An Elsevier Indexed Journal ISSN-2230-7346

Journal of Global Trends in Pharmaceutical Sciences

REVIEW ON ETHNOBOTANY, PHYTOCHEMISTRY, AND PHARMACOLOGICAL PROPERTIES OF *CASSIA AURICULATA*

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ARTICLE INFO

Key Words

Cassia auriculata, Ayurvedic formulations, Ethnobotanical uses, Pharmacological activities

ABSTRACT

The herbal medicines are selecting over modern medicine due to their efficacy, safety, and lesser side effects. *Cassia auriculata* extremely used in Ayurvedic medicine. *C. auriculata* is commonly known as tanner's cassia, and it belongs to the family Caesalpiniaceae. It is reported to contain many phytoconstituents such as alkaloids, terpenoids, phenols and tannins, sugar saponins, flavonoids, quinines, steroids, and proteins. The ethnobotanical survey revealed that the *C. auriculata* was using for the treatment of diabetes, joint pain and inflammation, muscle contract, illness, cold,venerealdisease, hair cleaner, reduce body heat, abdominal pain, vomiting, diarrhea, and toothache. *C. auriculata* have many pharmacological properties, such as anti-diabetic, anti-oxidant, hepatoprotective,anti-cancer, anti-inflammatory, anti-hyperlipidemic activities, and many more. The present review work focused on its botanical characters, phytochemical constituents, ethnobotanical uses, and pharmacological properties of *C. auriculata*.

INTRODUCTION

Traditional herbs hold a long history of practice and are mostly considered to be secure than synthetic drugs. In the 21st century, herbal medicines are selecting over modern medicine due to their safety, cultural acceptability, efficacy, and lesser adverse effects. Plantsand products made from plant materials have used with varying success to relieve and prevent disorders all the time.[1] WHO has predicted that 80% of the world population depends on folklore medicine for their chief health care needs.The screening of medicinal plants for further pharmacological studies of bioactive compounds.[2] Many phytotherapy ofsome medicinal plants has been mentioned for treating diseases, one such plant is *C.auriculata* profoundly used in Ayurvedic medicine.[3] *C. auriculata* belongs to the family Caesalpiniaceae. The common name is tanners cassia[4].It has a different names in different languages like English (tanners Cassia),Hindi (tarwar),Telugu (tangedu),Tamil(avarai,avaram),Sanskrit (avartaki,pitapuspa,pitakalika,manojyana,carmaranga,pitakala), Malaysia (mataran tea,tanners tea)[5]. This shrub is evergreen and has attractive yellow colorflowers that grow in various parts of India as well as other parts of

Asia[6]. *C. auriculata* is mainly usedtraditionally for the treatment of diabetes, rheumatism,conjunctive, and further disorders like leprosy, ulcer, eye irritation, skin disorders[7,8].And the plant is reported for their antidiabetic[9], anti-oxidant[10] , antibacterial[11],hepatoprotective[12],nephroprotective[13],anti-cancer[14],anti-inflammatory[15],anti-microbial[16], anti-hyperlipidemic activities.[17]

Botanical characters

Leaves: Leaves are dull green; these are alternate, stipulate, paripinattly compound leaves with 16-24 pairs of leaflets. Leaves are firm, narrowly rugged, pubescent, thin, with verticaland linear gland between the leaflets of each pair. And shortlystalked, 2-2.5 cm long, 1-1.3 cm wide.Marginally overlapping, rectangular ,dull-witted at both ends, andglabrous. (Fig 1)

Figure 1 LEAVES

Flowers: Flowers are bright yellow and irregular and large (5cmnear). The pedicels are glabrous, and 2.5 cm long, the five sepals are separate, concave, glabrousimbricate, membranous, and unequal. Twoexternal and three internal sepals, outer ones are longer than the inner ones. The petals also 5 in numbers are free imbricate, crisped along the edge, and bright yellow veined. The panthers are 10 in numbers also separated by the three stamens barren; the ovary is unilocular, superior, with peripheral ovules. (Fig 2)

Figure 2 FLOWERS

Fruit: Fruits are pale brown or green in color and little legume, 7-11cm long, 1.5 cm broad, rectangular, long style base, flat, thin, papery, pilose, undulate crimpled and tripped with long style base. It has about12-20 seeds per fruit, each in its distinct cavity[18] (Fig 3).

Figure 3 FRUITS

Ethnobotanical uses: The ethnobotanical survey of the hill area in Tamilnadu, Maharashtra, Andhra Pradesh, and Gujarat elevated that *C. auriculata*leaf paste was used in joint pain and inflammation.[19] Fresh leaves have been using in muscle contraction, body pain, and gastritis.[20]The leaves are crushed and made in to paste, which is useful in sore on skin and ulcers.[21] Further, leaf decoction uses to arrest thirst during illness.[22] Leaves are use to cure common cold and internally infusion to treat mouth disease and with jaggery to cure tympani ties.[23]In addition to leavers, flowers are also used as health beneficial agents. Crushed flowers are mixed with goats milk to cure venereal disease.[24]Dried flowers powder is using to clean the hair, and taken by diabetic patients and use to reduce body heat.[25]The root is used by chewing, and the juice is swallowed to cure abdominal complaints, vomiting and diarrhea.[26]Powder of various parts used to treat toothache by applying that powder to the gums[27](Table 1).

Phytoconstituents: Chemical constituents of *C. auriculata* are alkaloids, terpenoids, phenols and tannins, sugar saponins, flavonoids, quinines, steroids and proteins.[28]

Flowers: Flowers of *C. auriculata* shows a significant amount of alkaloids, glycosides, saponins, phenols, tannins, phlorotannins, phenols terpenoids,

triterpenes carbohydrates, proteins, and amino acids. And also revealed the presence of anthraquinone, aloe-emodin, and sitosterols.[29,30]

Leaves: There are twenty-nine compounds were identified in the leaves of *C. auriculata*mainly 3-omethy- d glucose (48.50%) , alpha-tocopherol – beta – D –mannosidase (14.22%) , n-hexadecanoic acid (3.21%), resorcinol (11.80%), octadecenal(2.18%) and carboxylic acid (1.98%).[31]

Seeds: The seeds of *C. auriculata* contain 40.8% of light yellow oil. Major componentsamong fatty acids content are palmitic, oleic, and linoleic acids. The ethanolic seed extract showed the presence of benzoic acid, 2- hydroxyl methyl ester (0.07%), glycine, n-(trifluroacetyl), 1-methybutul ester(0.10%), 2'3 dihydro 3'5dihydro-6methyl-4hpyaran-4one(0.12%), cupric acid ethyl ester (.016%), resorcinol (0.21%), water-soluble galactomannan like beta-D-manopyranosyl-1(1-4)-o-beta-D-manopyronosyl(1to4)-o-beta –D-monopyranose. [32]

Roots: Roots of *C. auriculata* shows the presence of anthraquinone glycosides such as 1,3-dihydroxy-2 methylantraquinone, 1,3,8-trihydroxy- 6methoxy -2 methyl-lantraqunone, 1, 8- dihydroxy -6 -methoxy-2methyllantraqinone -3-o-rutinoside, 1,8-dihydroxy-2-methylantraqinone-3-o-rutinoside and flavone glycoside.And also, some compounds like root bark are a chalcone 3,6,-dihydroxy-4-methoxychalcone, and two leucoanthocyanins like leucocyanidin -3-o-rhamnopyroside and leucopeonidin-3-o-1-rhamanopyroside[33](Table2).

Ayurvedic formulations and Preparations

C. auriculata was found to be the main ingredient in avarai kudineer, talapotaka churna,sugnil, Kalpa herbal tea, avarai panchanga choornam, diasulin.[34] Diasulin: A herbal preparationinclosing*C.auriculata*, *Curcuma longa*, *Gymnema Sylvestre*, *Coccinia indica*, *Momordica charantia*,*Scoparia dulcis*, *Syzygium cumini*, *Trigonella foenum graecum* ,*Tinospora cordifolia*. Diasulin use in the treatment of diabetes and to decrease tissue lipids and lipid peroxide formation.[35]

Sugnil: A polyherbal formulation from a combination of nine Indian medicinal plants, which are*Aristolochia bracteata* (whole plant), *Shorea roxburghii* (gum),*C. auriculata* (flower), C*asearia esculanta*(leaf), *Coscinium fenestratum* (bark), *Curcuma longa* (tubers), *Eugenia jambolana* (seeds), *Gymnema sylvestre* (leaves), andTriphala (fruits). It is used in the reduced of vascular complications in diabetes mellitus.[36]

Kalpa herbal tea:*C. auriculata*is one of the mainingredients of tea and it was used in the treatment of diabetes.

Avarai panchanga choornam: It has equal quantities of fruits, leaves ,roots, flowers, and bark, to prepare Avarai panchanga choornam, which is extensively used in the management of diabetes. [37]

Kudineer: It isa polyherbal formulation consisting of seven herbal ingredients, *viz.*,*C. auriculata*, *C. fistula*, *Syzygium Jambos*, *Olax scandens*, *Saussurea lappa*, *Terminaliaarjuna*, and *Cyperus rotundus*. Useful in the treatment of diabetes and antimicrobial and fungalinfection.[38]

Talapotaka churna: It is a poly-herbal preparation contains such as *C.auriculata*,*Emblica officinalis*, *berberisaristata*, and*Curcuma longa*. It is useful to reduce bloodglucose level hence this churna is used to treat diabetes[39] (Table 3).

Pharmacological activities:

Anti-diabetic activity: Several anti-diabetic activities of*C. auriculata*are reported. For instances, anti-diabetic activity of the ethanolic flower and bud extract of *C. auriculata* was studied using a high-fatfed diet cum streptozotocin-induced animal model. This study shows that extract of *C. auriculata* bud has more anti-diabetic activity compare to flower extract [40]. Aqueous flower extract of *C. auriculata* is reported to show anti-diabetic activityin streptozotocin-induced diabetes rats.[41]Dianthrone rich methanolic extract of *C. auriculata* flowersin alloxan induced diabetic rats[42].

Table 1: Ethnobotanical uses of *Cassia auriculata*

Parts of Cassia auriculata	Ethnobotanical uses	Reference
Leaves	Joint Pain And Inflammation Muscle Contract Illness Cold Gastritis	19-23
Flowers	Venereal Disease Hair Cleaner Reduce Body Heat Diabetes	24-25
Roots	Abdominal Pain Vomiting Diarrhea Toothache	26-27

Table 2: Chemical constituent reported in *Cassia auriculata*

Parts studied	Chemical constituent	References
Flowers	Alkaloids, glycosides, saponins, phenols, terpenoids, flavonoids, tannins and steroids	29-30
Leaves	O-methyl-d-glucose, resorcinol, alpha-tocopherol- beta – mannosidase, and carboxylic acid	31
Seeds	Palmitic acid, linoleic acid, benzoic acid 2-hydroxyl methyl ester, 1-methyl butyl ester, and resorcinol	32
Roots	Anthraquinone glycosides and flavone glycosides	33

Table 3: Uses of Ayurvedic formulations of *Cassia auriculata*

Formulation	Used to treat
Avarai kudineer	Diabetes, fungal and microbial infection
Kalpa herbal tea	Diabetes
Talapotaka churna	Diabetes and obesity
Diasulin	Diabetic
Sugnil	Diabetic
Avarai panchanga choornam	Diabetes and obesity

Furthermore; the various fractions such as hydroethanolic, ethyl acetate, and n-butanol extract of flowers were studied in alloxan produce diabetic rats. From this study, it was concluding that n- butanol was found to be more potent compared to other fractions, and n-butanol fraction is responsible for its anti-hyperglycemic effect.[43] The aqueous extract of leaves in streptozotocin-induced mild and severely diabetic rats, and boththe rats demonstrate potent anti-hyperglycemic activity.[44]

Antioxidant activity: The various fractions of *C. auriculata* flower-like petroleum ether, ether, ethanol, and methanolic extracts, from these extracts the petroleum ether shows less potent towards scavenging and reducing power.[45]

Anti-hyperlipidemia activity: Ethanolic flower extract of*C. auriculata* in triton WR induces hyperlipidemia in rats. And the ethanol flower extract has anti-hyperlipidemic activity.[46]Ethanolic extract of aerial parts of *C. auriculata* has anti-hyperlipidemic activity through *in-vitro* studies the aerial part of the plant extract inhibit lipase activity.[47]Ethanolic cassia auriculata flower extract reported for their anti-hyperglycemic effect in the budding yeast cells induced with oleic acid .[48]

Hepatoprotective activity: *C. auriculata* is the main component of many herbal preparations in liver disorders. And the study

found that *C. auriculata* leaf extract has shown hepatoprotective activity against alcohol-induced liver damage. By protecting against free radical-mediated oxidative stress, which is due to hepatotoxicity.[49]Methonolic leaf extract is used to evaluate potential events against carbon tetrachloride-induced liver damage on Wistar albino rats.[50]*C. auriculata* leaves acetone extract shows a protective effect on d-galactosamine induced cytotoxicity in mice model .[51] The methanol extract of *C. auriculata* roots have potent hepatoprotective activity against ethanol and anti-tubercular drug-induced hepatotoxicity.[52]

Anti-inflammatory and analgesic activity: Analgesic and anti-inflammatory activity of petroleum ether and ethyl acetate fraction of *C. auriculata*was carried out by using various experimental models of pain and inflammation. This study found that the ethyl acetate fraction is more effective compared to petroleum ether.[53] The methanol extract of *C. auriculata* leaf shows analgesic and anti-inflammatory activity, by using tail immersion and hot plate method, cotton pellet induced chronic granulomatousand carrageenan-induced rat paw edema methods.It shows that anti-inflammatory activity and central analgesic activity due to its antioxidant mechanism.[54]Anti-inflammatory activity of flower extract of *C. auriculata* in an *in vitro* study. And the anti-inflammatory activity was elevated using albumin denaturation assay, proteinase inhibitory activity and membrane stabilization assays the result shows that acetone flower extract of *Cassia auriculata* possess anti-inflammatory activity.[55]

Antibacterial activity: Anti-bacterial activity of flowering stages of the cassia auriculata buds, seedling and dried stage with different solvents like DMSO, methanol, and water, and it concluded that fresh flowers of the cassia auriculata have potential activity.[56]*In vitro*study of*C. auriculata*flower methanol extract shows antibacterial effect by using agar disc diffusion method.[57]

Anti-cancer activity: *C. auriculata* leaf extract is affected in apoptosis which is usefull in human breastancer, larynx cancer and cell lines through its in-vitro method. The *C. auriculata* leaf extract inhibits the growthof hepG-2 and mcf- 7 cells through the induction of apoptosis.[58]Isolated compoundsobtained from *C. auriculata* are helpful in the prevention of cancer against colon cancer cell line HCT15, and the various compounds from*C. auriculata*possess chemopreventive activity.[59]

Immunomodulatory activity: Polyphenols derived from flowers of *C. auriculata*induce T cell immunity by increasing the number of cells and decreasing ROS stimulation by neutrophils that produce multiple mechanism aged individuals.[60]

Anthelminthic Property: The anthelminthic activity of methanolic, chloroform and petroleum ether leaf extract of *C. auriculata* against earthworms and the methanolic extract exhibits more anthelmintic activity.[61]

Anti-ulcer activity: Methanolic extract of *C. auriculata* leaf decreases the ulcer formation in pyloric ligated rats. The percentage of incidence of ulcer and ulcer index parameters are us to an evaluation of antiulcer activity, and the extract shows a decrease in and ulcer index compare to control group.[62]

Anti-microbial activity: Methanol, chloroform, and aqueous extract of Cassia auriculata leaf show anti-microbial effect by a suitable diffusion method. The methanol and chloroform extracts exhibit potent inhibitory activity compared to aqueousextract.[63]The saponins rich fraction of cassia auriculata roots used as a natural remedy to cure various infections and diseases caused by microorganisms.[64]

Nephroprotective activity: The ethanolic root extract of *C. auriculata* has nephroprotective activity in gentamicin and cisplatininduced renal damage ,because of the antioxidant property .[65]

Anti-arthritic Property: *C. auriculata*leaf has anti-arthritic activity, arthritic induced by using Freund's complete adjuvants. The study indicates that ethyl acetate extract has a potent protective effect against Freund's complete adjuvants induced arthritic, which are due to its significant phytoconstituents.[66] (Table 4)

CONCLUSION

Overview of *C. auriculata* revealed that the plant is the source of many therapeuticalimportant chemical constituents, ethnobotanical, an ayurvedic formulation, and folklore claims indicate the traditional medicinal system of India. And some of the formulations are used as therapeutic purpose. *C. auriculata* is the main ingredient in various herbal formulations such as avarai kudineer, talapotaka churna, sugnil, Kalpa herbal tea, avarai panchanga choornam, and diasulin. Studies have exposed that it has anti-diabetic, anti-hyperlipidemia, anti-oxidant, hepatoprotective, anti-cancer, anti-inflammatory, anti-ulcer, immunomodulatory, anti-microbial, anti-bacterial, anthelminthic, nephroprotective, anti-arthritic activity. Further, studies should also be focused on its bioactive principles of cassia auriculata, which are responsible for the health befits offered by these plants so that the bioactive compounds could give some leads for new drug discovery to various chronic diseases.

Acknowledgments: We are thankful tothe Head, Department of Biochemistry,and the Director, CSIR-CFTRI Mysuru, for the opportunity given in the CSIR-CFTRI.

Conflict of interest: We declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported

Funding: This work was financially supported by the DST under DST INSPIRE Fellowship scheme (No. DST/INSPIRE Fellowship/2014/IF150409) and CSIR under CSIR-RA fellowship (File number – 31/05 0558)/2018-EMR-I)

REFERENCES

1. Taylor, J.L.S., Rabe, T., McGaw, L.J., Jäger, A.K., &Van Staden, J. (2001). Towards the scientific validation of traditional medicinal plants. *Plant growth regulation*, 34(1), 23-37.
2. Raj, J. Y., Peter, M. P. J., & Joy, V. (2012). Chemical compounds investigation of *Cassia auriculata* seeds: A potential folklore medicinal plant. *Asian J Plant Sci Res*, *2*(2), 187-192.
3. Nandan, A., Eswaran, R., Doss, A., Sangeetha, G., &Anand, S. P. (2011). Chemical compounds investigation of *Cassia auriculata* leaves–a potential folklore medicinal plant. *Bulletin of Environment, Pharmacology & Life Sciences*, *1*(1), 20-23.
4. Siva, R., & Krishnamurthy, K. V. (2005). Isozyme diversity in Cassia auriculata L. *African Journal of Biotechnology*, *4*(8), 772-775.
5. Nwangwa, E. K. (2012). Antifertility effects of ethanolic extract of *Xylopiaaethiopica* on the male reproductive organ of Wistar rats. *Am J Med MedSci*, *2*(1), 12-5.
6. Pari, L., &Latha, M. (2002). Antidiabetic activity of *Cassia auriculata* flowers: effect on lipid peroxidation in streptozotocin-diabetic rats. *Pharmaceutical biology*, *40*(7), 512-517.
7. Hakkim, F. L., Girija, S., Kumar, R. S., &Jalaludeen, M. D. (2007). Effect of aqueous and ethanol extracts of *Cassia auriculata* L. flowers on diabetes using alloxan-induced diabetic rats. *Int J Diabetes Metab*, *15*, 100-6.
8. Habtemariam, S. (2013). Antihyperlipidemic components of *Cassia auriculata* aerial parts: identification through in vitro studies. *Phytotherapy Research*, *27*(1), 152-155.
9. Pari, L., &Latha, M. (2002). Effect of *Cassia auriculata* flowers on blood sugar levels, serum and tissue lipids in streptozotocin-diabetic rats. *Singapore Med J*, *43*(12), 617-621.
10. Purushotham, K. N., Annegowda, H. V., Sathish, N. K., Ramesh, B., &Mansor, S. M. (2014). Evaluation of phenolic content and antioxidant potency in various parts of *Cassia auriculata* L.: a traditionally valued plant. *Pak J BiolSci*, *17*, 41-48.
11. Maneemegalai, S., & Naveen, T. (2010). Evaluation of the antibacterial activity of flower extracts of *Cassia auriculata*. *Ethnobotanical Leaflets*, *2010*(1), 3.
12. Dhanasekaran, J. J., &Ganapathy, M. (2011). Hepatoprotective effect of *Cassia auriculata* L. leaf extract on carbon tetrachloride intoxicated liver damage in wister albino rats. *Asian J. Biochem*, *6*, 104-112.

13. Gaikwad, K., Dagle, P., Choughule, P., Joshi, Y. M. &Kadam, V. (2012). A review on some nephroprotective medicinal plants. *International Journal of Pharmaceutical Sciences and Research*, *3*(8), 2451.
14. Kanchana, A., &Balakrishna, M. (2011). Anti-cancer effect of saponins isolated from *Solanumtrilobatum* leaf extract and induction of apoptosis in human larynx cancer cell lines. *Int J Pharm PharmSci*, *3*(4), 356-364.
15. Manogaran, S., &Sulochana, N. (2004). Anti-inflammatory activity of *Cassia auriculata*. *Ancient Science of Life*, *24*(2), 6.
16. Raja, D. K., Jeganathan, N. S., &Manavalan, R. (2013). In vitro antimicrobial activity and phytochemical analysis of *Cassia auriculata* Linn. *International Current Pharmaceutical Journal*, *2*(6), 105-108.
17. Devi, P. U., Selvi, S., Suja, K., Selvam, K., &Chinnaswamg, P. (2006). Antidiabetic and Hypolipidemic effect of *Cassia auriculata* in alloxan-induced diabetic rats. *Internat J of Pharm*, *2*, 601-07.
18. PrakashYoganandam, G., Gopal, V., &Thanka, J. (2014). Aavarai kudineer-A potent polyherbal siddha formulation for management of diabetes mellitus. *International Journal of Pharmaceutical Development & Technology*, *4*, 98-103.
19. Kosalge, S. B., &Fursule, R. A. (2009). Investigation of ethnomedicinal claims of some plants used by tribals of Satpuda Hills in India. *Journal of Ethnopharmacology*, *121*(3), 456-461.
20. Jagatheeswari, D. (2012). A survey of some medicinally essential plants in Villupuram district of Tamil Nadu, India. *Int J Pharm Biol Arch*, *3*(4), 905-909.
21. Punjani, B. L., & Kumar, V. (2002). Folk medicinal plants used for skin disorders in the tribal pockets of Sabarkantha district, Gujarat. *Journal of Natural Remedies*, *2*(1), 84-87.
22. Ignacimuthu, S., Ayyanar, M., &Sankarasivaraman, K. (2008). Ethnobotanical study of medicinal plants used by Paliyartribals in Theni district of Tamil Nadu, India. *Fitoterapia*, *79*(7-8), 562-568.
23. Patel, Y. S., Joshi, E. P., & Joshi, P. N. (2010). Ethnobotanical study of Tapkeshwari Hill, Bhuj, Kachchh, India. *Life Sci Leaflets*, *2*, 22-31.
24. Veeramuthu, D., Muniappan, A., &Ignacimuthu, S. (2006). Antimicrobial activity of some ethnomedicinal plants used by Paliyar tribe from Tamil Nadu, India. *BMC complementary and alternative medicine*, *6*.
25. Thirumalai, T., Kelumalai, E., Senthilkumar, B., & David, E. (2009). Ethnobotanical study of medicinal plants used by the local people in Vellore District, Tamilnadu, India. *Ethnobotanical leaflets*, *2009*(10), 10.
26. Punjani, B. L. (2002). Ethnobotanical aspects of some plants of Aravalli hills in north Gujarat. *Ancient science of life*, *21*(4), 268.
27. Pawar, S., &Patil, D. A. (2007). Ethnomedicinal uses of barks in Jalgaon district. *Natural Product Radiance,6*(4), 341-346.
28. Monisha, M., Sowmiya, M., Ragunathan, R., &Johney, J. (2017). Extraction of bio Active Compounds from Cassia Auriculata Pods and Leaves and its Medicinal Uses. *International Journal of Current Microbiology and Applied Sciences,6*(8), 425-434.
29. Kanthimathi, M., &Soranam, R. (2014). Phytochemical screening and Invitro antibacterial Potential of Cassia auriculata Linn. Flowers Against Pathogenic Bacteria. *International Research Journal of Pharmaceutical and Biosciences, 1*(1), 45-56.
30. Deshpande, H. A., &Bhalsing, S. R. (2013). Recent advances in the phytochemistry of some medicinally important Cassia species: a Review. *International journal of pharma medicine and biological sciences*, *2*(3), 60-78.
31. Anandan, A., Eswaran, R., Doss, A., Sangeetha, G., &Anand, S. P. (2011). Chemical compounds investigation of *Cassia auriculata* leaves–a potential folklore medicinal plant. *Bulletin of*

Environment, Pharmacology & Life Sciences, *1*(1), 20-23.

32. Meena, V., Baruah, H., &Parveen, R. (2019). Cassia auriculata: A healing herb for all remedy. *Journal of Pharmacognosy and Phytochemistry*, *8*(3), 4093-4097.
33. Jaydeokar, A. V., Bandawane, D. D., Bibave, K. H., &Patil, T. V. (2014). Hepatoprotective potential of Cassia auriculata roots on ethanol and antitubercular drug-induced hepatotoxicity in experimental models. *Pharmaceutical biology*, *52*(3), 344-355.
34. Reddy, K. R. C. (2018). Talapotaka pushpa: a promising herbal remedy for diabetes mellitus. *Asian Journal of Pharmaceutics (AJP): Free full text articles from Asian J Pharm*, *11*(04).
35. Srivastava, S., Lal, V. K., & Pant, K. K. (2012). Polyherbal formulations based on Indian medicinal plants as antidiabetic phytotherapeutics. *Phytopharmacology*, *2*(1), 1-15.
36. Karthikeyan, P., Sridhar, S., &Anuradha, C. V. (2011). Antihyperlipidemic potential of a traditional siddha polyherbal formulation sugnil in streptozotocin-induced diabetic rats. *International Journal of Current Research*, *3*(11), 331-335.
37. Latha, M., &Pari, L. (2003). Preventive effects of *Cassia auriculata* L. flowers on brain lipid peroxidation in rats treated with streptozotocin. *Molecular and cellular biochemistry*, *243*(1-2), 23-28.\
38. Rajalakshmi, K., Shanmugapriya, P., Christian, G. J., Gladys, R. J., Banumathi, V., &Geethalakshmi, S. (2018). Antimicrobial Potential of Siddha Polyherbal Formulation Aavarai Kudineer. *Journal of Pure and Applied Microbiology*, *12*(2), 1019-1025.
39. Reddy, K. R. C. (2016). Hypoglycemic effect of Talapotaka Churna in streptozotocin-induced hyperglycemia in rats. *International Journal of Green Pharmacy (IJGP)*, *10*(03).
40. Nambirajan, G., Karunanidhi, K., Ganesan, A., Rajendran, R., Kandasamy, R., Elangovan, A., &Thilagar, S. (2018). Evaluation of antidiabetic activity of bud and flower of Avaram Senna (*Cassia auriculata* L.) In high fat diet and streptozotocin induced diabetic rats. *Biomedicine & Pharmacotherapy*, *108*, 1495-1506.
41. Latha, M., &Pari, L. (2003). Antihyperglycaemic effect of *Cassia auriculata* in experimental diabetes and its effects on key metabolic enzymes involved in carbohydrate metabolism. *Clinical and experimental pharmacology and physiology*, *30*(1-2), 38-43.
42. Khader, S. Z. A., Ahmed, S. S. Z., Balasubramanian, S. K., Arunachalam, T. K.,Kannappan, G., Mahboob, M. R., Ponnusamy, P.& Ramesh, K. (2017). Modulatory effect of dianthrone rich alcoholic flower extract of Cassia auriculata L. on experimental diabetes. *Integrative medicine research*, *6*(2), 131-140.
43. Surana, S. J., Gokhale, S. B., Jadhav, R. B., Sawant, R. L., &Wadekar, J. B. (2008). Antihyperglycemic activity of various fractions of *Cassia auriculata* Linn. in alloxan diabetic rats. *Indian journal of pharmaceutical sciences*, *70*(2), 227.
44. Gupta, S., Sharma, S. B., Bansal, S. K., &Prabhu, K. M. (2009). Antihyperglycemic and hypolipidemic activity of aqueous extract of *Cassia auriculata* L. leaves in experimental diabetes. *Journal of Ethnopharmacology*, *123*(3), 499-503.
45. Elayarani, M., Shanmuganathan, P., &Muthukumaran, P. (2011). *In vitro* anti-oxidant activity of the various extracts of *Cassia auriculata* L. flower by UV spectrophotometer. *Asian J. Pharma. Technol*, *1*, 70-72.
46. Vijayaraj, P., Muthukumar, K., Sabarirajan, J., &Nachiappan, V. (2013). Antihyperlipidemic activity of *Cassia auriculata* flowers in triton WR 1339 induced hyperlipidemic rats. *Experimental and Toxicologic Pathology*, *65*(1-2), 135-141.
47. Habtemariam, S. (2013). Antihyperlipidemic components of *Cassia auriculata* aerial parts: identification through *in vitro* studies. *Phytotherapy Research*, *27*(1), 152-155.

48. Rajendran, V., Krishnegowda, A., &Nachiappan, V. (2017). Antihyperlipidemic activity of *Cassia auriculata* flower extract in oleic acid induced hyperlipidemia in Saccharomyces cerevisiae. *Journal of Food Science and Technology*, *54*(9), 2965-2972.
49. Rajagopal, S. K., Manickam, P., Periyasamy, V., &Namasivayam, N. (2003). Activity of *Cassia auriculata* leaf extract in rats with alcoholic liver injury. *The Journal of nutritional biochemistry*, *14*(8), 452-458.
50. Dhanasekaran, J. J., &Ganapathy, M. (2011). Hepatoprotective effect of *Cassia auriculata* L. leaf extract on carbon tetrachloride intoxicated liver damage in wister albino rats. *Asian J. Biochem*, *6*, 104-112.
51. Nakamura, S., Xu, F., Ninomiya, K., Nakashima, S., Oda, Y., Morikawa, T., Muraoka, O., Yoshikawa, M.& Matsuda, H. (2014). Chemical structures and hepatoprotective effects of constituents from Cassia auriculata leaves. *Chemical and Pharmaceutical Bulletin*, *62*(10), 1026-1031.
52. Jaydeokar, A. V., Bandawane, D. D., Bibave, K. H., &Patil, T. V. (2014). Hepatoprotective potential of *Cassia auriculata* roots on ethanol and antitubercular drug-induced hepatotoxicity in experimental models. *Pharmaceutical biology*, *52*(3), 344-355.
53. Mali, A. A., Bandawane, D. D., &Hivrale, M. G. (2013). Anti-inflammatory and analgesic activities of ethyl acetate and petroleum ether fractions of *Cassia auriculata* Linn. leaves. *Oriental Pharmacy and Experimental Medicine*, *13*(3), 191-197
54. Mali, A. A., Bandawane, D. D., &Hivrale, M. G. (2013). Evaluation of anti-inflammatory and analgesic activity of methanol extract of *Cassia auriculata* leaves. *Pharmacologia*, *4*(2), 117-125.
55. Rani, A. A., Punitha, S. M. J., &Rema, M. (2014). Anti-inflammatory activity of flower extract of *Cassia auriculata*–an *in-vitro* study. *Int. Res. J. Pharm. Appl. Sci.*, *4*, 57-60.
56. Sujith, P., &Senthilkumar, P. K. (2012). Bactericidal Activity of Extracts of Different Flowering Stages of *Cassia auriculata* and Screening of its Amino Acids. *International Journal of Microbiological Research*, *3*, 144-148.
57. Doshi, G. M., Supriya, S. S., Aggarwal, G. V., Bhalerao, P. P. P. A. B., & Desai, S. K. (2011). Antibacterial potential of *Cassia auriculata* flowers. *J. Microbiol. Biotech. Res*, *1*(3), 15-19.
58. Prasanna, R., Harish, C. C., Pichai, R., Sakthisekaran, D., &Gunasekaran, P. (2009). Anti-cancer effect of *Cassia auriculata* leaf extract in vitro through cell cycle arrest and induction of apoptosis in human breast and larynx cancer cell lines. *Cell Biology International*, *33*(2), 127-134.
59. Prasanna, R., Harish, C. C., Pichai, R., Sakthisekaran, D., &Gunasekaran, P. (2009). Anti-cancer effect of *Cassia auriculata* leaf extract in vitro through cell cycle arrest and induction of apoptosis in human breast and larynx cancer cell lines. *Cell Biology International*, *33*(2), 127-134.
60. John, C. M., Sandrasaigaran, P., Tong, C. K., Adam, A., &Ramasamy, R. (2011). Immunomodulatory activity of polyphenols derived from *Cassia auriculata* flowers in aged rats. *Cellular immunology*, *271*(2), 474-479.
61. Chaudhary, S., & Kumar, A. (2014). Phytochemical analysis and assessment of in-vitro anthelmintic activity of *Cassia auriculata* Linn leaves. *American Journal of phytomedicine and clinical Therapeutics*, *2*(2), 153-160.
62. Ahmed, M. F., Thayyil, H., Rasheed, A. S., & Ibrahim, M. (2010). Anti-ulcer activity of *Cassia auriculata* leaf extract. *Pharmacognosy Journal*, *2*(16), 53-57.
63. Parveen, A., Roy, A. S., &Rao, S. (2012). Biosynthesis and characterization of silver nanoparticles from *Cassia auriculata* leaf extract and in vitro evaluation of antimicrobial activity.
64. Deshpande, S., Kewatkar, S., &Paithankar, V. (2013). Antimicrobial activity of Saponins rich fraction of *Cassia auriculata* Linn against various microbial strains. *International Current Pharmaceutical Journal*, *2*(4), 85-87.

65. Annie, S., Rajagopal, P. L., &Malini, S. (2005). Effect of *Cassia auriculata* Linn. root extract on cisplatin and gentamicin-induced renal injury. *Phytomedicine*, *12*(8), 555-560.
66. Ba ndawane, D. D., Beautikumari, S., Gate, S. S., & Patel, A. N. (2014). Evaluation of anti-arthritic activity of ethyl acetate fraction of *Cassia auriculata* Linn. leaves. *Biomedicine & Aging Pathology*, *4*(2), 105-115.