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Review Article

Medicinal and Versatile Uses of an Amazing, Obtainable and Valuable Grass: *Cynodon dactylon*

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ABSTRACT

There are many grasses in this world have some unique medicinal properties. *Cynodon dactylon* (L) pers. (Family: Poacea) a perennial weedy grass has a prime position in ethno medicinal practices and traditional systems of medicine. The plant is rich in various metabolites such as proteins, carbohydrates, mineral, flavanoids, β-sitosterol, alkaloids, tri-terpenoides, glycosides, steroids, saponins, tannins, resins, phytosterols, reducing sugars, volatile oils and fixed oils. The plant shows various biological activities such as antiviral, antimicrobial, wound healing, central nervous, cardiovascular, antidiabetic, gastrointestinal, antioxidant, immunological, antiallergic, anti-inflammatory, antipyretic, analgesic, anticancer, diuretic, protective, antimicrobial, antiparasitic properties. The plant is also used to treat various maladies such as cancer, anasarca, convulsions, cough, cramps, diarrhea, dropsy, dysentery, epilepsy, headache, hemorrhage, hypertension, hysteria, measles, rubella, snakebite, sores, stones, tumors, urogenital disorders and warts. This review attempts to gather updated information about pharmacognostic characters, traditional uses, and chemical constituents, summary of various pharmacognostic and pharmacological activities of *Cynodon dactylon*.

1. Introduction

The earth is enriched with a rich wealth of medicinal plants. Many weeds of our surroundings are often very powerful medicinal plant to address many of our today's major health problems[1]. According to an estimation of the World Health Organization, about 80 percent of the world's population depends on herbs for its Primary healthcare needs[2]. Ayurveda and Siddha in India, the Chinese medicines in China, the Unani medicines in Islamic countries are Traditional Knowledge Systems that use herbs or plant products for therapeutics on large scales. Many potent and powerful drugs are prepared from medicinal plants. They present healthier and safer alternative to the synthetic drugs[3]. Several phytochemical constituents are obtained from various parts such as root, stem, leaf, fruit, seed, bark etc. Various biologically active compounds of medicinal plants play an important role in drug discovery. In addition, extracts of medicinal plants are useful in the treatment of several health problems[4].

C. dactylon (L.) Pers. is a perennial grass having a variety of medicinal properties[5]. It is cultivated throughout the tropics and subtropics. Entire plant and its root stalk are used for medicinal use[6]. It possesses much therapeutic, decorative and other unexplored potential. Besides its significant uses, the species is natural resources and therefore needs to be explored. For this purpose, this review is presented to provide adequate updated information about pharmacognostic characters, traditional uses, chemical constituents, summary of various pharmacognostic and pharmacological activities of *C. dactylon* which may be served as a useful tool for the researchers for proper evaluation of the plant to explore the concealed areas and their practical clinical applications, which can be used for the welfare of the mankind.

1.1 Plant profile

Taxonomy
Kingdom-Plantae
Division-Magneliophyta
Class-Liliopsida
Order-Cyperales
Family-Poaceae
Genus-*Cynodon*
Species-*Cynodon dactylon*

Common name

Cynodon dactylon is also known as Durva grass, Bermuda grass, Dog's Tooth grass, Indian Doab, Scutch grass, Bahama grass, Devil's grass, Couch grass, Dhub, doob and durba in different parts of the world.

Table 1: Different vernacular names around the world

Country	Common name
Africa	Kweekgras
Bangladesh	Durba
Cambodia	Smao Anchien
Canada	Ambate-Hullu, Graikae

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Fiji	Kabuta
Franch	Chiendent Dactyle, Chiendent Pied-De-Poule, Grand Chiendent
Germany	Hundezahngras
Hawaii	Manienie
India	Doob, Durva, Haryali, Kabbar, Karuka-Oulli, Talla.
Indonesia	Jukut Kakawatan, Gigirinling, Rumput Bermuda, Rumput Grinting, Sukit Grinting
Israel	Yablith
Laos	Hnha:z, Phe:d
Malaysia	Rumput Minyak
Myanmar	Mye-Sa-Myet
Nepal	Motie molulu, Dubo
Philippine	Kawad-kawad, Bakbaka, Kapot-kapot
Portugal	Capim-Bermuda
Spain	Chepica Brave, Came De Niño, Pate De Perdiz, Gramilla Blanca
Suriname	Griming, Tigriston
Thailand	Ya-Phraek
Vietnam	Cochi, Coong**[1],[7]**

Botanical description

Figure No. 1: *Cynodon dactylon*

C. dactylon is a perpetual creeping herb, stem (culms) lean and wiry. Leaves are 2-10 cm x 1.25-3 mm, narrowly linear or non-subdivided, acute and soft. It contains spikes 2-6, diverging from slender ascending peduncle, green or purplish. Grains are 1.05 mm long. Flowering and Fruiting time is August-October (also throughout the year). Other characteristics are stated bellow,

Root: The root of *C. dactylon* is fibrous, cylindrical, up to 4 mm thick, minute hair like roots arise from the main roots; cream colored.

Stem: Willowy, horizontal, up to 1 mm thick, jointed leafy, very smooth, yellowish green in color.

Leaf: 2 to 10 cm long and 1.25 to 3 mm wide, narrowly linear or un-subdivided, finely acute more or less opaque, usually conspicuously opaque in the barren shoots and at the base of the stem; covered light, sometimes bearded, ligule a very fine ciliate rim**[8-12]**.

Natural habitat

The plant *C. dactylon* grows well in light sandy, medium loam and heavy clay soils. It can even grow in very acidic, alkaline and saline soils but cannot grow in shady places. It needs moisture in soil. Many workers reported that this plant is used primarily as a lawn grass or as a forage grass throughout the warm-temperate and the sub-tropical world especially in saline habitats**[13,14]**.

Cultivation

Along the roadsides and in lawns, *C. dactylon* is found abundant as weed and can readily take possession of any uncultivated area. The grass becomes dormant and turns brown in color in winter season. The growth of the plant is promoted by full sun and retarded by full shade. It can spread very quickly from the rooted runners, which grow more than 7.5 cm per day. Quick sprouting of the plant can be ensured by planting in wet weather. Within 4-8 weeks, it gives a complete ground cover when sprigged 30-45 cm apart**[15]**.

Used parts

The entire plant can be used.

Properties

According to the Ayurvedic Pharmacopoeia, the plant is pungent and bitter in nature with characteristic fragrance and has cold potency. According to Unani system of medicine, the plant possesses sharp hot taste with good odor **[7, 16]**.

1.2 Chemical compositions

Various phytochemical analyses explored that the plant contained flavanoids, alkaloids, glycosides, terpenoides, triterpenoids steroids, saponins, tannins, resins, phytosterols, reducing sugars, carbohydrates, proteins, volatile oils and fixed oils**[17-21]**.

Quantitative estimation of phytoconstituents showed glycosides reached 12.2 %, tannins 6.3%, alkaloids 0.1%, resins 1.0%, free reducing sugar 10% and total reducing sugar 12%**[22]**.

From nutritional analysis it has been explored that each 100 g contained (on a zero-moisture basis) 11.6 g protein, 2.1 g fat, 75.9 g total carbohydrate, 25.9 g fiber, 10.4 g ash, 530 mg Ca, 220 mg P, 112.0 mg Fe, 1630 mg K, 28 µg beta-carotene equivalent**[21]**. A total of 20 compounds were identified from the hydroalcoholic extract of the whole parts of *C. dactylon*. Hexadecanoic acid, ethyl ester linolenic acid, ethylester d-mannose were the major components of the hydroalcoholic extract, and hexadecanoic acid ethyl ester was the most abundant one (17.49%). However, the isolated compounds were included: 3H-pyrazol-3-one, 2,4-dihydro-2,4,5-trimethyl 2.2112%, 4H-pyran-4-one, 2,3-dihydro-3,5-

dihydroxy-6-methyl3.2157%, menthol 1.1807%, benzoic acid, 2-hydroxy-, methyl ester 2.0455%, benzofuran, 2,3-dihydro 0.9639%, 2-furancarboxaldehyde, 5-(hydroxymethyl)- 2.3088%, 2-methoxy-4-vinylphenol 3.2348%, decanoic acid, ethyl ester 2.4063%, d-mannose 11.4820%, 3-Tert-butyl-4-hydroxyanisole 0.9040%, Ar-tumerone 5.7431%, tumerone1.9123%, curlone 4.2422%, tricycle [6.3.0.0(1,5)] undec-2-en-4-one, 2,3,5,9-tetramethyl2.89 14%, 3,7,11,15-Tetramethyl-2-hexadecen-1-ol 10.3540%, hexadecanoic acid ethyl ester 17.4905%, phytol 5.2078%, 9,12-octadecadienoic acid ethyl ester 6.9257%, linolenic acid ethyl ester 11.2885% and octadecanoic acid ethyl ester 3.9916%. On the other hand, 22 compounds were identified from the phenolic fraction of the whole parts of *C. dactylon*. Hydroquinone was the most abundant one (69.49%). The isolated compounds were included: propanoic acid, 2-oxo 1.5939%, furfural 6.0224%, 2H-pyran-2-one, 5,6-dihydro 1.3323%, pantolactone 0.8977%, pentanoic acid, 4-oxo 0.7289%, levoglucosenone 2.7253%, hexanediamide, N,N'-dibenzoyloxy 0.9019%, 3-hydroxy-1-methylpyridinium hydroxide 1.4121%, 2-furancarbox-aldehyde, 5- methyl 1.5718%, propanedioic acid, phenyl1.8379%, hydroquinone 69.4771%, phthalic anhydride 1.3128%, 1,3-benzenediol, 5-chloro 1.1284%, benzaldehyde, 3-(chloroacetoxy)- 4-methoxy 0.8016%, ethanone, 1-(4-hydroxy-3-methoxyphenyl)- 0.5183%, 1,6-anhydro-á-D-glucopyranose (levoglucosan) 1.0982%, vanillic acid 1.2001%, 1-(2-Hydroxy-4,5-dimethoxyphenyl)-ethanone 0.3610%, Syringic acid 1.1154%, pyrrolidin-2-one, N-(2,4- dimethylcyclopent-3-enoyl)-, cis 1.8603%, cinnamic acid, 4-hydroxy-3-methoxy 1.2345% **[23]**.

A total of 24 compounds were isolated from *C. dactylon* leaves using GC-MS analysis, these included: glycerin 38.49%, 4H-pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- 2.16%, thymol 1.15%, conhydrin 0.79%, 1,2-cyclopentanediol, 3-methyl- 1.65%, benzenepropanol, 4-hydroxy-à-methyl-, (R)- 0.36%, ethyl à-d-glucopyranoside 8.42%, 3,7,11,15-tetramethyl-2-hexadecen-1-ol 2.01%, n-hexadecanoic acid1.01%, hexadecanoic acid, ethyl ester 9.50%, phytol 4.89%, linoleic acid ethyl ester 5.32%, 9,12-octadecadienoyl chloride, (Z,Z)- 15.61%, octadecanoic acid, ethyl ester 0.72%, pentanal, 2-methyl- 0.58%, 1-(cyclopropyl-nitro-methyl)-cyclopentanol 0.29%, 2-propenamide, N-[2-(dimethylamino)ethyl]- 0.36%, hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester 0.43%, didodecyl phthalate 0.29%, 13-tetradece-11-yn-1-ol 1.01%, 10-undecyn-1-ol 0.43%, Squalene 1.94%, 9,12-octadecadienoic acid (Z,Z)-, phenylmethyl ester 1.15% and diazoprogesterone 1.44% [24]. The presence of many flavonoids including apigenin, luteolin, 6-C-pentosyl-8-C-hexosyl apigenin and 6-C-hexosyl-8-C-pentosyl luteolin have identified by HPLC–ESI MS**[21]**.

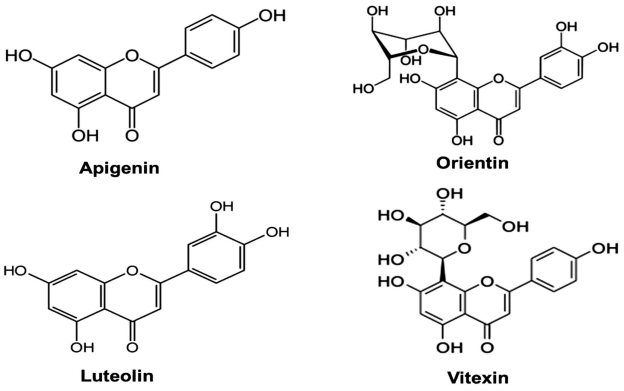

Figure No. 2: Flavonoids constituents from *Cynodon dactylon***[25]**

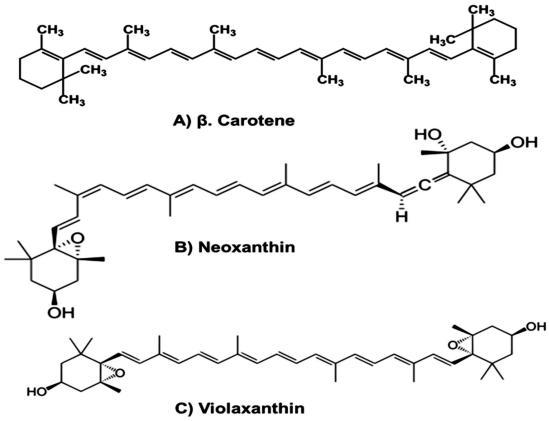

Figure No. 3: Carotenoid constituents (A to C) from Cynodondactylon**[25]**

1.3 Versatile uses in different system

Traditional

- Decoction of the entire plant used as diuretic
- Crushed leave used as styptic in minor wounds to stop bleeding. Also used for inflammatory conditions
- Decoction of the root used as diuretic in dropsy and syphilis
- The roots are used as a substitute for sarsaparilla
- Infusion of root to stop bleeding for piles
- Juice of plant applied to fresh cuts and wounds
- Paste of plant applied to forehead in headaches
- Used for tooth aches
- Mixed with clove (*Syzygium aromaticum*) used as anthelmintic
- In morocco, used in the treatment of kidney stone
- Folk remedy for cancer, epilepsy, cough, dysentery, warts, snakebites, bronchitis, anasarca, calculus, dropsy, hemorrhage, urogenital disorders, cough, sores, cancer, carbuncles, convulsions, cramps, cystitis, dysentery, hemorrhoids, leucoderma, hypertension, hysteria, asthma, tumors, measles, rubella, tumors, warts, wounds, eye disorders weak vision and Dandruff, fever.
- The paste made of the plant mixed with honey is used in epitaxis. Oral administration of the juice of the plant with

honey 2-3 times a day for few days effective treats menorrhagia.

- Local application in the form of paste of the plant extract upon the lower abdomen reduces severe bleeding in vagina.
- A decoction of *C. dactylon* mixed with sugar is useful in the problem of urine retention[7].

Ayurvedic

- **Skin Diseases** – Ayurveda acharyas have grouped durva grass under skin friendly herbs. It helps to heal the wound fast and restores the color of skin. Use of Durva grass is recommended in Psoriasis, Herpes, unhealed wounds, allergic rashes and haemorrhoids. It heals the patches of psoriasis and restores the normal color of skin. This herb reduces itching, heals the scaly skin and imparts normal color to skin[26, 27].
- **Improvement of female fertility** – Ayurvedic physicians recommend this grass in menorrhagia (excess bleeding during menstrual cycle), irregular menstrual cycle, and habitual abortion (repeated abortion). This herb also helps to fight PCOS (Polycystic Ovarian syndrome). It prevents abortion and strengthens the uterus[26, 27].
- **Cystitis and Urinary Tract Infection (UTI)** – This grass has cooling properties. It increases the urine output and soothes the inner layers of bladder. It helps to reduce inflammation of mucosal layer of bladder in Cystitis and UTI[26, 27].

Unani system

C. dactylon is used as a laxative, expectorant, emetic, emmenagogue, carminative, coolant, brain and heart tonic, useful against grippe in children and for pain and inflammation[28].

1.4 Other biological uses

Anti-diabetic activity

The aqueous extract of *C. dactylon* has high antidiabetic potential along with significant hypoglycemic and hypolipidemic effects[29]. The Total Cholesterol Level (TCL), Low Density Lipoprotein (LDL) and triglyceride level (TGL) were also found to decrease by 35, 77 and 29% respectively in severely diabetic rats whereas high density lipoprotein level (HDL) was found to be increased by 18%[29]. The ethanolic extract of *C. dactylon* at doses of 250, 500 and 750 mg/kg body weight were administered orally to normal as well as streptozotocin-induced diabetic rats showed a good antidiabetic potential of the extract against the treated model[30]. The effect was also studied on serum lipid profile of severely diabetic rats. The dose of 500 mg/kg body weight was identified as the most effective dose as it lowered the blood glucose levels of normal by 42.12% and of diabetic by 43.42% during fasting blood glucose and glucose tolerance test respectively[30]. Total cholesterol, low density lipoprotein and triglyceride levels were also decreased by 32.94, 64.06 and 48.46%, respectively in severely diabetic rats whereas cardio protective high density lipoprotein was found to increase by 16.45%[30]. In another investigation the aqueous extract and non-polysaccharide fraction of *C. dactylon* were found to exhibit significant anti-hyperglycemic activity. The non-polysaccharide fraction alone can produce hypoglycemia in fasted normal rats[31].

The extract of leaves of *C. dactylon* is able to reduce hyperglycemia and hyperlipidemia risk and also reduced the oxidative stress in diabetic rats. A momentous diminution of fasting blood sugar level was observed. A significant increase in HDL and decrease ($P<0.05$) in cholesterol, triglyceride, LDL and VLDL were also observed after 15 days of treatment. The investigation also revealed, the activities of AST, ALT, ALP, AP, LDH, and CPK ($P<0.05$) were decreased in the group treated with extract. The significant decrease in protein content and SOD, CAT, GPX, and GSH ($P<0.05$) activity and increase in LPO in plasma were found to be ameliorated after treatment[32].

Antiviral activity

Antiviral activity of *C. dactylon* was found against White Spot Syndrome Virus (WSSV) and it also possesses antiviral activity against human vaccinia virus[33].

The plant extract of *C. dactylon* was incorporated with artificial pellet feed at a concentration of 1% or 2% to the experimental challenge black tiger shrimp (*P. monodon*) that were fed with WSSV-infected shrimp meat. PCR technique, bioassay and Western blot analysis at the end of the experiment were performed to confirm the WSSV-infection. The results of the study showed that the plant extract of *C. dactylon* was found to be highly effective in preventing WSSV infection with no mortality and no signs of WSD in black tiger shrimp (*P. monodon*)[34].

Anti-inflammatory activity

Anti-inflammatory activity of aqueous extracts of *C. dactylon* at different doses (200, 400, and 600 mg/kg of body weight, orally) was investigated using the carrageenan, serotonin dextran and histamine induced rat paw edema and results showed significant anti-inflammatory activity in all the models[35]. In another investigation, the 50% ethanolic extract of *C. dactylon* at 300 and 600 mg/kg body weight showed significant anti-inflammatory activity in rodent[36]. The chloroform-methanolic extract of *C. dactylon* at doses of 125, 250 and 500 mg/kg body weight in carrageenan induced rat paw edema showed significant inhibition for both acute and chronic models and are comparable with standard anti-inflammatory drug, indomethacin. This study also confirmed the significant anti-inflammatory activity of the chloroform-methanolic extract of *C. dactylon* [37].

Immunomodulatory activity

The protein fraction of *C. dactylon* showed significant immunomodulatory activity in healthy Swiss albino mice. The protein fraction was administered by intra peritoneal route and immunomodulatory activity was assessed by testing humoral and cellular immune responses to the antigenic challenges with sheep RBCs and by neutrophil adhesion test. A significant increase in the test parameters viz., neutrophil test, haemagglutinating antibody titer and delayed type hypersensitivity response was observed**[38]**.

An investigation showed that the daily treatment of 70 µl of ethyl acetate fraction of *C. dactylon* polyphenols significantly prevent the immunosuppression caused by pyrogallol in Balb/c mice **[39]**.

Fresh juice of *C. dactylon* of 1.46% (w/w) solid content had a phenolic content of 47±0.33 mg/kg GAE. At doses equivalent to 50, 100 and 200mg total solids/kg body weight the juice protected human DNA against doxorubicin-induced DNA damage as demonstrated in DNA spectral studies, where the ratio of absorbance of DNA at 260 and 280nm in samples pre-treated with the juice was 1.66, 1.53 and 1.63 respectively, while it was 1.37 for DNA treated with doxorubicin only. Oral administration of the juice at 250 and 500 mg/kg in Balb/c mice increased humoral antibody response upon antigen challenge, as evidenced by a dose-dependent, statistically significant increase in antibody titer in the haemagglutination antibody assay and plaque forming cell assay**[40]**.

Antiulcer activity

Antiulcer activity of the alcoholic extract of *C. dactylon* was proved in albino rats at dose level of 200, 400 and 600 mg/kg body weight. Significant (>0.001) antiulcer activity has been observed at dose of 400 mg/kg body weight and 600 mg/kg body weight as compared to the standard drug, ranitidine. The presence of flavonoids in the extract may be responsible for antiulcer activity**[41]**.

Anti-arrhythmic activity

An experiment showed that the hydroalcoholic extract of *C. dactylon* has antiarrhythmic activity against ischemia/reperfusion induced arrhythmias in isolated rat heart**[42]**. During ischemia, the extract produced marked reduction in the number, duration and incidences of ventricular tachycardia (VT) at 25 and 50µg/ml ($p<0.001$ and $p<0.01$, respectively). Total number of ischchemic ventricular ectopic beats (VEBs) were lowered by 25-100 µg/ml ($p<0.001$ and $p<0.05$, respectively). At the reperfusion phase, *C. dactylon* (25 and 50 µg/ml) decreased incidence of VT from 100% (control) to 13 and 33% ($p<0,001$ and $p<0.05$) respectively. Duration and number of VT and total VF incidence were also reduced at the same concentration ($p<0.05$ for all). Perfusion of the extract (25 –100 µg/ml) was markedly lowered reversible VF duration from 218± 99 sec to 0sec, 0sec and 10 ± 5 sec ($p<0.01$, $p<0.01$ and $p<0.05$) respectively. Moreover, *C. dactylon* (25 and 50 µg/ml) decreased number of total VEBs from 349±73 to 35±17 ($p<0.001$) and 66±26 ($p<0.01$). *C. dactylon* produce protective effects against I/R-induced arrhythmias in isolated rat hearts probably by increase in the myocardial contractility and as a result by improvement of hemodynamic factors**[42]**.

Diuretic activity

An investigation on aqueous extract of the root stalk of *C. dactylon* showed diuretic activity in albino rats. Oral administration of the aqueous extract of root stalk of *C. dactylon* at a dose of 100, 250, 500 and 750 mg/kg body weight shows diuretic activity with increased excretion of sodium, potassium, and chloride ions and results were comparable to furosemide**[43]**.

Cardioprotective activity

The effects of hydroalcoholic extract of *C. dactylon* rhizomes on cardiac contractility in normal hearts and on cardiac functions in right-heart failure in rats were studied. The treated rats showed very less signs of fatigue, peripheral cyanosis and dyspnea. The survival rate was high in the extract treated groups (90%). Administration of *C. dactylon* in monocrotaline-injected rats led to profound improvement in cardiac functions as demonstrated by decreased right ventricular end diastolic pressure and elevated mean arterial pressure. The results of this study indicated that *C. dactylon* exerted a strong protective effect on right heart failure, in part by positive inotropic action and improving cardiac functions**[44]**.

Wound Healing activity

The wound healing property of druva gritha was evaluated by incision and excision wound model in male Wister rat promotes wound contraction and reduces the time for closure showing healing potential comparable to Framycetin sulphate 1% cream [45]. Wounds dressed with *Azadirachta indica* and *C. dactylon* extract with honey formulations, as topical application of wounds significantly accelerate the rate of wound healing process. The most effective concentration of aqueous *C. dactylon* extracts was found to be 6.0%, for dead space, excision and incision wound models**[46]**.

Anticonvulsant activity

The ethanolic extracts of aerial parts of *C. dactylon* were evaluated for Central Nervous System (CNS) activities in mice**[47]**. The extract caused significant depression in general behavioral profiles in mice. It significantly potentiated the sleeping time in mice induced by standard

hypnotic's viz., pentobarbitone sodium, diazepam and meprobamate in a dose dependant manner. It also showed a significant increase in analgesic property by potentiating the analgesia induced by morphine and pethidine in mice.

Antioxidant activity

A study was undertaken to evaluate the antioxidative potential of ethyl acetate fraction of *C. dactylon* in Balb/c mice. The activity of enzymic antioxidants (U/ mg of protein) such as catalase (CAT), superoxide dismutase (SOD) and glutathione peroxidase (GPX) were found to be significantly high in ethyl acetate fraction treated mice when compared to the control mice. The levels of nonenzymic antioxidants such as vitamin A, vitamin C, vitamin E and reduced glutathione in the ethyl acetate fraction treated mice was found to be significantly higher than that found in control mice. These results suggest that ethyl acetate fraction of *C. dactylon* has very good antioxidant and hepatic protective effect of normal oxidative stress in Balb/c mice**[48]**.

The enzymic and non enzymic antioxidants were determined in Ehrlich's Lymphoma Ascite (ELA) transplanted Swiss albino mice treated with the protein fraction of *C. dactylon*. The study showed an enhanced enzymic antioxidants levels and non enzymic antioxidants level in the test animals. It proved the protective action of the plant against the free radical damage caused by ELA tumor cells**[49]**.

In the ABTS test performed by [50] revealed that the ethanolic extracts of the plants showed antioxidant activity in the following order: S. cordifolia>/E. alsinoides>/C. dactylon. However, a different order of activity was observed when the same test was performed with the corresponding water infusions (E. alsinoides>C. dactylon>/S. cordifolia), indicating the differential solubility of active principles**[50]**.

Hepatoprotective activity

The evaluation of hepatoprotective activity of ethanolic extract of *C. dactylon* was done against CC14-induced hepatotoxicity in Wister rat model. The extract was given at a dose level of 100, 250 and 500 mg/kg orally for one week. Silymarin (100 mg/kg, orally) was used as a reference drug. *C. dactylon* at a dose of 500 mg/kg showed a reduction in the SGPT, SGOT and ALP levels to 57.01±0.2 (96.80%), 61.28±0.2 (94.93%), and 110.69±0.2 (99.64%) IU/L, respectively. There was a significant increase in serum bilirubin [total (102%), direct (101%)], triglycerides (98.38%) and cholesterol levels (96.48%) after CC14, which was reversed by co-administration of *C. dactylon* or Silymarin**[13]**.

Anticancer Activity

The anticancer activity of *C. dactylon* was evaluated in Swiss albino mice inoculated with EAC (Ehrlich Ascites Carcinoma) cells. Treatment showed significant anticancer activities in the tested animal models, with enhancement of life span and restoration of hematological parameters**[51]**. Antitumor activity of methanolic extracts of leaves of *C. dactylon* against ascitic lymphoma (ELA) in Swiss albino mice was evaluated**[52]**, and tumor was induced in mice by intraperitoneal injection of EAC (1 × 106 cells/mouse). The result revealed that methanolic extract of *C. dactylon* was found to possess significant antitumor and hepatoprotective effect.

Anti-diarrheal activity

In an investigation hexane, dichloromethane, ethyl acetate and methanol extracts of *C. dactylon* whole plant were tested for anti-diarrheal activity on castor oil induced diarrhea, gastro intestinal motility by charcoal meal and entero pooling models in albino rats. Methanolic extract exhibited considerable reduction in inhibition of castor oil induced diarrhea and also showed a significant decrease in gastrointestinal motility by charcoal meal and decreased weight on intestinal contents in enter pooling models . These results indicate that the plant possess good anti-diarrheal activity**[53]**.

Anti-Nephrolithiatic activity

A Study investigates the preventive effects of hydroalcoholic extract of *C. dactylon* roots on calcium oxalate calculi in rats. Urine oxalate level decreased in nephrolithiatic rats treated with the extract. This study showed that the *C. dactylon* extract was able to reduce the growth of urinary stones in rat**[54]**.

Anti-Pyretic activity

The analgesic and anti-pyretic activities of aqueous extract of *C. dactylon* at different doses was studied using hot plate, acetic acid induced writhing and yeast induced hyperthermia in rats. *C. dactylon* showed significant analgesic and anti-pyretic activities in all models studied. The antipyretic effect of aqueous extract of *C. dactylon* was studied in mice; it was found that at the dose of 600 mg/kg, the aqueous extract possessed significant decrease in rectal temperature of mice similar to that shown by paracetamol**[55]**.

Snakebite therapy

A survey of the medicinal plants with antisnake venom activity was performed in Chengapattu district, Tamilnadu, India. The survey in Chengapattu district, Tamilnadu shows

that the *C. dactylon* is very effective in snakebite therapy and the antisnake venom from the plant extract is very effective in the treatment of snakebite[56].

Anti-Arthritic activity

C. dactylon showed significant antiarthritic activity against Freund's complete adjuvant induced arthritis in rats. The ethanolic extract of *C. dactylon* was found to be safe at all the dose levels (100, 200 and 400 mg/kg, orally) and there was no mortality up to the dose of 5000 mg/kg of extract when administered orally. The ethanolic extract of *C. dactylon* at a dose of 400 mg/kg is more effective in improving haematological level, CRP and reducing TNF alpha level. Study evaluated the effect of *C. dactylon* against rats with adjuvant-induced arthritis. Orally administered *C. dactylon* produced significant attenuation in the inflammatory response, oxidative stress and ameliorated the arthritic changes to near normal condition[57].

Bronchodilatory effect

The bronchodilatory effect of *C. dactylon* was investigated by in vitro and in vivo models. Acetylcholine (Ach)-induced bronchospasm was conducted in guinea pig while isolated rat tracheal strip was suspended in organ bath to measure the concentration response curve using multichannel data acquisition system. The chloroform extract of *C. dactylon* (CECD) protected against Ach-induced bronchospasm in guinea pigs, similar to atropine. In the *in-vitro* studies, CECD relaxed carbachol (CCh) and high K^+ -induced contraction of rat tracheal strip, similar to atropine and verapamil, suggesting antimuscarinic and calcium channel blocking (CCB) activities, which were confirmed by right ward shifting of CCh and Ca^{+2} concentration response curve (CRC). The phosphodiestrase (PDE) inhibitory activity was confirmed by potentiation of isoprenaline-induced inhibitory response, similar to papaverine. Densitometry analyses led to the identification of scopoletin as an active ingredient. It significantly inhibited high K^+, and Ca^{+2} induced contractile response, similar to verapamil. The phosphodiestrase inhibitory activity was confirmed by direct evidence of potentiation of isoprenaline-induced inhibitory response, similar to papaverine. The results revealed that the bronchodilator activity of CECD was partly due to presence of scopoletin, and mediated possibly through CCB and PDE inhibition[58].

Reproductive effect

The effect of administration of aqueous extract of entire plant of *C. dactylon* for thirty days on reproductive hormones and reproductive organ weight of female was studied in Wistar rats. Administration of the extract produced significant increase ($p<0.001$) in the serum estradiol concentration whereas, follicle stimulating and luteinizing hormones were significantly ($p<0.001$) reduced. Furthermore, a significant increase ($p<0.001$) in the weight of the uterus and significant decrease in the weight of the ovaries ($p<0.001$) was observed in the treated group when compared to the control group. In addition, the estrous cycle was found to be irregular and disturbed[59].

Table No. 2: Recorded pharmacological properties of *Cynodon dactylon*

Extract	Parts used	Activity	References
Aqueous	Whole plant	Antipyretic and analgesic	[55]
	Whole plant	Anthelmintic	[20]
	Whole plant	Anticataleptic	[60]
	Whole plant	Anti-inflammatory	[61]
	Leaves	Antimicrobial	[62]
	Rhizome	Anti-diuretic	[43]
Aqueous and ethanolic	Leaves	Antiepileptic	[63]
	Aerial parts	Wound healing	[19]
	Aerial parts	Anti-diabetic	[29, 30, 64]
Aqueous and non-polysaccharide fraction	Whole plant	Anti-diabetic	[31]
50% aqueous-ethanolic	Aerial parts	Reduce kidney stone	[65]
Chloroform-methanolic	Whole plant	Anti-inflammatory	[37]
Ethanolic	Whole plant	Anticonvulsant	[66]
	Aerial parts	Gastoprotective	[53]
	Aerial parts	Central Nervous system	[47]
50% ethanolic	Whole plant	Anti-inflammatory	[36]
Ethyl acetate fraction	Leaves	Antioxidant	[67]
	Aerial parts	Antioxidant	[48]
	Leaves	Immunomodulatory	[39]
Hydroalcoholic	Rhizome	Anti-arrhythmic	[42]
	Rhizome	Cardio-protective	[44]

	Aerial parts	Antioxidant	[68]
	Whole plant	Antibacterial	[69, 70]
Methanolic	Roots	Anticancer	[71]
	Whole plant	Anti-diarrheal	[53]
Phospate buffered saline	Leaves	Antilipidperoxidative	[72]

1.5 Dosage forms

Paste: It is used in application on any inflammation, wounds, skin ailments and pain. It is very effective in skin disorders, wounds and scar**[14].**

Powder: It is very helpful in nausea, diarrhoea, and piles**[14].**

Juice: It is useful in urine related disorders and urinary tract infections. It is also useful to stop bleeding occurring in body**[14].**

Dose: Juice: 10-20 ml**[11].**

1.6 Biosafety

Most of the varieties of *C. dactylon* are non-toxic but an occasional case of HCN poisoning may occur. The species was found to possess 1.10% total oxalic acid in dry matter without showing any toxicity**[1]**. The aqueous extract of *C. dactylon* was found safe and there was no mortality up to 4000 mg/Kg in rats**[35]**.

1.7 Future prospects

Treatment of various diseases with natural herbal products is increased in recent years. *C. dactylon* has a prime position in ethno medicinal practices and traditional systems of medicine. It is extremely useful in wide variety of ailments. Many researchers all around the world have been investigated on various pharmacognostic and pharmacological actions of *C. dactylon* supporting its medicinal uses mentioned in the traditional medical knowledge systems. So, it can be expected that the proper evaluation of the plant will help in the development of new, safe, potent and cost effective drugs in near future to control many diseases.

2. Conclusion

From the very beginning of civilization, medicinal plants have provided enormous leads to combat diseases. *C. dactylon* is a weed and has been found to possess various potential medicinal with diverse pharmacological activity spectrum. This review article provided adequate information about medicinal, pharmacognostic and pharmacological properties of this plant. In the near future it may be used as a novel drug to treat many diseases such as anticancer, antiulcer, anti-diabetics, antibacterial, antimicrobial, antiviral, cardiovascular and wound healing. Since this versatile medicinal plant is the unique source of various types of chemical compound, extensive investigation is necessary to utilize their therapeutic aptness to cure diseases.

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