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Medicinal and Therapeutic value of Sesbania grandiflora

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ABSTRACT

There are around 60 global species belonging to the genus Sesbania which are commonly found to be grown in Africa, Australia, and Asia. The leaves of Sesbania grandiflora have been used in local traditional medicine since ancient times. Major chemical constituents are alkaloids, flavonoids, glycosides, tannin, anthraquinone, steroid, pholobatannins, and terpenoids. Isovestitol, medicarpin, sativan (isoflavonoids) and betulinic acid (tannin substance) are the major constituents responsible for antibacterial and antifungal, antioxidant, anti-urolithiatic, anticonvulsant and anxiolytic, and hepatoprotective properties. Also, the plant extract contains alkaloids, phenolics, tannins, triterpenoids, and sterols. All parts of S. grandiflora are used in traditional medicine and phytochemical investigations have been conducted on extracts of the leaves, seeds and roots of S. grandiflora to provide scientific validation of its properties.

Keywords: Sesbania grandiflora; isoflavonoids; Heron flower; traditional medicine; Bengali cuisine

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Leaves of *Sesbania grandiflora* have the potential to be used as a remedy for thrombosis, diarrhea, and inflammatory diseases and against few important bacterial pathogens [3,4]. The juice of the leaves of *S. grandiflora* has been reportedly used in the treatment of bronchitis, cough, vomiting, wounds ulcers, diarrhea, and dysentery. The flowers have reported antimicrobial activity. Powdered roots of this plant are mixed in water and applied externally as a poultice or rub for rheumatic swelling [5]. The leaves are traditionally used to treat nasal catarrah, nyctalopia and cephalagia. Studies show that, *S. grandiflora* possess antioxidant, antiuroithiatic, anticonvulsive, anti-arthritic, antiinfammatory, anti-helminthic, anti-bacterial and anxiolytic activity [6-8]. Gandhi et.al, 2017 reported that anti-biofilm and antibacterial efficacy of *S. grandiflora* plays a vital role over biofilm producing pathogens and act as a good source for controlling the microbial population [9]. Saifudin et.al, 2016 reported that flower acts as a promising material to develop the active ingredient of anti-plaque toothpaste as well as mouthwash solution [10]. It has been reported that a biofilm is strongly associated with the drug resistance property [11]. Hence, eradication of biofilm is often considered to be a difficult task and therefore use of plant products to inhibit biofilm may be a viable alternative [12]. Ramesh et.al, 2015 showed brain oxidative damage restored by *Sesbania grandiflora* in cigarette smoke-exposed rats [13]. Earlier, the lead author and associates presented cardio-protective action of *S. grandiflora* aqueous suspension that restored the antioxidant status and retained the levels of micronutrients in cigarette smoke-exposed rats [14,15]. Afterwards, Ramesh et.al, 2010 reported that S. grandiflora aqueous suspension significantly decreased the elevated hepatic, renal and lipid peroxidation markers and ameliorated the diminished antioxidant levels while restored the hepatic and renal architecture in cigarette smoke-exposed rats [16]. Semwal et.al, 2018 reported significant neuroprotective effect in celecoxib treated mice through the modification in cholinergic system or by the blockage of oxidative stress and inhibition of AchE enzyme.at the doses of 200 and 400 mg/kg in mice [17]. *S. grandiflora* protects the lung from the oxidative damage through its antioxidant potential [18]. Earlier, Pajaniradje et.al, 2014 reported methanolic fraction of *S. grandiflora* was found to exert potent antiproliferative effects especially in the human lung cancer cell line, A549 [19]. Bhoumik et.al, 2016 reported hepatoprotective activity against CCl4 induced hepatotoxicity in rats by aqueous extract [20]. Plants contain a huge range of active compounds with the most abundant being polyphenols, carotenoids, vitamin (vitamin A, C, riboflavin, nicotinic acid), and minerals like zinc and selenium which form an integral part of antioxidant systems and reduce cellular damages [21,22]. Roy et.al, 2013 reported that a fraction isolated from flowers, preferentially kills leukemic cells (particularly those of histiocyte lymphoma) by triggering programmed cell death [23]. In 4 different studies from 2012 to 2016, it was found that the flower, fruit and the whole plant extract reduced blood glucose, cholesterol, TG and LDL, lipid peroxidation and increased and superoxide dismutase and catalase of insulin and hemoglobin in experimental animals [24-27]. Afterwards, Prasanna et.al, 2018 demonstrated the hydroxy methoxy benzaldehyde (HMB) content as anti-glycogen lead that inhibited formation of early HbA1c and advanced glycation end products (AGEs) [28]. The hypoglycemic activity is thought to be due to increased hepatic metabolism followed by stimulation of synthesis and/or release of insulin from pancreatic beta cells and/or insulin sparing effect. High contents of quercetin, myricetin and kaempferol were identified in a methanolic extract of the leaves and a novel protein fraction was isolated from the fresh flowers, which displayed chemo-preventive effects [29,30]. The ethanol extract of the leaves and flowers were effective in inhibiting

Figure 1. Top View of *Sesbania grandiflora* [1]**.** Native to tropical Asia, commonly known as vegetable hummingbird, agati or hummingbird tree, is a small tree in the genus Sesbania. It is a short-lived, soft-wooded, loosely-branching tree with a rather open crown; it can grow 8 - 15 meters tall**.**

Figure 2. Bok phool or Heron flower [2]. The *Sesbania gradiflora* or the humming bird tree bears a big white flower that is heartily used in Bengali cuisine. white flower variety of S. grandiflora found to be non-toxic, the purple flower type is highly toxic. The tree's leaves, fruits and flowers can all be consumed – eaten alone as vegetables and added to curries or salads. Known as bok phool in West Bengal, the flower is commonly consumed by dipping in batter and frying. The flowers and leaves are enriched with vitamins and minerals and have been reportedly associated with anti-inflammatory, analgesic and antipyretic effects. A fraction isolated from flowers, preferentially killed leukemic cells in another study.

the tumor growth in ascitic models and that is comparable to 5-Fluorouracil [31]. Chung et.al, 2016 reported that silver nanoparticles (AgNPs) synthesized with leaf extracts were demonstrated to be cytotoxic to MCF-7 cancer cells [32,33]. Moreover, the synthesized AgNPs showed potent antibacterial activity against multi-drug resistant (MDR) bacteria such as *Salmonella enterica* and *Staphylococcus aureus* [34]. Later on, several studies revealed antimicrobial potential of S. grandiflora synthesized AgNPs [35-40]. Gupta et.al, 2018 revealed antioxidant action of flavonoids especially quercetin and hydro-alcoholic extract found to reduce the levels of TNF-α and IL-6 in acetic acid induced ulcerative colitis in mice [41]. Sesbania could afford a significant protective effect against erythromycin estolate-induced hepatotoxicity [42]; alcohol and polyunsaturated fatty acid (PUFA)-induced oxidative stress and nephrotoxicity (due to presence of phenolic compounds and anthocyanins) [43]. Also, the leaf juice of *S. grandiflora* showed significant antiurolithiatic activity against calcium oxalate-type stones in an older study [44]. The fruits are used for anemia, bronchitis, fever, tumors. They are laxative, and possess intellectually stimulating properties [45]. Fruit extract significantly decreased the levels of blood glucose, cholesterol, TG and LDL, lipid peroxidation and increased and superoxide dismutase and catalase in rats [46]. Hasan et.al, 2012 first reported of the four compounds (Isovestitol, medicarpin, sativan and betulinic acid) isolated from the root of *S. grandiflora* and their anti-tuberculosis properties [47]. The bark extract has shown the protective effects against the acute and chronic inflammation [48,49]. The bark of *S. grandiflora* is very bitter and considered as an astringent and bitter tonic. Decoctions of leaves and flowers is used to treat leucorrhoea and vomiting of blood. The bark of *S. grandiflora* is used as an astringent and treatment of small pox, ulcers in the mouth and the alimentary canal, infant stomach disorders and scabies [43], [50]. Use of leaf powder as an iron and folate supplement showed improvement in hemoglobin levels of individuals with mild and moderate anemia [51].

Conclusion

Among very few plants of the world, *S. grandiflora* is the one whose all parts are utilized for the treatment of various types of ailments. Other than this, it has capability to fix atmospheric nitrogen and can be used as green manure to improve soil conditions. It can also be planted as windbreak and shade tree in plantations. The wood is soft and light, used as poles, in floating fishing nets, for fuel and charcoal-making. It is also a major source of pulp for making paper. So, the diversity of use surely demands more research in future regarding its cultivation, adaptation in new environments, impact of environmental factors on its major therapeutic contents, raw material collection, storage conditions and availability sources for regular use in pharmaceuticals.

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Abbreviations

Hydroxy Methoxy Benzaldehyde (HMB); Advanced Glycation End Products (AGEs); Polyunsaturated Fatty Acid (PUFA); Low-density lipoprotein (LDL); Triglyceride (TG); multi-drug resistant (MDR); Silver Nanoparticles (AgNPs); Hemoglobin A1c (HbA1c); Tetrachloromethane (CCl4); Michigan Cancer Foundation-7 (MCF-7); Acetylcholinesterase (AchE)

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References

1. Tropical Plant Catalog. Available From: toptropicals.com
2. Kapila S. Flowers on the menu. Media India (Lifestyle), January 17, 2018.
3. binte Arfan N, Islam T, Sultana Julie A, Mohiuddin AK, Alam Khan S, Khalid Labu Z, Thrombolytic, Membrane stabilizing, Antidiarrhoeal and Antimicrobial Properties of Bioactive Compounds Isolated from lea ves of Sesbania grandiflora Naturally Growing in Bangladesh. Iranian Journal of Pharmaceutical Sciences, 2016, 12 (3): 31-46
4. binte Arfan N, Sultana Julie A, Mohiuddin AK, Alam Khan S, Khalid Labu Z. Ibnosina J Med BS 2016;8(6):271-277. DOI: 10.4103/1947-489X.210243
5. Aye MM, Aung HT, Sein MM, Armijos C. A Review on the Phytochemistry, Medicinal Properties and Pharmacological Activities of 15 Selected Myanmar Medicinal Plants. Molecules. 2019 Jan 15;24(2). pii: E293. doi: 10.3390/molecules24020293. Review. PubMed PMID: 30650546; PubMed Central PMCID: PMC6359042.
6. Gomase P.V. Sesbania sesban Linn: a review on its ethnobotany, phytochemical and pharmacological profile. Asian. J. Biomed. Pharm. Sci. 2012;2:11.
7. China R, Mukherjee S, Sen S, Bose S, Datta S, Koley H, Ghosh S, Dhar P. Antimicrobial activity of Sesbania grandiflora flower polyphenol extracts on some pathogenic bacteria and growth stimulatory effect on the probiotic organism Lactobacillus acidophilus. Microbiol Res. 2012 Sep 6;167(8):500-6. doi: 10.1016/j.micres.2012.04.003. Epub 2012 May 12. PubMed PMID: 22583547.
8. Rajagopal P.L., Premaletha K., Sreejith K.R. Anthelmintic activity of the flowers of Sesbania grandiflora Pers. J. Innov. Appl. Pharm. Sci. 2016;1:8–11.
9. Gandhi AD, Vizhi DK, Lavanya K, Kalpana VN, Devi Rajeswari V, Babujanarthanam R. In vitro anti- biofilm and anti-bacterial activity of Sesbania grandiflora extract against Staphylococcus aureus. Biochem Biophys Rep. 2017 Oct 23;12:193-197. doi: 10.1016/j.bbrep.2017.10.004. eCollection 2017 Dec. PubMed PMID: 29090281; PubMed Central PMCID: PMC5655386.
10. Saifudin A., Forentin A.M., Fadhilah A., Tirtodiharjo K., Melani W.D., Widyasari D., Saroso T.A. Bioprospecting for anti-Streptococcus mutans: the activity of 10% Sesbania grandiflora flower extract comparable to erythromycin. Asian. Pac. J. Trop. Biomed. 2016;6:751–754.
11. Arun A, Karthikeyan P, Sagadevan P, Umamaheswari R, Peo RR. Phytochemical screening of Sesbania grandiflora (Linn). Int J Biosci Nanosci. 2014;1(2):33–36.
12. Das A., Das M.C., Sandhu P., Das N., Tribedi P., De U.C., Akhter Y., Bhattacharjee S. Antibiofilm activity of Parkia javanica against Pseudomonas aeruginosa: a study with fruit extract. RSC Adv. 2017;7:5497–5513.
13. Ramesh T, Sureka C, Bhuvana S, Begum VH. Brain oxidative damage restored by Sesbania grandiflora in cigarette smoke-exposed rats. Metab Brain Dis. 2015 Aug;30(4):959-68. doi: 10.1007/s11011-015-9654-4. Epub 2015 Jan 27. PubMed PMID: 25620659.
14. Ramesh T, Mahesh R, Sureka C, Begum VH. Cardioprotective effects of Sesbania grandiflora in cigarette smoke-exposed rats. J Cardiovasc Pharmacol. 2008 Oct;52(4):338-43. doi: 10.1097/FJC.0b013e3181888383. PubMed PMID: 18791462.
15. Shah SMA, Akram M, Riaz M, Munir N, Rasool G. Cardioprotective Potential of Plant-Derived Molecules: A Scientific and Medicinal Approach. Dose Response. 2019 May 26;17(2):1559325819852243. doi: 10.1177/1559325819852243. eCollection 2019 Apr-Jun. Review. PubMed PMID: 31205459; PubMed Central PMCID: PMC6537262.
16. Ramesh T, Sureka C, Bhuvana S, Hazeena Begum V. Sesbania grandiflora diminishes oxidative stress and ameliorates antioxidant capacity in liver and kidney of rats exposed to cigarette smoke. J Physiol Pharmacol. 2010 Aug;61(4):467-76. PubMed PMID: 20814075.
17. Semwal BC, Murti Y, Verma M, Yadav HN. Neuroprotective Activity of Semba - Nia grandiflora Seeds Extract Against Celecoxib Induced Amnesia in Mice. Pharma cog J. 2018;10(4):747-52. Afailable From: https://www.phcogj.com/sites/default/files/PharmacognJ-10-747.pdf
18. Bhoumik D, Mallik A, Berhe AH. Hepatoprotective activity of aqueous extract of Sesbania grandiflora Linn leaves against carbon tetrachloride induced hepatotoxicity in albino rats. Int J Phytomed. 2016;8(2):294–299.
19. Pajaniradje S, Mohankumar K, Pamidimukkala R, Subramanian S, Rajagopalan R. Antiproliferative and apoptotic effects of Sesbania grandiflora

leaves in human cancer cells. Biomed Res Int. 2014;2014:474953. doi: 10.1155/2014/474953. Epub 2014 May 15. PubMed PMID: 24949454; PubMed Central PMCID: PMC4053233.

20. Ramesh T, Begum VH. Protective effect of Sesbania grandiflora against cigarette smoke-induced oxidative damage in rats. J Med Food. 2008 Jun;11(2):369-75. doi: 10.1089/jmf.2006.205. PubMed PMID: 18598182.
21. Zarena AS, Gopal S, Vineeth R. Antioxidant, antibacterial, and cytoprotective activity of agathi leaf protein. J Anal Methods Chem. 2014;2014:989543. doi: 10.1155/2014/989543. Epub 2014 Jan 28. PubMed PMID: 24616824; PubMed Central PMCID: PMC3927847.
22. Velusamy P, Kumar GV, Jeyanthi V, Das J, Pachaiappan R. Bio-Inspired Green Nanoparticles: Synthesis, Mechanism, and Antibacterial Application. Toxicol Res. 2016 Apr;32(2):95-102. doi: 10.5487/TR.2016.32.2.095. Epub 2016 Apr 30. Review. PubMed PMID: 27123159; PubMed Central PMCID: PMC4843976.
23. Roy R, Kumar D, Chakraborty B, Chowdhury C, Das P. Apoptotic and autophagic effects of Sesbania grandiflora flowers in human leukemic cells. PLoS One. 2013 Aug 13;8(8):e71672. doi: 10.1371/journal.pone.0071672. eCollection 2013. PubMed PMID: 23967233; PubMed Central PMCID: PMC3742510.
24. Kumar R, Janadri S, Kumar S, Dhanajaya DR, Swamy S. Evaluation of antidiabetic activity of alcoholic extract of Sesbania grandiflora flower in alloxan induced diabetic rats. Asian J. Pharm. Pharmacol. 2015;1:21–26. Available from: http://ajpp.in/uploaded/p3.pdf
25. Ghanshyam P, Chhayakanta P, Shankar MU, Sujata M, Gourishyam P, Kuman AA. Investigation of possible hypoglycemic and hypolipidemic effect of methanolic extract of Sesbania grandiflora. Int Res J Pharm 2012;3:275-80.
26. Ghanshyam P, Panda C, Patra A. Extract of Sesbania grandiflora Ameliorates Hyperglycemia in High Fat Diet-Streptozotocin Induced Experimental Diabetes Mellitus. Scientifica (Cairo). 2016;2016:4083568. doi: 10.1155/2016/4083568. Epub 2016 May 22. PubMed PMID: 27313954; PubMed Central PMCID: PMC4893447.
27. Sureka C, Ramesh T, Begum VH. Attenuation of erythrocyte membrane oxidative stress by Sesbania grandiflora in streptozotocin-induced diabetic rats. Biochem Cell Biol. 2015 Aug;93(4):385-95. doi: 10.1139/bcb-2015-0039. Epub 2015 Jun 4. PubMed PMID: 26176361.
28. Prasanna G, Hari N, Saraswathi NT. Hydroxy methoxy benzaldehyde from Sesbania grandilfora inhibits the advanced glycation end products (AGEs)-mediated fibrillation in hemoglobin. J Biomol Struct Dyn. 2018 Mar;36(4):819-829. doi: 10.1080/07391102.2017.1300543. Epub 2017 Mar 20. PubMed PMID: 28317461.
29. Sangeetha A, Prasath GS and Subramanian S: Antihyperglycemic and antioxidant potentials of Sesbania grandiflora leaves studied in STZ induced experimental diabetic rats. Int J Pharm Sci Res2014; 5(6): 2266-75.doi: 10.13040/IJPSR.0975-8232.5(6).2266-75
30. Mustafa RA, Abdul Hamid A, Mohamed S, Bakar FA. Total phenolic compounds, flavonoids, and radical scavenging activity of 21 selected tropical plants. J Food Sci. 2010 Jan-Feb;75(1):C28-35. doi: 10.1111/j.1750-3841.2009.01401.x. PubMed PMID: 20492146.
31. Laladhas KP, Cheriyan VT, Puliappadamba VT, Bava SV, Unnithan RG, Vijayammal PL, Anto RJ. A novel protein fraction from Sesbania grandiflora shows potential anticancer and chemopreventive efficacy, in vitro and in vivo. J Cell Mol Med. 2010 Mar;14(3):636-46. doi: 10.1111/j.1582-4934.2008.00648.x. Epub 2009 Jan 14. PubMed PMID: 19183244; PubMed Central PMCID: PMC3823462.
32. Chung IM, Park I, Seung-Hyun K, Thiruvengadam M, Rajakumar G. Plant-Mediated Synthesis of Silver Nanoparticles: Their Characteristic Properties and Therapeutic Applications. Nanoscale Res Lett. 2016 Dec;11(1):40. doi: 10.1186/s11671-016-1257-4. Epub 2016 Jan 28. PubMed PMID: 26821160; PubMed Central PMCID: PMC4731379.
33. M JF, P L. Apoptotic efficacy of biogenic silver nanoparticles on human breast cancer MCF-7 cell lines. Prog Biomater. 2015;4(2-4):113-121. Epub 2015 Oct 23. PubMed PMID: 26566469; PubMed Central PMCID: PMC4636515.
34. Das J, Paul Das M, Velusamy P. Sesbania grandiflora leaf extract mediated green synthesis of antibacterial silver nanoparticles against selected human pathogens. Spectrochim Acta A Mol Biomol Spectrosc. 2013 Mar;104:265-70. doi: 10.1016/j.saa.2012.11.075. Epub 2012 Dec 5. PubMed PMID: 23270884.
35. Jeyaraj M, Sathishkumar G, Sivanandhan G, MubarakAli D, Rajesh M, Arun R, Kapildev G, Manickavasagam M, Thajuddin N, Premkumar K, Ganapathi A. Biogenic silver nanoparticles for cancer treatment: an experimental report. Colloids Surf B Biointerfaces. 2013 Jun 1;106:86-92. doi:

10.1016/j.colsurfb.2013.01.027. Epub 2013 Jan 23. PubMed PMID: 23434696.

36. Ajitha B., Ashok Kumar Reddy Y., Rajesh K.M., Sreedhara Reddy P. Sesbania grandiflora leaf extract assisted green synthesis of silver nanoparticles: Antimicrobial activity. Mater. Today Proc. 2016;3:1977–1984. doi: 10.1016/j.matpr.2016.04.099.
37. Venkatesan J, Kim SK, Shim MS. Antimicrobial, Antioxidant, and Anticancer Activities of Biosynthesized Silver Nanoparticles Using Marine Algae Ecklonia cava. Nanomaterials (Basel). 2016 Dec 6;6(12). pii: E235. doi: 10.3390/nano6120235. PubMed PMID: 28335363; PubMed Central PMCID: PMC5302724.
38. Firdhouse MJ, Lalitha P. Biosynthesis of silver nanoparticles using the extract of Alternanthera sessilis-antiproliferative effect against prostate cancer cells. Cancer Nanotechnol. 2013;4(6):137-143. Epub 2013 Sep 15. PubMed PMID: 26069509; PubMed Central PMCID: PMC4451506.
39. Otunola GA, Afolayan AJ. In vitro antibacterial, antioxidant and toxicity profile of silver nanoparticles green-synthesized and characterized from aqueous extract of a spice blend formulation, Biotechnology & Biotechnological Equipment, 2018;32(3):724-733, DOI: 10.1080/13102818.2018.1448301
40. Hembram KC, Kumar R, Kandha L, Parhi PK, Kundu CN, Bindhani BK. Therapeutic prospective of plant-induced silver nanoparticles: application as antimicrobial and anticancer agent, Artificial Cells, Nanomedicine, and Biotechnology, 2018;46(3):38-S51, DOI: 10.1080/21691401.2018.1489262
41. Sreelatha S, Padma PR, Umasankari E. Evaluation of anticancer activity of ethanol extract of Sesbania grandiflora (Agati Sesban) against Ehrlich ascites carcinoma in Swiss albino mice. J Ethnopharmacol. 2011 Apr 12;134(3):984-7. doi: 10.1016/j.jep.2011.01.012. Epub 2011 Jan 18. PubMed PMID: 21251969.
42. Gupta RA, Motiwala MN, Mahajan UN, Sabre SG. Protective effect of Sesbania grandiflora on acetic acid induced ulcerative colitis in mice by inhibition of TNF-α and IL-6. J Ethnopharmacol. 2018 Jun 12;219:222-232. doi: 10.1016/j.jep.2018.02.043. Epub 2018 Mar 10. PubMed PMID: 29530609.
43. Pari L, Uma A. Protective effect of Sesbania grandiflora against erythromycin estolate-induced hepatotoxicity. Therapie. 2003 Sep-Oct;58(5):439-43. PubMed PMID: 14682193.
44. Doddola S, Pasupulati H, Koganti B, Prasad KV. Evaluation of Sesbania grandiflora for antiurolithiatic and antioxidant properties. J Nat Med. 2008 Jul;62(3):300-7. doi: 10.1007/s11418-008-0235-2. Epub 2008 Apr 12. PubMed PMID: 18408896.
45. Kumaravel M, Karthiga K, Raviteja V, Rukkumani R. Protective effects of Sesbania grandiflora on kidney during alcohol and polyunsaturated fatty acid-induced oxidative stress. Toxicol Mech Methods. 2011 Jun;21(5):418-25. doi: 10.3109/15376516.2010.550015. Epub 2011 Mar 21. PubMed PMID: 21417636.
46. LAKSHMI.T, “Hadga (Sesbania Grandiflora Linn.) –A Unique Ayurvedic Remedy”, Int. J. Drug Dev. & Res., Oct- Dec 2011, 3(4): 1-3
47. Hasan N, Osman H, Mohamad S, Chong WK, Awang K, Zahariluddin AS. The Chemical Components of Sesbania grandiflora Root and Their Antituberculosis Activity. Pharmaceuticals (Basel). 2012 Aug 23;5(8):882-9. doi: 10.3390/ph5080882. PubMed PMID: 24280680; PubMed Central PMCID: PMC3763669.
48. Patil RB, Nanjwade BK, Manvi FV. Effect of Sesbania grandiflora and Sesbania sesban Bark on carrageenan induced acute inflammation and adjuvant-induced arthritis in rats. Pharma Sci Monitor: An Int J Pharmaceut Sci. 2010;1:75–89.
49. Srivastava S, Singh P, Jha KK, Mishra G, Srivastava S, Khosa RL. Evaluation of anti-arthritic potential of the methanolic extract of the aerial parts of Costus speciosus. J Ayurveda Integr Med. 2012 Oct;3(4):204-8. doi: 10.4103/0975-9476.104443. PubMed PMID: 23326092; PubMed Central PMCID: PMC3545241.
50. Munde-Wagh K.B., Wagh V.D., Toshniwal S.S., Sonawane B.R. Phytochemical, antimicrobial evaluation and determination of total phenolic and flavonoid contents of Sesbania grandiflora flower extract. Int. J. Pharm. Sci. 2012;4:229–232.
51. Mishra RR, Savith A, Purushotham S, Geethanjali G. Sesbania Grandiflora (Humming Bird Tree) in the Management of Anemia. Int. J Cont. Med. Res. 2016 Oct;3(10):3060-3062. Available From: https://www.ijcmr.com/uploads/7/7/4/6/77464738/ijcmr_1013_nov_5.pdf