Exploring the Pharmacological and Phytochemical Properties of Cynodon dactylon

Shruti Shinde*, Yukta Phulwani & Sampada Waghmare.

Matoshri Education Society`s, Matoshri College of Pharmacy, Ekhlare, Nashik Maharashtra.

ABSTRACT: Cynodon dactylon, commonly known as Bermuda grass, is an herbaceous perennial with global distribution in tropical and subtropical regions. It has gained immense interest due to its multifaceted pharmacological activities, including antioxidant, anti-inflammatory, antimicrobial, antidiabetic, and hepatoprotective activities. Phytochemical studies have revealed the presence of bioactive constituents, including flavonoids, alkaloids, terpenoids, and phenolic compounds responsible for its medicinal activities. This review is intended to provide an overview of the phytoconstituents, pharmacological activities, and traditional uses of Cynodon dactylon, its therapeutic potential, and future research direction for the development of pharmaceuticals.

Keywords: Cynodon dactylon, Phytoconstituents, Pharmacology, Traditional Medicine, Herbal Therapeutics

Introduction:

Interest in medicinal plants and their historical applications has increased dramatically in recent years. These plants have been used to create a wide range of medications and bioactive chemicals, including antibacterial, antioxidant, anticancer, and anti-inflammatory properties. Flavonoids, alkaloids, and terpenoids are among the substances found in Cynodon dactylon, according to phytochemical analyses. Its wide range of medicinal qualities, including as cardiovascular, antidiabetic, antioxidant, antibacterial, and anticancer activities, are highlighted by research. The chemical makeup and therapeutic potential of Cynodon dactylon are the main topics of this review **[1].**

With uses for both internal and exterior application, Cynodon dactylon has many therapeutic advantages. Root decoctions are used to treat urinary tract irritations and secondary syphilis because of their antiviral and antibacterial qualities.**[2]** Of the 22 compounds found in C. dactylon, the most common were hydroquinone (69.49%), levoglucosenone (2.72%), and furfural (6.0%). Additionally, 20 compounds were described.**[3]** In tropical and subtropical areas, it is frequently grown. Both the root stalk and the entire plant are used medicinally.**[4]** The perennial grass C. dactylon (L.) Pers. is well-known for its many therapeutic uses.**[5]** According to estimates from the World Health Organization, almost 80% of people worldwide get their primary medical care from herbs.**[6]**

Numerous medical benefits are provided by this grass, which known by several names, including Indian doob, Durva grass, Bahama grass, Bermuda grass, wiregrass, villain's grass, dhoob, love seat grass, vilfastellata, grama, dubo, scutch grass, arugampul, and canine's tooth grass. It is thought to be useful in treating asthma, leucoderma, spleen enlargement, bronchitis, poor breath, and piles. In homeopathy, its medicinal qualities are especially regarded for treating many kinds of skin and bleeding issues. In addition to its therapeutic applications, this grass has cultural importance and is customarily utilized in religious ceremonies in Bangladesh, Bhutan, Nepal, India, and Sri Lanka.**[7]**

Bermuda grass, or Cynodon dactylon, comes in a variety of forms, each with unique traits. Tall and leafy, the Midland variety is winter-hardy and coastal. Conversely, Hardie is sterile and does best in environments with a pH lower than 5. After being seeded, Guymon shows good winter hardiness and dense tillering. Another seeded cultivar, Wrangler, has mediocre winter hardiness but yields good fodder. Sprigging is used to establish the Greenfield type, which has a strong stand capacity, dense sod, and good cold tolerance. Tifton 44 is a coastal and winter-hardy type that is leafy, tall, and known for its better yield and good stand. Midland 99 is a hay type characterized by cold tolerance and average forage quality. Quick Stand, which is winter hardy, is primarily used for turf, erosion control, and features a very dense sod. Lastly, the World Feeder type has moderate winter hardiness but is noted for inferior forage yield**.[8]**

Taxonomical classification:

Kingdom: Plantae,

Subkingdom: Tracheobionta,

Super division: Spermatophyta,

Division: Magneliophyta,

Class: Liliopsida,

Subclass: Commelinidae,

Order: Cyperales,

Family: Poaceae,

Genus: Cynodon,

Species: Cynodon dactylon

Common names:

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.

Different vernacular names around the world:-

- India: Doob, Durva, Haryali, Kabbar, KarukaOulli, Talla.
- Africa: Kweekgras
- Bangladesh: Durba
- Cambodia: Smao Anchien
- Canada: Ambate-Hullu, GraikaeIndia: Doob, Durva, Haryali, Kabbar, KarukaOulli, Talla.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

Phytochemical properties:

The different morphological elements of C. dactylon clearly presented a number of recognized phytoconstituents.

It includes:

- Ethyl acetate (9.50%)
- Ethyl hexopyranoside (8.42%)
- Ethyl linoleate (5.32%)
- Phytol (4.89%)**[9]**
- Hydroquinone (69.49%)
- Furfural (6.0%)
- Levoglucosenone (2.72)**[10]**
- Tricosane (22.05%)
- 1, 2-propanediol (20.30%)
- 3- benzyloxy-1, 2 diacetyl (12.62%)**[11]**
- Hexadecanoic acid (17.49%)
- D-mannose (11.48%)
- Linolenic acid (11.28%)**[11]**

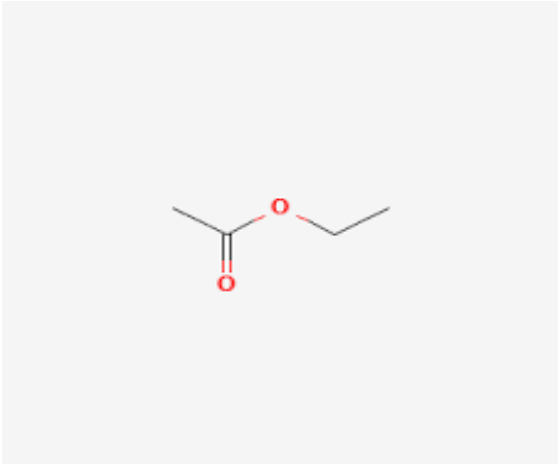

Fig 1: Ethyl Acetate

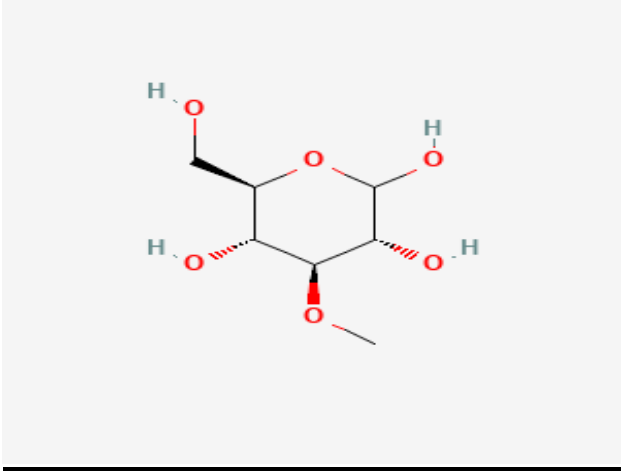

Fig 2: Ethyl hexopyranoside

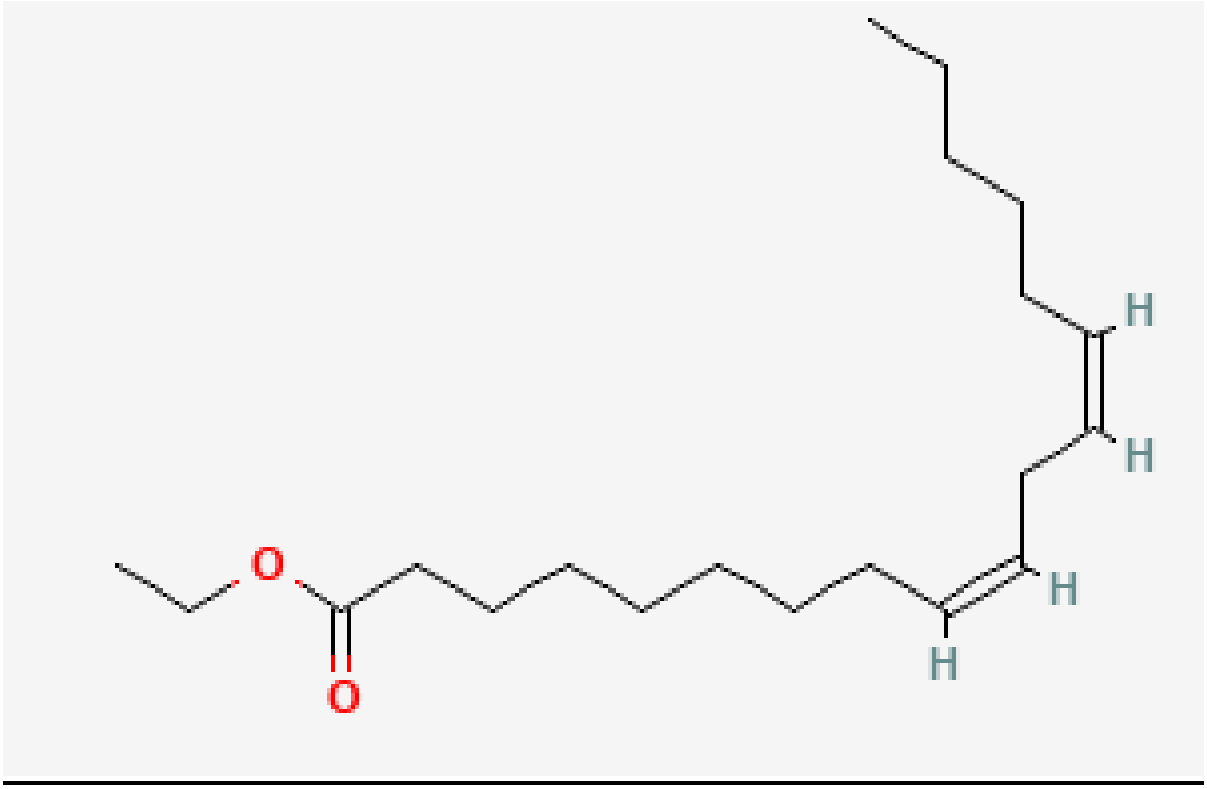

Fig 3: Ethyl Linoleate

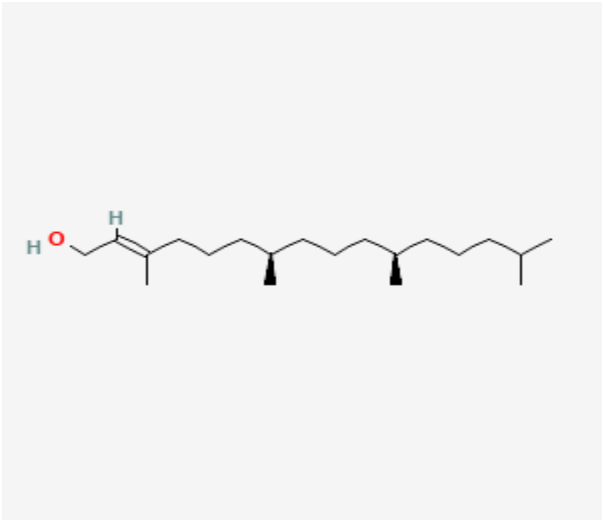

Fig 4: Hydroquinone

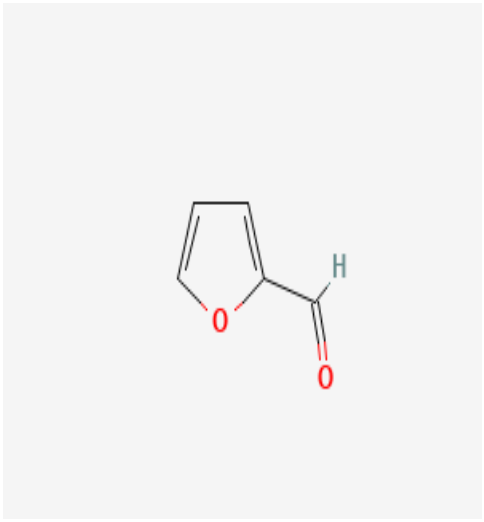

Fig 5: Furfural

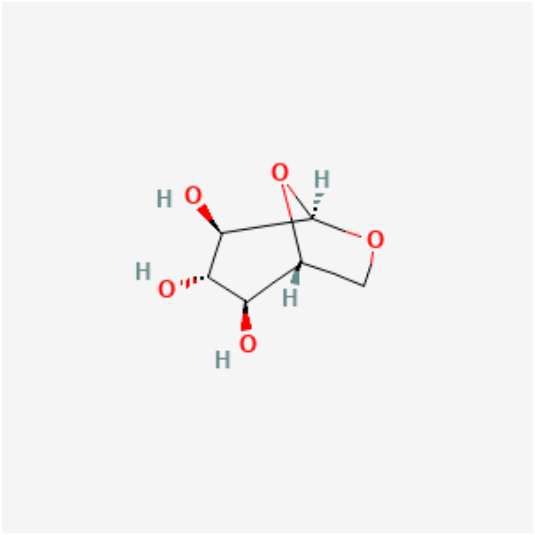

Fig 5: Levoglucosane

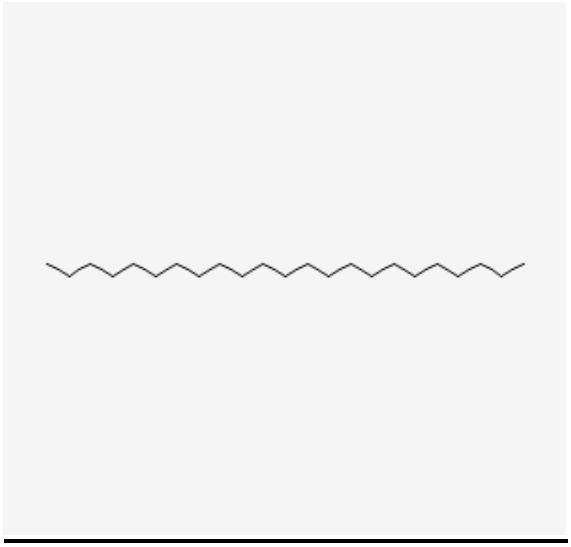

Fig 6: Tricosane

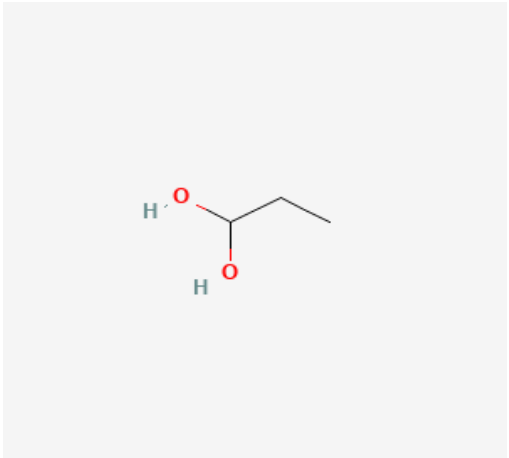

Fig 7: 1, 2-propanediol

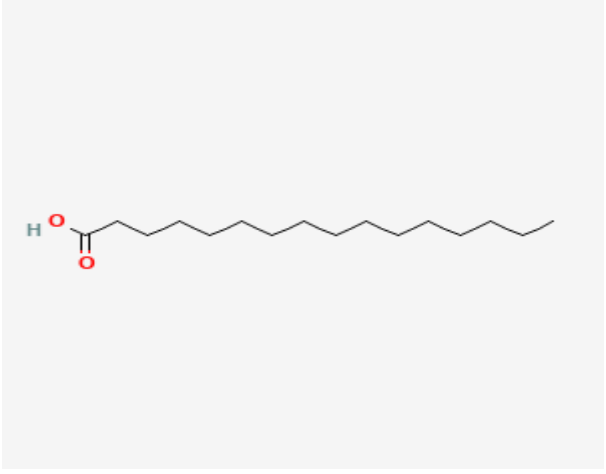

Fig 8: Hexadecanoic Acid

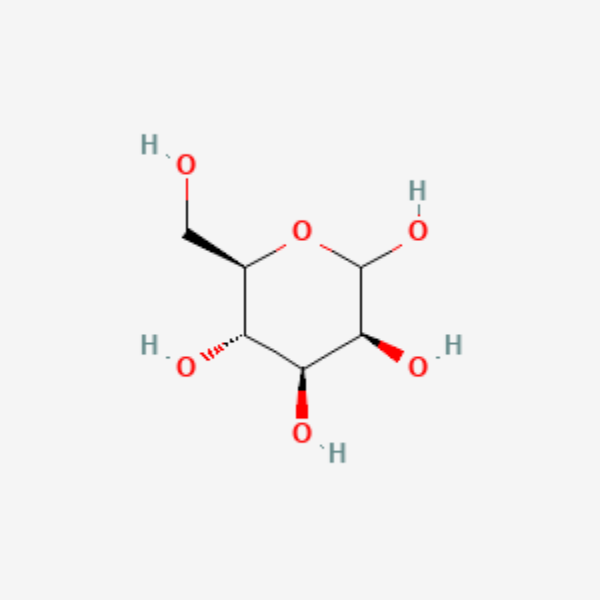

Fig 9: D-mannose

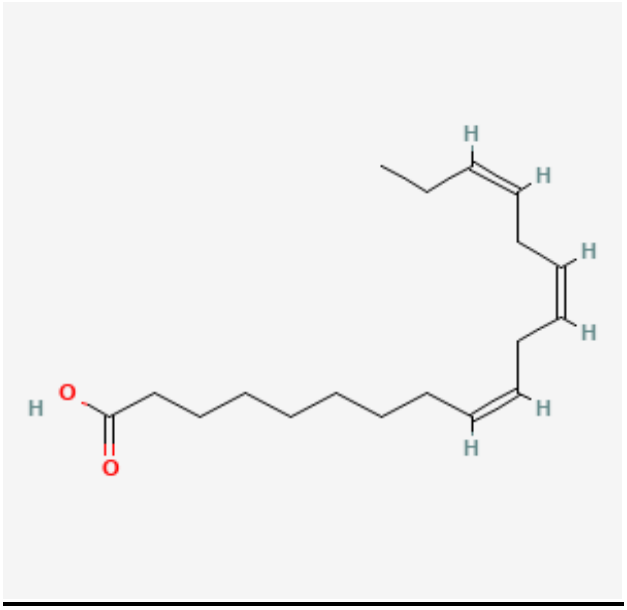

Fig 10: Linolenic Acid

Microscopic characters :

- Roots:-The fibrous, cylindrical root of *cynodon dactylon* can reach a thickness of 4mm. Smaller cream colored roots that resembles hairs grow from the main roots.

- Stem: - It's very smooth upto 1mm thick with greenish yellow hue.

- Leaf: - 2 to 10 cm long and 1.25 to 3 mm broad. The shaped of leaves are slender. **[12,13,14,15,16]**

Pharmacological Characteristic :

Anti – oxidant Activity:

Chemical substances known as antioxidants scavenge or inhibit the production of reactive oxygen species (ROS), which can postpone the onset or reduce the rate of food systems' lipid oxidation reaction. Free radical harms cells and contributes significantly to the aging process and in the course of illness.

Antioxidants are essential for protecting against damage from free radicals. in order to preserve optimal health.**[17]** Alcoholic It was discovered that C. dactylon aerial part extracts have strong DPPH free radical scavenging capabilities and the ability to scavenge nitric oxide.**[18]** An extract of ethyl acetate from the ground portion of the Plants have demonstrated increased antioxidant capacity in vitro based on calculating the non-enzymatic glycosylation of haemoglobin according to colorimetric**.[19]**

In Ehrlich's lymphoma ascite (ELA) transplanted mice, the impact of Cynodon dactylon ethyl acetate fractions on the concentration of enzymatic and non-enzymatic antioxidants was investigated. The concentrations of non-enzymatic and enzymatic antioxidants, such as glutathione peroxidase, catalase, and superoxide dismutase.

For example, ELA-induced mice had lower levels of reduced glutathione, vitamin A, and vitamin E because of the release of the liver's free radicals. When 80 µg of ethyl acetate extract was administered intraperitoneally in 100 µl ofDMSO, the amount of ELA-transplanted mice's levels of enzymatic and non-enzymatic antioxidants**.[19]**

Anti – inflammatory Activity :

Cynodon dactylon found positive in showing antiinflamantory effect.The Phytochemical compound of Cynodon dactylon may interfere with the process of epithelial Cell damage induced by crystals or may exert inhibitory effect on inflammation.

Rats were given substances like histamine,carrageenan,and serotonin dextran to cause paw oedema in order to confirm the anti-inflammatory effects. A body part that's wells or bulges because of To the body's fluids becoming trapped**.[20]** 200mg/kg and 400mg/kg fractions And 600mg/kg per rat bodyweight, the aqueous extract of C.dactylon, Were used in oedema treatment. Every necessary trial revealed significant C.dactylon's anti-inflammatory properties**.[21]**

Anti – ulcer Activity:

The plant extract's antisecretory qualities, which are comparable to those of the H2-antagonist drug, may be the reason for its effectiveness in treating ulcers.[22]

In a study investigating C. dactylon's anti-ulcer properties, rats were given indomethacin to generate stomach ulcers. A common drug called famotidine was used as a benchmark to assess the anti-ulcer effects.

Half of the ethanolic extract of C. dactylon was given orally 30 minutes before the indomethacin therapy at doses of 300 mg/kg and 600 mg/kg in order to evaluate the anti-ulcer activity. Both dosages showed a 54.74% reduction in the ulcers caused by indomethacin, indicating a preventive effect.**[23]**

Pharmacognostic analysis and phytochemical evaluation of various extracts from Cynodon dactylon reveal a wealth of phytochemical compounds that warrant a comprehensive exploration of the plant's medicinal potential. Initial screening of these extracts has identified the presence of flavonoids, alkaloids, phenolic glycosides, carbohydrates, fixed oils, and lipids. Notably, research indicates that flavonoids possess bioactive properties beneficial for ulcertreatment. The results of this study suggest that the aerial parts of Cynodon dactylon hold significant promise for further investigation, potentially leading to the creation of effective ulcer treatment therapies. Moreover, the development of phytomedicines is relatively cost-effective and time-efficient, making it an attractive avenue for research and application.**[24]**

Anti-diabetic Activity:

The antidiabetic properties of a 70% ethyl acetate extract of Cynodon dactylon root and stem were investigated in mice with diabetes brought on by a combination of xylazine (10 mg/kg) and ketamine (60 mg/kg), which produced chronic hyperglycemia. It dramatically reduces blood glucose levels.**[25]**

In diabetic rats, the aqueous and non-polysaccharide portion of Cynodon dactylon markedly decreased the levels of urea, high density lipoprotein, low density lipoprotein, triglycerides, cholesterol, and glucose.**[26]**

The antidiabetic, antioxidant and hypolipidemic efficacy of Cynodon dactylon were studied in alloxan-induced diabetic rats. A significant diminution of fasting blood sugar level with a significant increase in HDL and decrease ($p<0.05$) in cholesterol, triglyceride, LDL and VLDL were recorded after 15 days of treatment with 450 mg/kg bw Cynodon dactylon leaves extract.**[27]**

Rats with diabetes induced by streptozotocin were used to test the ethanolic extract of Cynodon dactylon root stalks' antidiabetic properties. The study demonstrated that the ethanolic extract of Cynodon dactylon root stalks (500 mg/kg) had anti-diabetic properties comparable to those of the common medication tolbutamide.**[28]**

Hepatoprotective Activity:-

In 2007, Gupta et al. conducted research on the protective properties of an extract from M. koenigii leaves. Mahanimbine, Girinimbie, Isomahanimbine, Murrayazoline, Murrayazolidine, Mahanine and ascorbic acid, α-tocopherol, and the mineral (Zn, Cu, Fe) contents of M. koenigii leaf extract were all responsible for the combined effect. This study demonstrated that M. koenigii is a rich and promising source of free radical quenchers, which are mediated by the stabilization of hepatocyte membranes and the decrease in fat metabolism.**[29]**

Singh SK et al. examined Cynodon dactylon's ability to shield rats' livers from STZ-induced hepatic damage. This study set out to investigate the possible hepatoprotective advantages of Cynodon dactylon aqueous extract, a well-liked traditional treatment for diabetes mellitus in India. Males received an intraperitoneal injection of streptozotocin (STZ, 50 mg/kg).

180–220 g albino Wister rats are used to induce experimental diabetes. Prior to this, the following parameters were measured: And following the 14-day treatment: serum glutamate oxaloacetate transaminase, creatinine (CRTN), and total protein (TP). (SGOT), total hemoglobin (Hb), urine sugar (US), and serum glutamate pyruvate transaminase (SGPT). Numerous biochemical When an aqueous extract of Cynodon dactylon suspended in distilled water was taken orally once a day, parameters were almost balanced. **[30]**

Anti-Microbial Activity :-

The antibacterial assessment of Cynodon dactylon leaf extract was conducted in vitro against Escherichia coli, Staphylococcus aureus, and Streptococcus pyogenes. The extract at a concentration of 10% was determined to be the most effective against bacterial growth.**[31]**

In another study, the capacity of naturally occurring biologically active substances in plant leaves to fend off microbial pathogens like bacteria was investigated. Six different kinds of organic solvents were used to extract the bioactive ingredients. The most effective leaf extract was butanolic, which was followed by extracts from methanol, petroleum ether, ethyl ester, and chloroform**.[32]**

The antibacterial activity of Cynodon dactylon's hydroalcoholic extract was examined using the agar well diffusion method (zone of inhibition) and the micro-dilution method (minimum inhibitory concentration) against two gram-positive bacteria (Staphylococcus aureus and Staphylococcus albus) and two gram-negative bacteria (Escherichia coli and Pseudomonas aeruginosa). According to results of lowest inhibitory concentration, the hydroalcoholic extract of Cynodon dactylon exhibited effective antibacterial activity, and it seemed that all tested bacterial strains were susceptible to the extract.**[33]**

The antibiotic activity against Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Proteus mirabilis, and Candida albicans was assessed using an aqueous extract of Cynodon dactylon (50–400 mg/ml). With the exception of Candida albicans, the aqueous extract of Cynodon dactylon demonstrated concentration-dependent antibacterial activity against every tested pathogen.**[34]**

The crude extract of Cynodon dactylon was tested for its ability to prevent infection with the porcine reproductive and respiratory syndrome virus (PRRSV) in vitro using both virustatic and virucidal methods. For the purpose of measuring virustatic and virucidal effects, a crude extract of Cynodon dacylon was prepared for cytotoxicity on tissue-culture cells. Actions that are against PRRSV. At 0.78 mg/ml, the crude extract of Cynodon dactylon did not cause any cytotoxicity to the cells. Line, and even 24 hours after infection, it markedly reduced PRRSV replication at that concentration. The Immunoperoxidase monolayer assay (IPMA) detected that Cynodon dactylon also deactivated PRRSV. In contrast to the control trials .**[35]**

Wound Healing :-

Rat resection and repair models were used to test the effectiveness of doob in curing wounds. The findings showed that it has healing potential equivalent to that of framycetin sulphate 1% cream by encouraging the healing of an injury and speeding up the time it takes for a wound to close.**[36]**

The current study Is based on an assessment of Cynodon dactylon's capacity for wound healing. To examine dactylon's activity, alcoholic and aqueous extracts were made. 250 grams of herb were soaked in 2000 milliliters of distilled water to create the aqueous extract. After that, it was extracted for 12 hours at boiling temperature in a Soxhlet system. Six groups of six animals each were formed from the animals. Rats' paravertebral regions were incised, and a topical preparation of Cynodon dactylon extract was applied twice a day. Observations were compared with the standard medication povidone iodine (Betadin) after two days. In the study of prospective wound healing, rats' rates of wound healing were considerably accelerated by aqueous and alcoholic extracts when compared to the control group. **[37]**

Anti-Cancer Activity :-

The efficacy of the C. dactylon extract was assessed using Swiss albino mice that had been inoculated with Ehrlich ascites carcinoma (EAC) cells. The substance was given in doses of 100, 200, and 400 mg/kg in each Over the course of ten days, the cells received oral doses of the amounts. As stated The antitumor efficacy of the plant isolates was demonstrated in relation to mice mean survival time (MST). And grew. In 52.6% of cases, HT-29 normal intestinal tumor cells demonstrated strong anti-tumor activity. When exposed to a plant extract containing 0.625 mg/ml of ethanol. Methanolic extracts of C. dactylon leaves were given to Swiss albino mice suffering from ascitic lymphoma (ELA), and tumors produced in the EAC were given through the abdomen.**[38]**

Conclusion:

Cynodon dactylon, commonly known as Bermuda grass, is an herb that gained immense interest because it exhibits multifaceted pharmacological and phytochemical activities. It possesses several medicinal activities like antioxidant, anti-inflammatory, anti-ulcer, antidiabetic, hepatoprotective, and antimicrobial activities. It possesses bioactive constituents like flavonoids, alkaloids, phenolic glycosides, and terpenoids, which are accountable for its therapeutic potential. It is also valuable due to its easy availability and traditional use in the field of herbal medicine. It needs further research and clinical studies to achieve its full potential in the domain of drug development and therapeutic applications.

REFERENCES:

1. Ali Esmail, Al-Snafi Department of Pharmacology, College of Medicine, Thi qar University, Iraq .A Review on Chemical constituents and pharmacological effects of Cynodon dactylon July 2016;17.
2. Ninad Shendye, S.S. Gurav. Cynodon dactylon: A systemic review of pharmacognosy, phytochemistry and pharmacology. International Journal of Pharmacy and Pharmaceutical Sciences.2014 Jan 1;6(8):7–12.
3. Shabi MM, Gayathri K, Venkatalakshmi R, Sasikal C. Chemical constituents of hydro alcoholic extract and phenolic fraction of Cynodon dactylon. Int J Chemtech Res 2010;2:149-54.
4. Kritikar KK, Basu BD. C. dacylon. In: Indian Medicinal Plants. 2nd ed. Dehradun: International Book Distributors; 1980. p. 2650.
5. Singh SK., Rai PK., Mehta S., Gupta RK., Watal G., Curative effect of Cynodon dactylon against STZ induced hepatic injury in diabetic rats. Indian Journal of Clinical Biochemistry 2009; 24: 410-413.
6. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines.Who.int, World Health Organization, 14 July 2017, https://www.who.int/publications/i/item/9290611103.
7. Das S, Morya S, Neumann A, Chattu VK. A review of the pharmacological and nutraceutical properties of Cynodon dactylon. Pharmacogn Res. 2021;13(3):104-12.
8. Jianxiu L, Aigui G, Hailin G. Morphological variation and types of Cynodon dactylon. Acta Prataculturae Sinica. 2003;12(6):99-104.
9. Jananie RK, Priya V, Vijayalakshmi K. In vitro assessment of free radical scavenging activity of Cynodon dactylon. J. Chem. Pharm. Res. 2011;3(4):647-54.
10. Shabi MM, Gayathri K, Venkatalakshmi R, Sasikala C. Chemical constituents of hydro alcoholic extract and phenolic fraction of Cynodon dactylon. Int J Chem Tech Res. 2010;2(1):149-54
11. Ashokkumar K, Selvaraj K, Muthukrishnan SD. Cynodon dactylon (L.) Pers.: An updated review of its phytochemistry and pharmacology. Journal of Medicinal Plants Research. 2013;7(48):3477-83.
12. Lewis WH., Elvin- Lewis., Medicinal botany. JohnWiley and Sons, New York, 1977.
13. Duke JA., The gene revolution Paper, 1981; 1:1- 61.
14. Duke JA., and Wain KK., Medicinal plants of the world, 3 Vols. 1981.

15. The Ayurvedic Pharmacopoeia of India, Ministry of Health and Family Welfare, Department of Ayush.Gov. Of India. 2004; 1(4): 33-35.
16. Amrita A., Anil K., Sumit G., Jyotsna D., Pharmacological Perspectives of Cynodon dactylon. Research Journal of Pharmaceutical, Biological and Chemical Sciences 2012; 3(2): 113.
17. Sies H (1997). Oxidative stress: oxidants and antioxidants. Exp. Physiol. 82(2):291-295.
18. Bhalerao SS, Vadnere GP, Patil AV, Chirmade HD, Patil SN (2011). In Vitro antioxidant activity of over ground parts of Cynodon dactylon. L. Pers. Int. J. Herbal Drug Res. 2(2):7-10 mice. Acta Pol. Pharm. 65(1):37-43.
19. Saroja M, Santhi R and Annapoorani S. Antioxidant potential of ethyl acetate fraction of Cynodon Dactylon against ELA implanted Swiss albino mice. Int J Pharm Biol Sci 2012; 3(2):415-419.
20. Sindhu G, Ratheesh M, Shyni GL, Helen A. Inhibitory effects of Cynodon Dactylon L. Int J Res Pharm Sci. 2016;7(1):52–6.
21. Garg VK, Paliwal SK. Anti-inflammatory activity of aqueous extract of Cynodon Dactylon. International Journal of Pharmacology. 2011;7(3):370-5.
22. Najafi M., Nazemiyeh H., Ghavimi H., Gharakhani A., Garjani A. Effects of Hydroalcoholic extract of Cynodon dactylon (L.) pers. On ischemia/reperfusion-Induced arrhythmias. DARU, 2008.
23. Ramesh H. Preclinical evaluation of protective effect of Cynodon dactylon pers On experimentally induced gastric mucosal damage. Journal of Medical and Health Sciences. 2013;2(3):89-93.
24. Venkateswarlu K, Chandrasekhar KB. Evaluation of antiulcer activityOf various aerial parts extracts of Cynodon dactylon on ParacetamolInduced ulcers in albino rats. Int J Res Pharm Sci. 2016;7(1):52–6.
25. Nafisi S, Nezhady MA and Asghari MH. Comparative and mixture effect of Cynodon dactylon, electromagnetic field and insulin on diabetic mouse. Balkan Med J 2012; 29(4): 345-348.
26. Jarald EE, Joshi SB and Jain DC. Antidiabetic activity of aqueous extract and non-polysaccharide fraction of Cynodon dactylon Pers. Indian J Exp Biol 2008; 46(9): 660-667.
27. Karthik D and Ravikumar S. A study on the protective effect of Cynodon dactylon leaves extract in diabetic rats. Biomed Environ Sci 2011; 24(2): 190-199.
28. Kumar AS, Gnananath K, Kiran D, Reddy AM and Raju Ch. Antidiabetic activity of ethanolic extract of Cynodon dactylon root stalks in streptozotocin induced diabetic rats. International Journal of Advances in Pharmaceutical Research 2011; 2(8): 418-422.
29. Gupta RS, Singh D. Protective nature of Murraya koenigii Leaves against hepatosupression through antioxidant Status in experimental rats. Pharmacology online. 2007; 1: 232-242.
30. Shivalinge Gowda KP. Et. Al., studied the, Diuretic Activity of Cynodon dactylon root stalk extract in albino rats- Research J. Pharm. And Tech. 2(2), pp. 338 –340, 2009
31. Pranita K, Sawarkar HA, Mishra K K. Antibacterial evaluation of ethanolic extract of Cynodon dactylon (L.) Pers. Global Journal of Research on Medicinal Plants & Indigenous Medicine 2012; 1(6): 218–224.

32. Chaudhari Y, Mody HR, Acharya VB: Antibacterial activity of Cynodon dactylon On different bacterial pathogens isolated from clinical samples. International Journal of Pharmaceutical Studies and Research 2011.
33. Renu S and Prakash NB. Screening of antibacterial activity of hydroalcoholic extract of Cynodon Dactylon (L.). Int J Res Ayurveda Pharm 2012; 3(6):827-829.
34. Rao As, Nayanatara AK, Rashmi Kaup S, Sharma A, Kumar B, Vaghasiya BD, Kishan K and Pai SR. Potential antibacterial and antifungal activity of aqueous extract of Cynodon dactylon. IJPSR 2011; 2(11): 2889-2893.
35. Pringproa K, Khonghiran O, Kunanoppadol S, Potha T and Chuammitri P. In vitro virucidal and Virustatic properties of the crude extract of Cynodon dactylon against porcine reproductive and Respiratory syndrome virus. Vet Med Int 2014; doi: 10.1155/2014/947589.
36. Thakare VM., Chaudhari RY., Patil VR.: Promotion of cutaneous wound healing By herbal formulation containing Azadirachta indica and Cynodon dactylon Extract in Wister rats. Inernational Journal of Pharmacological Research Development 2011; 34: 80–86.
37. Payal Dande, Anis Khan. Evaluation of wound Healing potential of Cynodon dactylon. Asian J Pharm Clin Res, 2012; 5(3): 161-164.
38. Leporatti ML, Corradi L.: Ethnopharmacobotanical remarks on the Province of Chieti town (Abruzzo, Central Italy). J Ethnopharmacol, 2001; 74: 17–40.