mm), and *P. vulgaris* (10-13mm) [40].

Ethanolic extract of *Desmostachya bipinnata* possessed antibacterial activity against *Micrococcus luteus, Bacillus subtilis, Proteus merabiles, Pseudomonas aeruginosa, Salmonella typhi, Sarcina ventricull, Staphylococcus aureus, Enterococcus faecalis, Escherichia coli* and *Serratia marcesens.* it also exerted antifungal effect against *Candida tropicalis, Candida albicans, Aspergillus fumigates, Aspergillus flavus* and *Pencillium chrysogenum* [41].

The antibacterial activity of the oil of the aerial parts of *Desmostachya bipinnata* was evaluated using agar diffusion and broth dilution methods. The results revealed that the oil possessed significant inhibitory effect against four bacteria strains [37].

The crude extract of *Desmostachya bipinnata* (64 µg) showed antibacterial activity against *Escherichia coli* (17mm), *Klebsiella* sp (15mm) and *Staphylococcus aureus* (16mm) [42].

Antiinflammatory, analgesic and antipyretic effects:

The Antipyretic effect of petroleum ether, benzene chloroform, ethanol and aqueous extracts of the whole parts of *Desmostachya bipinnata* was investigated in yeast induced pyrexia in albino rats. Oral administration of petroleum ether, chloroform, ethanol and aqueous extract of the whole parts of *Desmostachya bipinnata* at a dose of 300 mg/kg body weight induced significantly reduction of the elevated body temperature of rat comparable to the effect of paracetamol and diclofenac sodium. The anti-inflammatory activity was evaluated by using Digital plethysmometer. Inflammation in the hind paw of albino rat was induced by injection of 0.1 ml of 1% carrageenan suspension into sub-plantar surface of the right hind limb. The different extracts of *Desmostachya bipinnata* (300 mg/kg, orally) induced significant ($P< 0.05$) reduction of rat paw edema. The maximum inhibition was shown by the ethanol extract 53.84%, whereas the standard drug (Diclofenac sodium 100 mg/ kg ip) showed 32.30% inhibition. The tail immersion method was used to investigate the analgesic activity of petroleum ether, benzene, chloroform, ethanol and aqueous extract of the whole parts of *Desmostachya bipinnata*. Almost all the extracts possessed significant analgesic effect ($P< 0.05$) [43].

The hydro-alcoholic extracts of *Desmostachya bipinnata* roots were investigated for their anti-inflammatory (carrageenan induced paw oedema) and analgesic potential (hot plate method) on experimental model and compared to standard drugs (indomethacin for anti-inflammatory activity and analgin for analgesic activity). In the carrageenan-induced rat paw edema test for acute inflammation, the extract of *Desmostachya bipinnata* in doses of 200, 300 and 400 mg/kg body weight showed 46%, 33.3% and 62.5% inhibition of edema, respectively, at the end of 3h. However, the analgesic effect of the extract (300 mg/kg) was comparable to that produced by 150 mg/kg of analgin [33].

Gastrointestinal effect:

The antiulcerogenic activity of *Desmostachya bipinnata* was studied in ethanol induced gastric damage in rats. Three treatment groups received the ethanol extract of *Desmostachya bipinnata* in doses of 150, 250 and 300 mg/kg and another two treatment groups were administered trycin and trycin-7-glucoside isolated from the ethanol extract of *Desmostachya bipinnata* in a dose of 100 mg/kg. The total extract (200 and 300 mg/kg) and the two isolated compounds (trycin and trycin-7-glucoside.100 mg/kg each) showed a very promising antiulcerogenic activity with curative ratios of 68.31, 70.54, 77.39 and 78.93%, respectively [34].

In studying the potential *in vitro* antihelicobacter activity of selected Egyptian plants,
The methanolic extract of *Desmostachya bipinnata* (DEM) proved to be the most active one, with MIC of 40 µg/ml. After fractionation of the DEM extract, ethyl acetate fraction exhibited excellent antihelicobacter activity. By further fractionation and purification, using TLC and column chromatography, a flavonoid compound was isolated, with MIC value of 62 µg/ml. The isolated compound was spectroscopically identified as 4'-methoxy quercetin-7-O-glucoside [44].
The antidiarrhoeal effect of both alcoholic and aqueous extracts of the roots of *Desmostachya bipinnata* were studied in rats against castor oil induced diarrhoea and charcoal meal test at the doses of 200 and 400 mg/kg body weight. The alcoholic extract and to a lesser extent aqueous extract significantly reduced the weight of the faces and decreased the propulsion of charcoal meal through the gastrointestinal tract [31].
The crude aqueous-methanolic extract of *Desmostachya bipinnata* produced an atropine-sensitive spasmogenic effect in rabbit jejunum up to 5 mg/ml, followed by a partial relaxation at 10 mg/ml. With atropine preincubation, a verapamil-like inhibitory effect was evident against spontaneous and high K^+ (80 mM)–induced contractions. The maximum stimulant effect was comparable with the acetylcholine-induced maximum contraction. On activity-directed fractionation, inhibitory effect was concentrated on organic and stimulant effect in aqueous fraction [45].
The hydroalcoholic extract of *Desmostachya bipinnata* whole plant showed no laxative activity in rats. The results of laxative activity revealed minimal increase of feces output at the dose of 500 mg/kg and the increase was negligible when compared with that of the standard drug sennosides (10mg/kg) [25].

Anticancer effect:
Four different concentrations of hydroalcoholic extract of *Desmostachya bipinnata* (10, 100, 500 and 1000 ppm) was screened for cytotoxicity *in vivo* using brine shrimp lethality test. The plant induced 17.4 and 42 % death at 500 and 1000 ppm respectively with an LD_{50} value of 1215.929 ppm [46].
A new xanthenes (2,6-dihydroxy-7-methoxy-3H-xanthen-3-one) isolated from the methanolic extract of *Desmostachya bipinnata*, exhibited inhibitions of signal transducer and activator of transcription 3-dependent luciferase activity in HCT-116 colon cancer cell line with IC_{50} value of 5µM and low-density lipoprotein-oxidation with IC_{50} value of 27.2µM [35].
The *in vitro* cytotoxic study of different concentrations of 70% methanolic extract of the roots of *Desmostachya bipinnata* were studied on the human cervical cancer cell lines (HeLa), human laryngeal epithelial carcinoma cells (HEp-2) and NIH 3T3 using 3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide [MTT]. The methanolic extract of *Desmostachya bipinnata* possessed significant *in vitro* anticancer activity at 400 µg/ml and showed inhibition in concentration dependant manner of range between 25 – 400 µg/ml on all the cell lines [47].

Diuretic and anti-urolithiasis:
The diuretic effect of hydroalcoholic extract of *Desmostachya bipinnata* whole plant was studied in rats. Frusemide (20 mg/kg) was served as positive control for diuretic activity. The hydroalcoholic extract showed significant diuretic activity, it increased the urinary output at 500 mg/kg when the effect was compared with that of the standard frusemide ($P< 0.01$). Moreover, this extract was found to be effective in increasing urinary electrolyte concentration (Na^+, K^+, and Cl^-) [25].
Desmostachya bipinnata alone and in combination with *Brassica oleracea* possessed antiurolithiatic effect on experimentally-induced urolithiasis in rats by ethylene glycol (0.75% v/v) with ammonium chloride (1% w/v) in drinking water for ten days . The aqueous extracts of both plants were administered separately and in combination to urolithiatic rats at a dose of 400 mg/kg for 10 days. Daily oral treatments with extracts were insignificantly decreased the quantity of calcium oxalate deposited in the kidneys, but they reverted all the biochemical changes compared with control [48].

Antioxidant effect:
The antioxidant activities of different concentrations of 70% methanolic extract of the roots of *Desmostachya bipinnata* were examined by different models including DPPH, nitric oxide, hydrogen peroxide and hydroxyl radical scavenging activities. The extract showed effective antioxidant activity in all assay techniques. Furthermore, *Desmostachya bipinnata* was potent scavenger of hydrogen peroxide with IC_{50} value 127.07± 6.44 µg/ml against standard ascorbic acid 122.60± 2.14 µg/ml [47].
The antioxidant and DNA damage protection activity of hydroalcoholic extract of *Desmostachya bipinnata* was investigated in both *in vitro* and *in vivo* studies. The extract showed significant antioxidant activity in a dose-dependent manner with an IC_{50} value of 264.18 ± 3.47 µg/ml in H_2O_2 scavenging assay and prevented the oxidative damage to DNA in presence of DNA damaging agent (Fenton's reagent) at a concentration of 50 µg/ml. Also, the presence of extract protected yeast cells in a dose-dependent manner against DNA damaging agent (Hydroxyurea) in spot assay. Moreover, the presence of extract exhibited significant antioxidant activity *in vivo* by protecting yeast cells against oxidative stressing agent (H_2O_2) [49-50].

Hepatoprotective effect:
The hepatoprotective effect of the polyphenolic fraction of *Desmostachya bipinnata* root (PFDB) was studied in liver damage induced in female Sprague-Dawley rats. A dose-dependent increase in percentage viability was observed when ethanol-exposed BRL3A cells were treated with PFDB. Both treatment groups upon pretreatment with PFDB exhibited a significant ($P \leq 0.05$) protective effect by lowering serum glutamic oxaloacetic transaminase, serum glutamic pyruvic transaminase, alkaline phosphatase, triglycerides, cholesterol, urea, uric acid, bilirubin and creatinin levels and improving protein level in serum in dose-dependent manner, which was comparable to that of silymarin group. In addition, PFDB also attenuated antioxidant enzymes in the tamoxifen-intoxicated rats in concentration-dependent manner and significantly ($P < 0.05$) reduced the lipid peroxidation in the liver tissue. The biochemical observations were confirmed by histopathological studies, which showed the attenuation of hepatocellular necrosis [51].
The hepatoprotective potential of dried powdered roots of *Desmostachya bipinnata* (100 and 200mg/kg, orally for 7 days) was studied against paracetamol- induced liver damage in Wistar rats. Animals before treatment with aqueous extract of *D. bippinata* showed significant reduction in the elevated level of serum marker enzymes, MDA, LH, bilirubin and significant improvement in the antioxidant enzymes when compared to paracetamol damaged rats. *Desmostachya bipinnata* showed good hepatoprotective and antioxidant activity when compared to silymarin [52].

Antidiabetic effect:
The effect of hydroalcoholic extract of *Desmostachya bipinnata* was evaluated in glycemic status in non- diabetic rats. The results showed that the hydroalcoholic extract possessed no effect on euglycemic levels with minimal insignificant alterations. But, the supplementation of this extract in hypoglycemic (food deprivation or swim exercise induced) rats reduced the extent of hypoglycemia significantly. In addition, this extract reduced significantly the degree of hyperglycemia induced by exogenous administration of dextrose [53].
The antidiabetic activity of ethanolic extract of *Desmostachya bipinnata* whole plant (EDB) was studied in alloxan induced diabetes in rat. The extract showed significant antidiabetic activity at 200 and 400mg/kg, it was significantly ($P< 0.05$) decreased blood glucose, cholesterol, TG, SGOT, SGPT, ALP, urea, uric acid and Creatinine [54].

Respiratory effect:
The crude aqueous-methanolic extract of *Desmostachya bipinnata* inhibited carbachol (1 mM)-induced contraction in rabbit trachea but caused an atropine-sensitive accentuation of high K^+–induced contraction at 0.003–0.3 mg/ml followed by inhibition at 1–5 mg/ml. On activity-directed fractionation, inhibitory effect was concentrated on organic and stimulant effect in aqueous fraction [45].

Anti-Histaminic effect:
The contractile responses of guinea pig ileum were measured for several *Desmostachya bipinnata* extracts against histamine induction. All the extracts were able to contract guinea pig ileum while alcoholic extract was the most potent extract. The results which indicated the good anti-histaminic activity of the extracts, were further confirmed with histamine induced lethality test. Histamine induced lethality in guinea pigs was prevented when the extracts were administered prior to histamine injection in guinea pigs [55].

Toxicity and side effects:
Acute toxicity studies of alcoholic and aqueous root extracts of this plant showed that it wa safe till 2000 mg/Kg body weight in female albino mice [56].
LD_{50} in rats was more than 5 g/kg, No deaths were recorded in mice treated with the alcohol extracts in doses from 0.1 to 5 g/kg body weight [34].

Doses:
For chronic fever: 20-25 g Root or flowers are boiled with 500 ml of water until the volume is reduce to 250 ml and take 15-20 ml three times a day for three days. For loose motions: Flower 10-15 g are boiled with 250 ml of water until the volume is reduced to half, then te syrup taken twice a day. For retention of urine: 10-15 g of root was boiled until the color of water is turned golden or yellowish, cool, that water and drink 1 glass of water, urine will passed within 10-20 minutes [57].

CONCLUSION:
The current review highlights the chemical constituents, pharmacological activities and therapeutic importance of *Desmostachya bipinnata* as promising herbal drug because of its safety and effectiveness.

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