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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
Impact Factor (RJIF): 6. 34
TPI 2025; 14(11): 01-07

www.thepharmajournal.com
Received: 10-08-2025
Accepted: 15-09-2025

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Review on *Cynodon dactylon* (L.) (Durba grass): The phytochemicals present and its biological utilities

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DOI: https://www.doi.org/10.22271/tpi.2025.v14.i11a.26296

Abstract
Cynodon dactylon is a long-lived weedy grass which is an auspicious herb among the all ten herbs and constituting of the group 'Dasapushpam' in Ayurveda, distributed globally, mainly in the tropical lands. In India, it is very sacred grass and used in the worship of Hindu God and Goddess. *Cynodon dactylon* is locally known as Durba grass in Bengal. This grass is very rich in metabolites such as carbohydrates, proteins, flavonoids, carotenoids, minerals, alkaloids, glycosides and triterpenoides. Whole parts of the grass *Cynodon dactylon* shows various activities like antimicrobial, antiviral, antibacterial and wound healing properties. Moreover, it is used extensively in traditional medicines to cure various ailments namely cough, hemorrhage, headache, hypertension, diarrhea, dysentery, hysteria, snakebite, sores, measles, stones urogenital disorders, tumors etc. Synthesis and characterization of silver nano-particles, gold nano-particles and bio-silica nano-particles using *Cynodon dactylon* extract and evaluation of their antibacterial activity have been reviewed in this manuscript.

Keywords: *Cynodon dactylon* (Durba grass), medicinal plants, flavonoids, triterpenes, antioxidant, antidiabetic, antidiuretic, anticancer, immunomodulatory, pharmacology

Introduction
There are many weeds around us and these can be used traditionally as medicinal plants to cure major health disorders. Various phytochemical constituents are obtained from different parts of the grass, such as leaf, stem, root, fruit, seed etc. *Cynodon dactylon* (L.), a weedy grass (the generic comes from Greek word 'kuon' means dog and 'odous' means tooth, whereas the specified name comes from 'daktulos' means finger refering to digitate inflorescence) [1]. is an auspicious herbs constituting the group 'Dasapushpam' in Ayurveda [2]. The 'Doob' is a Sanskrit name of durva, meaning is to cut or eaten by the animal. This is a sacred plant to lord Shiva, Ganesa and Visnu just like vilva, durva and tulsi respectively.

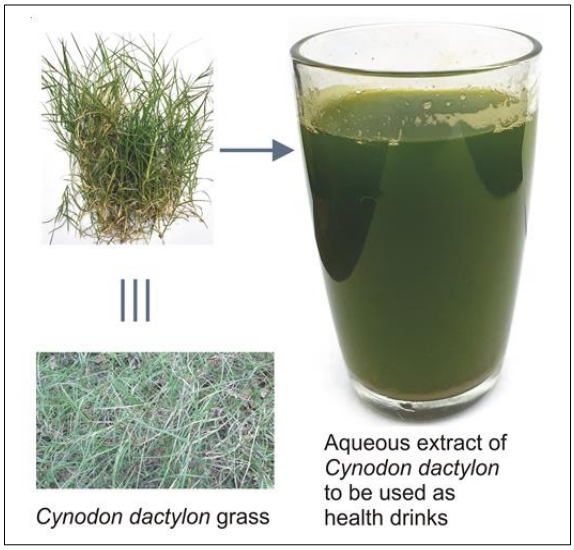

Fig 1: Photo of *Cynodon dactylon* and its aqueous extract to be taken as health drink

The god Ganesa is worshiped with the durva leaves religiously [3]. The plant extract is used traditionally as antidiabetic agent in India [4]. The extract of *C. dactylon* shows various activities such as antioxidant, [5] healing to the minor injuries, [6] hepatic antioxidant and immunomodulatory activities [7]. The aqueous extract from the root of *C. dactylon* is used to treat diuretic, [8] purifying agent and dysentery [9]. The extracts of *C. dactylon* had also been described to exhibit antimicrobial activity against fungus and bacterial pathogens [10]. From these activities, it is very clear that the *C. dactylon* shows various pharmacological activities. Synthesis and characterization of silver nano-particles, [11] gold nano-particles [12] and bio-silica nano-particles [13]. Using *Cynodon dactylon* extract and their antibacterial activity have also been described earlier. Therefore, this review will highlight the chemical constituents, pharmacological and biological utilities of *Cynodon dactylon*.

2. Local names in Indian language

Sanskrit: Bhargavi, Doorwa, Granthi, Sveta; Hindi: Doorva, Doob; Bengali: Durba. It is known as Durba grass, Bermuda grass, Dog's Tooth grass, Bahama grass, Devil's grass, Cough grass, Scuth grass, Dhub, Doob in different region of the world [14].

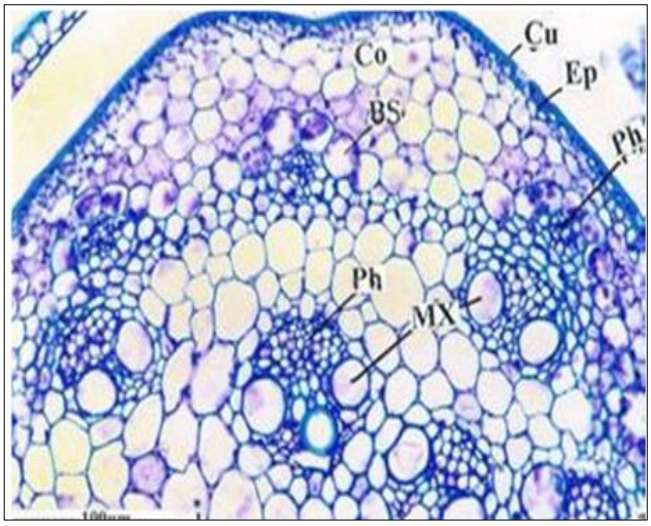

Fig 2: T. S of the Stem-portion enlarged [39]

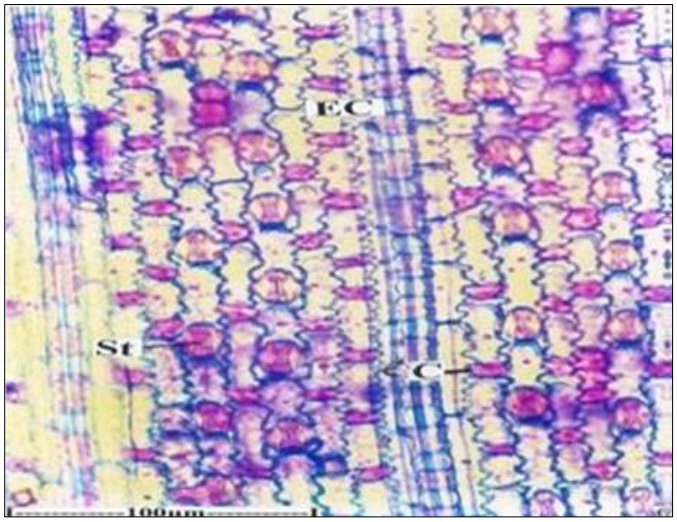

Fig 3: Epidermal cells and stomata enlarged [39]

3. Chemical Constituents

The plant contains carbohydrates, crude proteins and mineral constituents, phosphorous, oxides of magnesium, calcium, potassium and sodium. The plant containing triterpenes (Figure-6), carotene and sitosterol. Several compounds like cartone, vitamin-C, palmitic acid, alkaloids, triterpenoides, ergonovine and ergonovinine etc. are also present. Major phyto-constituents present are flavonoids: apigenin, luteolin, orientin and vitexin (Figure-5); [15]. carotenoids: beta-carotene, neoxanthin, violaxanthin, lutein, [16]. phenolics, [17]. phytosterols, glycosides, saponins, [18]. fatty acids (Figure-4), [19]. volatile oils [20].

4. Biological Utilities

Cynodon dactylon (L.) is very useful and medicinally active plant which plays a vital role in ancient as well as modern Ayurvedic medicines [37] It grows almost everywhere in India and also available in each and every seasons. Some of the people take it regularly as health drinks to stay away from several diseases (Figure-1). It is also very delicious drink, if somebody takes it by adding some salt into its aqueous drought solution. The cross-sectional images of *Cynodon dactylon* is shown in (Figures-2 and 3). It shows several biological utilities which have been reviewed in this article and discussed as follows:

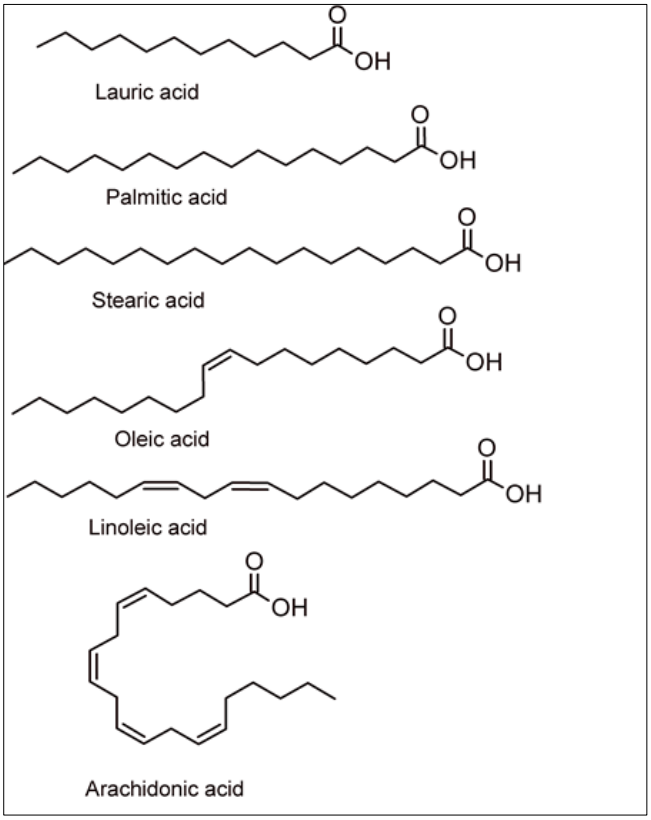

Fig 4: Fatty acids presents in *Cynodon dactylon*

4. 1 Pharmacological activities

Cynodon dactylon (L.) shows several Pharmacological activities (Figure-16) [37] so, it is very beneficial in Pharmacological aspects and its Pharmacological behavior takes it to the mountain top in Indian Ayurvedic medicines. The aqueous and alcoholic extracts of aerial parts of *Cynodon dactylon* exhibited wound healing, [6] anti-diabetic [21] and diverse pharmacological activities.

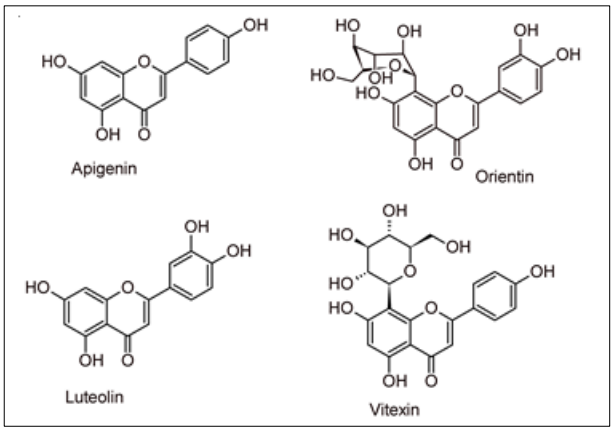

Fig 5: Flavonoids presents in *Cynodon dactylon*

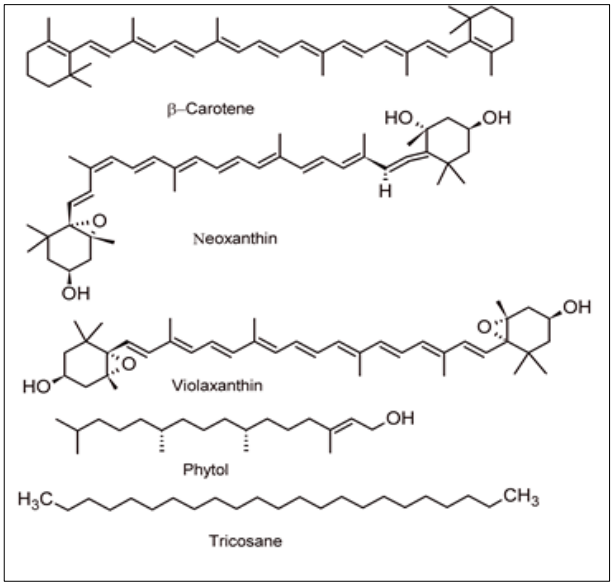

Fig 6: Triterpenes presents in *Cynodon dactylon*

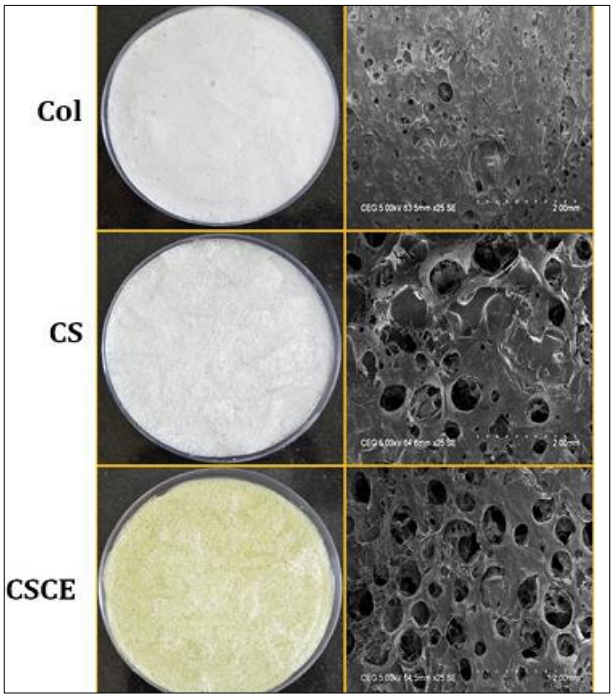

Fig 7: Photographic and SEM morphology of Col, CS and CSCE scaffolds at magnifications of 40X. Pore size measurement of scaffold using ImageJ software [38]

4.2 Antioxidant property

The enzymatic and non-enzymatic antioxidants effect in Ehrlich's lymphoma ascite (ELA) transplanted mice were influenced by the ethyl acetate extract of *Cynodon dactylon*. The normal intake of ethyl acetate extract about (80 µg in 100 µL of DMSO, ip) increased the enzymatic and non-enzymatic antioxidants in ELA transplanted mice [22]. The anticancer property was estimated in cytotoxic extracts of *Cynodon dactylon* through Annexin-fluorescein isothiocyanate-conjugated assay in human colon adenocarcinoma cell lines (COLO 320 DM). Thus, *Cynodon dactylon* extracts are very useful to show tremendous antioxidant activities [23]

4.3 Antidiabetic activity

Cynodon dactylon is very well-known for its anti-diabetic activities. It can tremendously reduce the diabetic level in diabetic affected patient. The antidiabetic effect of *Cynodon dactylon* was checked through using (70%) ethyl acetate extract of root and stem. It was observed that diabetes persuade by combination of ketamine as (60 mg/Kg) and xylazine as (10 mg/Kg) in mice, that persuade induced a sustained hyperglycemia. The 50 and 100mg/Kg extract of *Cynodon dactylon* was used in mice. Both dosages have reducing effect in the glucose level in blood. The first dose dominated the second, and having the impact just like insulin [24]

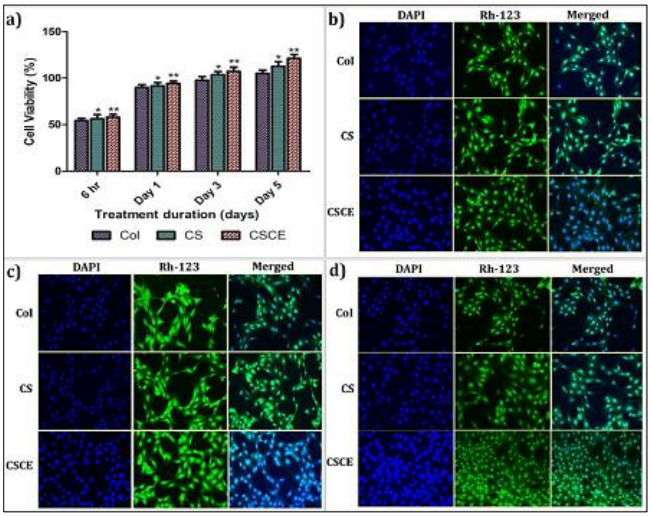

Fig 8: (a). *In Vitro* biocompatibility of scaffolds by MTT assay. Values are expressed as mean ± SD and the level of significance is expressed as *and ** corresponding to $p<0.05$ and $p<0.01$, respectively compared with the corresponding control group. Fluorescence microscopy images (400X magnifications) of DAPI and Rh-123 stained 3T3 mouse fibroblasts cells on developed scaffolds at different time intervals (b) Day 1, (c) Day 3 and (d) Day 5. DAPI staining (blue color) shows nucleus and Rh-123 staining (green color) indicates active mitochondrial membranes of cells [38]

4.4 Antidiuretic activity

Cynodon dactylon is very active to cure the Antidiuretic disorder in patient. The aqueous extracts of *Cynodon dactylon* rhizome shows antidiuretic potentials and were estimated by oral intake of different doses in hydrated male Wistar rats. The results showed that urinary output and electrolytes excretion increased at the dose of 500 mg/kg body weight by *Cynodon dactylon*. Thus, the rhizome extracts could be used for diuretic remedy [25].

4.5 Anticancer activity

Now a day the disease cancer is getting spread very prominently all over the world and several scientists and researchers are working on it to find a permanent and concrete remedy of it. However, *Cynodon dactylon* shows positive result in the above aspect. *Cynodon dactylon* extract shows anticancer activity that was estimated in Swiss albino mice after inoculated with Ehrlich as cites carcinoma (EAC) cells. The doses including, 100, 200 and 400 mg/kg of body weight of the extract were taken orally for respective ten days. The anticancer activity possessed by in the life duration of mice and mean survival time was increased [26]

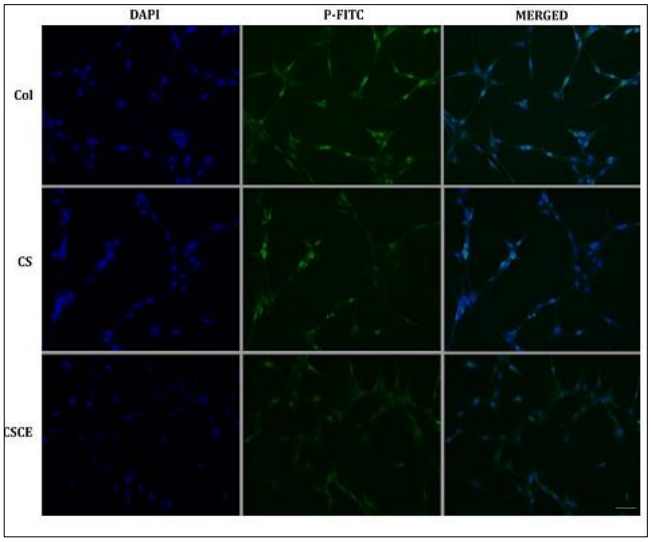

Fig 9: Fluorescence images of the cytoskeleton and nuclei of NIH3T3 fibroblasts cultured on Col, CS and CSCE scaffolds for 24 h. Actin microfilaments (green) and cell nuclei (blue) were visualized by FITC-phalloidin and DAPI respectively (The measurement of scale is 50 μm). [38]

4.6 Anti-inflammatory antipyretic and analgesic effects

The aqueous extracts of *Cynodon dactylon* shows anti-inflammatory activity which was estimated through carrageenan, serotonin dextran and histamine induced rat paw edema. All the doses possess tremendous anti-inflammatory activity in all models [27]

Hot plate, acetic acid induced writhing and yeast induced hyperthermia in rats were the used tools to show analgesic and anti-pyretic activities of the aqueous extract of *Cynodon dactylon*. Thus, *Cynodon dactylon* showed tremendous analgesic and anti-pyretic activities in all the above models [28]

4.7 Preparation of several nano-paticles

Synthesis and characterization of silver nano-particles (figure-15), [29] gold nano-particles [30] and bio silica nano-particles (Figures-7-12) [31,38]. Using *Cynodon dactylon* extract and assessment of their antibacterial activity have also been reported. The biological applications of the nano-particals containing gold (Figures- 13 and 14), bio-silica and silver sol have been shown below. All the figure images clearly demonstrate the biological activities of all the respective nano-particles *in vivo* and *In Vitro* systems. Thus, *Cynodon dactylon* extracts are useful for the preparation of several nano-particles and also to understand their biological activities.

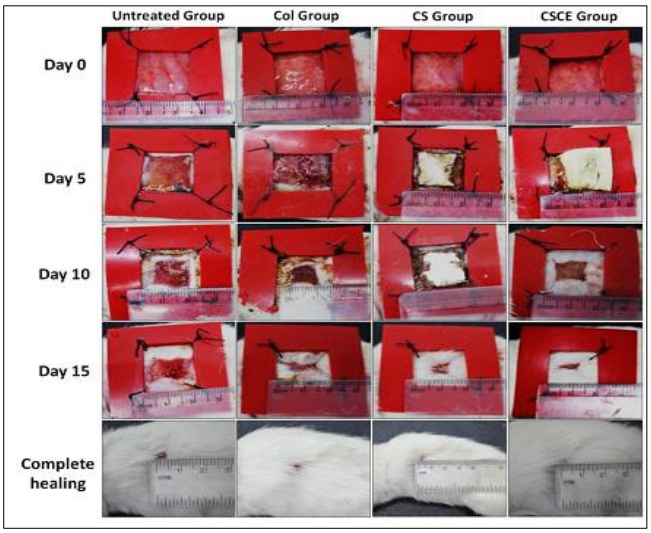

Fig 10: Photographs of the Col, CS, CSCE and control (untreated) wounds. Each wound shown here is representative of four rats per group on the given day [38]

4.8 Gastrointestinal effects

Cynodon dactylon extract is very useful in gastrointestinal disorders in patients and it shows positive results. The 50% ethanolic extract of *Cynodon dactylon* was estimated in indomethacin as gastro-ulcerogenic potential. 50% ethanolic extract of *Cynodon dactylon* was administered in the doses of 300 and 600 mg/ kg in male Sprague-Dawley rats through oral administration of indomethacin for ulcer induction [32]

4.9 Immunomodulatory activity

Cynodon dactylon is very active in Immunomodulatory activities. The experimental results recommends for its positive Immunomodulatory behavior. Ethyl acetate fraction of *Cynodon dactylon* polyphenols in using daily brings about the best prevention of the immune suppression through pyrogallol in Balb/c mice was seen in *Cynodon dactylon* protein fraction shows strong utility for the suitable immune stimulant in swine albino mice [7, 33]

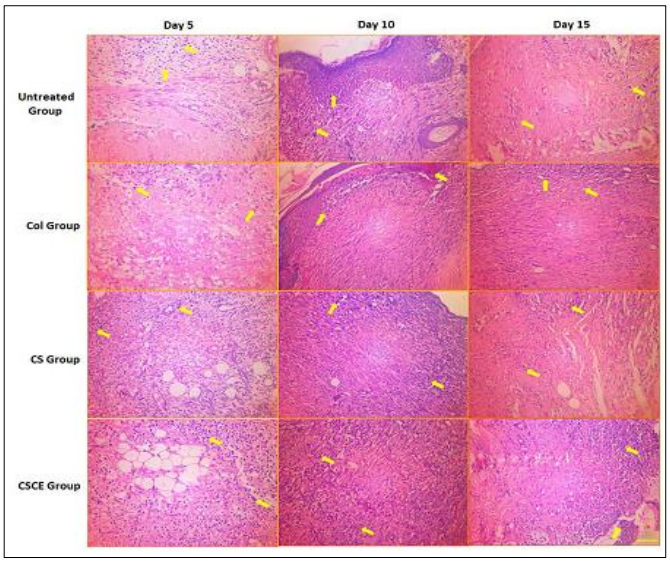

Fig 11: Hematoxylin and Eosin stained sections of the regenerated skins of control and experimental animal groups on 5th, 10th and 15th days. Arrow (Yellow in colour) indicates the fibroblasts cells of granulated tissues. The magnification is 20X with 50 μm scale bar[38]

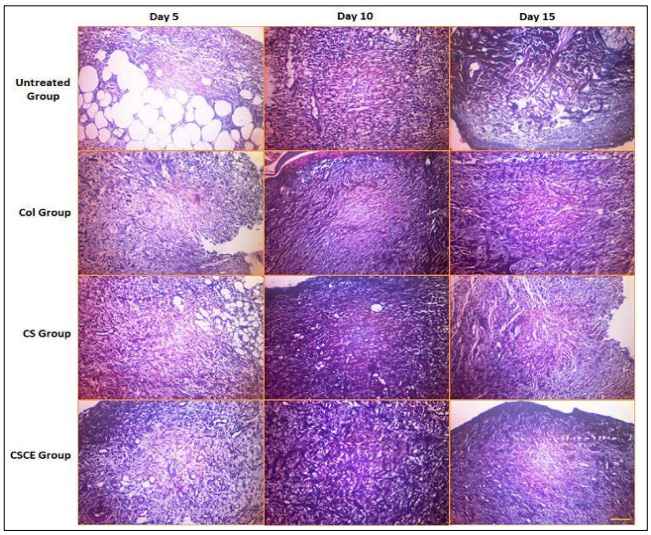

Fig 12: Masson's trichrome staining of skin tissues treated with Col, CS, and CSCE and an untreated control group of animals. The magnification is 20X with 50 µm scale bar [38]

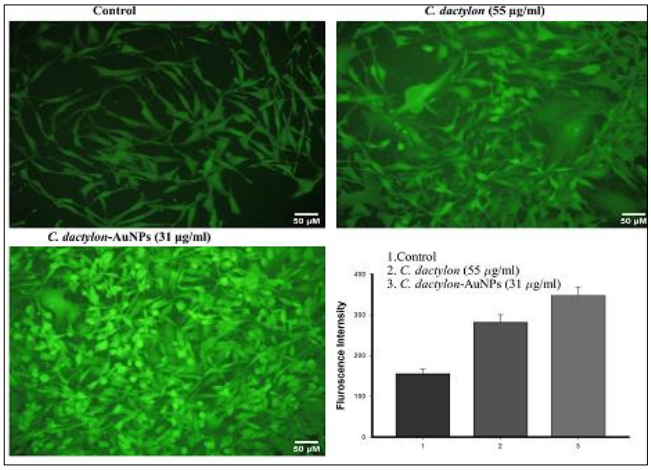

Fig 13: Quantitative analysis of *C. dactylon*-AuNPs induced ROS by DCFH-DA staining assay. Dichlorodihydroflurescenin diacetate (DCFHDA). [30]

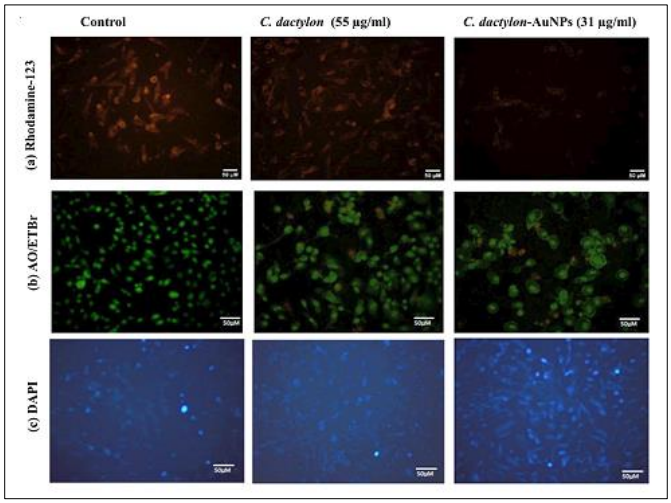

Fig 14: a Measurement of fluorescent microscopic by Rhodamine-123 staining, b analysis of *C. dactylon* and *C. dactylon*-AuNPs induced cell death in term of cell death stages by AO/EB staining. c Morphological evidence of apoptosis by DAPI. 4′,6-diamidino-2-phenylinodole (DAPI), acridine orange (AO), ethidium bromide (EtBr). Control: untreated cell [30]

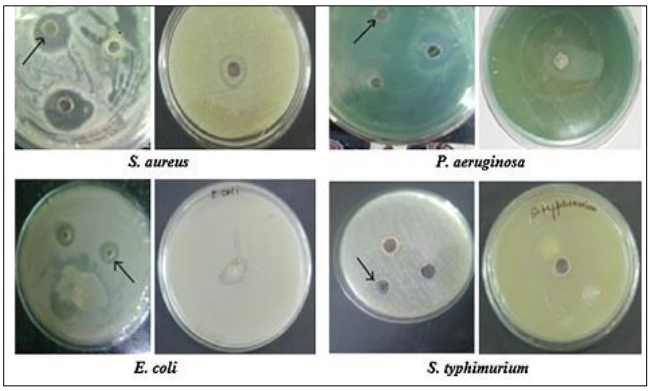

Fig 15: The diameter of inhibition zone (DIZ) exhibited by aqueous silver nanoparticles (10 lg/mL) indicated by arrow, silver nitrate solution (1 mM), and *Cynodon dactylon* leaf extract impregnated wells in presence of common pathogens [29]

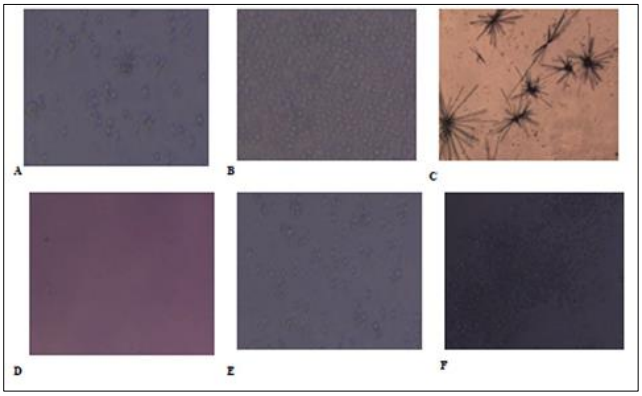

Fig 16: Splenocyte proliferation observed under an inverted microscope at 4 ×magnification (A) Spleen cells, (B) Spleen cells treated with CdL extracts, (C) Formazan formation, (D) Dissolved formazan, (E) Spleen cells without mitogen, (F) Spleen cells with the mitogen concanavalin A [37]

4.10 Antiparasitic insecticidal and repellent effects

Anthelmintic activity of the extracts of *Cynodon dactylon* from petroleum ether, methanol, and water was estimated on young indian earthworm *Pheretima posthuma* along with albendazole as a standard drug. The aqueous extract of *Cynodon dactylon* exhibits anthelmintic activity in comparison with the standard drug [34]

The volatile oils from *Cynodon dactylon* shows mosquito repellents activity against (*A. aegypti*) [35]

5. Toxicity

The aqueous extract of *Cynodon dactylon* is secure and no death was observed up to 4000 mg/Kg in rats. About half of percentage of rat death (LD50) at 4. 5 g/kg was seen on treating the aqueous *Cynodon dactylon* rhizomes extract [36]

6. Conclusion

Cynodon dactylon has been used extensively in ayurvedic medicine from primitive era for healing various diseases in human body. The aqueous extract from the plant, leaves, aerial parts and rhizomes of *Cynodon dactylon* has various medicinal and clinical applications that were confirmed from comprehensive research on biological activity, pharmacological activity, and immense safety. After studying its biological and pharmacological activities it would become much easier to develop new drug molecules. From the various studies it is clear that *Cynodon dactylon*, a natural drug

containing a universal, pharmacological and biological functions. Thus, it might be treated as novel drug to cure various diseases such as antimicrobial, anticancer, antiviral, antibacterial, antidiabetics, antiulcer, wound healing etc. The *Cynodon dactylon* grass is very abundant around us and thus very thoughtful to design the wide clinical trials in diabetic patients. Thus, the species might be easily explored in the benefits of human from natural habitat.

7. Acknowledgement

The author thankfully acknowledge his research supervisor: Honorable Professor Braja Gopal Bag, who always inspired and motivated to write such innovative review work. The article is solely for the informational and educational purpose and not to misinterpret, offend or harmful to any individual, group or belief. Secondly, the author thankfully acknowledges his gratitude to all the authors whose papers have been cited in this manuscript. The author is solely acknowledging Vidyasagar University for providing research facilities.

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