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A Brief Review on *Bauhinia variegata*: Phytochemistry, Antidiabetic and Antioxidant potential.

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ABSTRACT

Bauhinia variegata Linn widely used in folk medicine for varied purposes to treat different kinds of pathologies particularly diabetes, infections, pain and inflammation owing to the presence of numerous phytochemicals residing in the plant. The chemical constituents isolated so far from the plant are β -sitosterol, kaempferol-3-glucoside, tannins, carbohydrates, amides, reducing sugars, vitamin C, crude protein, fibers, calcium, phosphorus, quercetin, rutin, quercitrin, apigenin, apigenin- 7-O-glucoside, heptatriacontan-12, 13-diol and dotetracontan-15-en-9-ol. Different parts of *Bauhinia variegata* like leaves, bark and flowers have significant antioxidant activity. *Bauhinia variegata* can be considered as a model herbal drug for experimental studies including free radical induced disorders like cancer, diabetes, atherosclerosis etc.

Keywords: *Bauhinia Variegata*, Antidiabetic, Antioxidant, Flavanoids, Diabetes.

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INTRODUCTION

Bauhinia variegata Linn. (Leguminosae), commonly known as 'Kachnar', is a medium sized deciduous tree widely distributed in most tropical countries including rocky hills of Circars, Deccan and carnatic regions of South India ^{1,2}. Also known as 'Camel's foot tree or Orchid tree' it has been frequently used in folk medicine for varied purposes; to treat different kinds of pathologies, particularly diabetes, infections, as well as pain and inflammation owing to the presence of numerous phytochemicals residing in the plant ³.

The chemical constituents isolated so far from the plant are β -sitosterol, kaempferol-3-glucoside, tannins, carbohydrates, amides, reducing sugars, vitamin C, crude protein, fibers, calcium, phosphorus, quercetin, rutin, quercitrin, apigenin, apigenin- 7-O-glucoside, heptatriacontan-12, 13-diol and dotetracontan-15-en-9-ol ⁴.

Plant polyphenols act as strong antioxidants and they protect cell constituents against oxidative damage, thus averting the deleterious effects on nucleic acids, proteins and lipids in cells ⁵. High antioxidant capacities are observed in plants with high level of phenolic compounds ⁶. The redox properties of phenolic compounds, which enable them to act as reducing agents, hydrogen donors and singlet oxygen scavengers account for the antioxidant potential of medicinal plants ⁷. The phenolic content is considered as an important plant constituent as its hydroxyl groups have considerable scavenging ability ⁸. The flavonoids, which are the largest and most studied polyphenols, are gaining interest as antioxidants because of their high capacity to scavenge free radicals ⁹. Flavonoids prevent hydroxy radical induced damage ¹⁰ by donating an electron to neutralize the species ¹¹.

Plants synthesize compounds with biological activity, namely antioxidant, as secondary products, which are mainly phenolic metabolites ranging from simple to highly polymerized compounds ¹². Many epidemiological studies have shown that the consumption of phenolic-rich foods is associated with the prevention of chronic diseases ¹³.

Biological properties of different *Bauhinia* species have been investigated in numerous experimental *in vivo* and *in vitro* models and the results indicate that the reported therapeutic properties are mainly due to the presence of flavonoids ¹⁴.

Plant phenolics, in particular phenolic acids, tannins and flavonoids are known to be potent antioxidants and occur in vegetables, fruits, nuts, seeds, roots and barks ¹⁵. In the case of phenolic compounds, the ability of the phenolics to act as antioxidants depends on the redox potential of their phenolic hydroxyl groups that allow them to act as reducing agents, hydrogen-donating

antioxidants and oxygen quenchers¹⁶. These findings indicate that free radical scavenging in part has immense value in the prevention and treatment of deadly diseases and holds good only if the plant contains phenolics in considerable amount so that the plant can be commercially exploited. High yield of total phenolics from the stem bark of *Bauhinia variegata* has been obtained pointing that it can be utilised as a remarkable source for the preparation of not only nutraceuticals as potent antioxidants but also for the treatment of other major health problems³.

Different parts of *Bauhinia variegata* like leaves, bark and flowers have free radical scavenging activity by hydroxyl radical scavenging method. Overall *Bauhinia variegata* can be considered as a model herbal drug for experimental studies including free radical induced disorders like cancer, diabetes, atherosclerosis etc¹⁷. Different parts of this plant are used in folk medicine to treat different kinds of pathologies like, jaundice, infections, leprosy, bronchitis, tumors as well as pain and inflammation¹⁸

Root bark and root

Phytochemical analysis of the root bark of *Bauhinia variegata* yielded a new flavanone, (2S)-5, 7-dimethoxy-3, 4- methylene dioxy flavanone and a new dihydrodibenzoxepin, 5, 6 - dihydro - 1, 7 - dihydroxy - 3, 4 - dimethoxy 2 methylidibenzoxepin. The structures of the new compounds were determined on the basis of spectral studies¹⁹. A novel flavonol glycoside 5,7,3',4'-tetrahydroxy-3-methoxy-7-o-alpha- L rhamnopyranosyl(1--3)-o-beta-galactopyranoside was isolated from the roots of *Bauhinia* and its structure was identified by spectral analysis and chemical degradations²⁰. Also the following phytoconstituents were isolated: flavanone dihydrodibenzoxepin flavanol glycoside-5. 7. 3'. 4-tetrahydroxy-3-methoxy-7-O-alpha-L-rhamnopyranosyl (1 - 3)-o-beta galactopyranoside, (2S) -5.7-dimethoxy-3'4' methylenedioxyflavanone and dihydrodibenzoxepin, 5.6-dihydro- 1.7-dihydroxy- 3.4-dimethoxy-2-methylidibenz [b,f]oxepin¹⁹.

Leaves



Two new long chain compounds, heptatriacontan- 12, 13-diol and dotetracont-15-en-9-ol have been isolated from the leaves of *Bauhinia variegata*. Structures of these compounds have been

elucidated by spectral data analysis and chemical studies²¹. The leaves were also found to contain crude protein, calcium and phosphorous. Leaves of this plant were also reported to contain volatile oil. The analysis of oil by GC/MS showed presence of germacrene D, spathulenol, δ - and γ -cadinene²². Leaves have flavonoids like quercetin, rutin, kaempferol. It is scientifically proved that flavonoids have significant effects on blood glucose level. One study showed that, aqueous extract of leaves of *Bauhinia variegata* can effectively decrease the elevated plasma glucose level and can be evolved as a phytomedicine in treatment of type I diabetes²³.

Diabetes mellitus is a heterogeneous metabolic or endocrine disorder characterized by hyperglycemia, glycosuria and negative nitrogen balance leading to a number of microvascular (retinopathy, neuropathy & nephropathy) and macrovascular (heart attack, stroke and peripheral vascular disease) diseases²⁴. Evidence based on immunological cross-reactivity and anti-diabetic properties has suggested the presence of insulin-like peptides in plants. A chloroplast protein with a molecular mass similar to that of bovine insulin was extracted from 2-mm thick 15% SDS-PAGE gels and fractionated with a 2 x 24 cm Sephadex G-50 column. The activity of this insulin-like protein (0.48 mg/mL) on serum glucose levels of four-week-old Swiss albino diabetic mice was similar to that of commercial swine insulin used as control. Further characterization of this molecule by reverse-phase hydrophobic HPLC chromatographic analysis as well as its antidiabetic activity on alloxan-induced mice showed that it has insulin-like properties. Immunolocalization of the insulin-like protein in the leaves of *Bauhinia variegata* was performed by transmission electron microscopy using a polyclonal anti-insulin human antibody. Localization in the leaf blades revealed that the insulin-like protein is present mainly in chloroplasts where it is also found associated with crystals which may be calcium oxalate. The presence of an insulin-like protein in chloroplasts may indicate its involvement in carbohydrate metabolism²⁵.

Buds



Keto acids of flowering buds were analyzed during their development and correlated with the free amino acids and amides. Only four amino acids appeared in early stages. α -Alanine, aspartic acid, glycine and glutamic acid. Glutamic acid showed a sharp drop from initial to later stages.

Phosphoenolpyruvic acid, oxaloacetic acid and α -ketoglutaric acid appeared in later stages. Their absence in early stages is attributed to their rapid utilization in floral bud development²⁶

Stem bark and stem



The stem bark showed presence of hentriacontane, octacosanol, stigmasterol²⁷ and of sterols, glycosides, reducing sugars and nitrogenous substances on preliminary phytochemical screening²⁸. The stem yielded a flavonone glycoside characterized as 5, 7-dihydroxyflavonone-4- α -L-rhamnopyranosyl- β -D glucopyranoside²⁹. The isolation of β -sitosterol, lupeol, kaempferol-3-glucoside and a 5, 7-dimethoxyflavonone-4- α -L-rhamnopyranosyl- β -D glucopyranoside was also reported from the stem of the plant^{30,31}. A flavonol glycoside, characterized as kaempferol-3-glucoside, was isolated from stem of this plant³². A new phenanthraquinone, named bauhinione, has also been isolated from *Bauhinia variegata* and its structure has been elucidated as 2, 7-dimethoxy-3-methyl-9,10-dihydrophenanthrene-1,4-dione on the basis of spectroscopic analysis^{33,34} additionally 5, 7-dihydroxy flavanone - 4'-O- α -L-rhamnopyranosyl β -D- glucopyranoside³⁵, 5, 7 - dihydroxy and 5,7 dimethoxy flavanone-4-O- α -L-rhamnopyranosyl- β -D-glucopyranosides²⁹, hentriacontane, octacosanol, sitosterol, stigmasterol²⁸, neringenin-5,7-dimethylether-4'-rhamnoglucoside and lupeol³¹ were isolated. 5,7,3',4'-Tetrahydroxy-3-methoxy-7-O- α -L-rhamnopyranosyl-O- β -galactopyranoside²⁰, 2,7-dimethoxy-3-methyl-9,10-dihydrophenanthrene-1,4-dione named as bauhinione³³ were isolated.

Flowers:



The list of phytoconstituents isolated from flowers of this plant *Bauhinia variegata* are as follows: Quercitroside, Isoquercitroside, rutoside, taxifoline rhamnoside, kaempferol-3-glucoside, myricetol glycoside³⁰, apigenin, ascorbic, aspartic, glutamic, octadecanoic acid, keto acids, amino acid, tannins³⁵, cyaniding-3-glucoside, malvidin-3-glucoside, malvidin-3-diglucoside, peonidin-3-glucoside, peonidin-3-diglucoside, 3-galactoside and 3-rhamnoglucoside of kaempferol³⁶.

Seed:



The seeds contains carbohydrates, proteins, amino acids, ascorbic acid, flavonoids, alkaloids, leucoanthocyanines, aspartic acid, glutamic acid, arginine, glycine, alanine, histidine, isoleucine, lysine, methionine, phenylalanine, proline, serine, threonine, tyrosine, valine³⁷ and 5-hydroxy-7,3',4',5'-tetra-methoxyflavone-5-O-beta-D-xylopyranosyl-alpha-L-rhamnopyranoside³⁸

Antioxidant effects:

The crude extracts and fractions of *B. variegata* were evaluated for their antioxidant potential. The antioxidant activity was performed by DPPH radical scavenging assay. The ethyl acetate, methanol and n-hexane fractions show moderate scavenging activity as compared to the standard quercetin. *Bauhinia variegata* Linn has been extensively used in Indian traditional and folklore medicine to cure various human ailments. The presence of Phyto-constituents such as oleic acid, β -sitosterol is reported to reduce the hyperlipidemic states³⁹ and such components have been previously reported in *B. variegata*⁴⁰. Antiobesity effect of *Bauhinia variegata* bark extract on female rats fed on hypercaloric diet has been observed⁴¹. In other study methanol extract of *B. variegata* bark and its fractions were evaluated for antioxidant and DNA protective activity. The results concluded it has significant antioxidant activity and potential to prevent H₂O₂-induced oxidative damage to pBR322 DNA. The potent antioxidative activity and DNA protection ability of *B. variegata* bark extract/fractions may be attributed to their richness in phenolic/flavonoid compounds. Moreover, there was a significant correlation between antioxidant activity and the total phenolic/flavonoid content⁴². The chemical investigation of methanolic extract of the stems of *Bauhinia variegata* led to the isolation of four bioactive phytoconstituents - Lupeol, β -Sitosterol, Kaempferol and

Quercetin. All these isolated phytochemicals are well established to exhibit significant biological activities ⁴³

Anti-diabetic action:

Insulin like sequences including domain structures occur in plant species also. This could give a biological basis for the effectiveness of plant extracts and decoctions in the management of hyperglycemia ⁴⁴. Oral administration of ethanolic, aqueous and hydro-alcoholic extract of leaves and stem bark of *Bauhinia variegata* at different doses i.e 200 and 400 mg/kg in streptozotocin (STZ) and alloxan-induced diabetic rats reduced the elevated blood glucose level by increasing glucose metabolism ⁴⁵. Phytochemical screening and *in vitro* free radical scavenging activity of aqueous and ethanolic bark extracts of *Bauhinia variegata* was assessed by studying its ability to scavenge DPPH, Nitric oxide, hydroxyl radical and reducing power. Phytochemical analysis revealed the presence of steroid, phenol/ tannin, glycoside/ sugar, carbohydrate and terpenoids. Ethanolic extract showed significant nitric oxide scavenging activity, whereas aqueous extract was comparatively more potent against both ROS (Reactive Oxygen Species) and RNS (Reactive Nitrogen Species) generation systems. The results support its traditional use in curing various diseases and as a source of natural antioxidants which protect cells against oxidative stress ⁴⁶. In other study the aqueous and ethanolic extracts of *B. variegata* L. have shown significant antioxidant activity. The % free radical scavenging activity gradually increases with increasing concentrations of *B. variegata* extracts in DPPH radical scavenging assay. Dose dependent antioxidant activity pattern was also observed in phosphomolybdate assay. Antioxidant activity was directly correlated with the amount of total phenolic contents in the extracts. *B. variegata*. Oral administration of ethanolic, aqueous and hydro-alcoholic extract of leaves and stem bark of *Bauhinia variegata* at different doses i.e 200 and 400 mg/kg in streptozotocin (STZ) and alloxan-induced diabetic rats reduced the elevated blood glucose level by increasing glucose metabolism. Further it has been discovered that insulin-like proteins present in leaves of *Bauhinia variegata* are responsible for glucose metabolism. Treatment with ethanolic extract of *Bauhinia variegata* leaves at a dose of 300 mg/kg lowered the blood glucose level and improved lipid profile. It has been noted in an *in vitro* study that ethanolic extract of leaves of *Bauhinia variegata* and roseoside (active constituent) increased the release of insulin in beta-cell line INS-1. Treatment with ethanolic extract of bark at 250 mg/kg and 500 mg/kg improved blood glucose level by regenerating β -cells in alloxan-induced rats. Leaves extract of *B. variegata* exhibited hypoglycemic effects due to the presence of insulin-like proteins. The hypoglycemic activity may be ascribed to the presence of flavonoids, which have been shown to inhibit cyclooxygenase and

promote β -cell regeneration besides having insulin secretory property. Alloxan injection induces significant hyperglycemia and *Bauhinia* extract treatment significantly reduced the blood glucose levels in hyperglycemic animals. The results revealed the maintenance of blood sugar levels in diabetic rats during the 7 days administration of *Bauhinia* extract throughout the study period^{47 48}

In conclusion, *Bauhinia variegata* exhibited significant antihyperglycemic effects which may be attributed to increased glucose metabolism⁴⁹. Enhancement of insulin release from the beta-cell line INS-1 by an ethanolic extract of *Bauhinia variegata* and its major constituent roseoside. The crude extracts and the major metabolite were shown to increase insulin secretion in a dose-dependent manner⁵⁰. The effect of extracts of *B. variegata* L on blood glucose levels and serum lipid profile like Total cholesterol, triglycerides, phospholipids, low density, very low density and high density lipoprotein were measured in the diabetic and non diabetic rats. There was significant reduction in Total cholesterol, LDL, VLDL and improvement in HDL in diabetic rats. These results indicate that *B. variegata* possesses hypoglycemic effect⁵¹. The presence of insulin-like molecule was recently demonstrated in the leaves, where a 'chloroplast protein' was found that has a partial amino acid sequence identical to that of Bovine insulin. This protein may be responsible for the lowering of blood glucose concentration when it is injected in alloxan induced diabetic mice. Major metabolite of the ethanolic extracts of leaves; roseoside, demonstrates insulinotropic activity towards pancreatic β -cells of the INS-1 cell line and may act in conjunction with the chloroplast protein to contribute to the overall antidiabetic properties⁵²

CONCLUSION

It can be concluded that the plant *Bauhinia variegata* has potential antioxidant and antidiabetic activity. A critical analysis of the literature indicates it has numerous uses but more clinical and pharmacological studies at molecular level, are needed to investigate unexploited potential of this plant. Standardization of various extracts for using in specific herbal formulations, investigation of the molecular mechanisms of action of isolated phyto constituents using biological and clinical screenings like using cell lines to obtain new and more potent synthetic derivatives is required in future for commercial purpose.

REFERENCES:

1. Sahu G, Gupta P K. A review on *Bauhinia variegata* Linn. Int Res J Pharm, 2012; 3(1):48-51.
2. Gamble J S, Flora of the Presidency of Madras, Vol. 2. Botanical Survey of India, Calcutta. 1956.

3. Arvind Negi, Nimisha Sharma, Reetika Pant, Mamta F. Singh. Determination of total phenolic content of the stem bark of *Bauhinia variegata* Linn. an approach to standardization. The Pharma Research, 2012; Volume 7, Issue 2. Page 16-22.
4. Vijay Kumar M M J, Eswarappa B, Yadav D. Bodke, Jayadevaiah K V, Basavaraja H S. Isolation of Phytoconstituents from the Stem Bark of *Bauhinia Variegata* Linn. Pharma Tutor Magazine, 2014; Vol. 2, Issue 9
5. Rice-Evans C. Current Medicinal Chemistry, June 2001; Volume 8, Number 7, 1, pp. 797-807(11)
6. Moyo M, Ndhlala A R, Finnie J F, Staden J V. Phenolic composition, antioxidant and acetylcholinesterase inhibitory activities of *Sclerocarya birrea* and *Harpephyllum caffrum* (Anacardiaceae). Food Chem, 2010; 123: 69-76.
7. F Lukmanul Hakkim, C Gowri Shankar, and S Girija. Chemical Composition and Antioxidant Property of Holy Basil (*Ocimum sanctum* L.) Leaves, Stems, and Inflorescence and their in Vitro Callus Cultures. J. Agric. Food Chem, 2007; 55, 9109–9117.
8. A T Diplock. Will the ‘good fairies’ please prove to us that vitamin E lessens human degenerative of disease? Free Rad. Res, 27 1997; pp. 511–53
9. Souza R S O, Albuquerque U P, Monteiro J M, Amorim E L C: *Jurema-preta* (*Mimosa tenuiflora* [wild.] *poir*) a review of its traditional use, phytochemistry and pharmacology. Braz Arch Biol Techn, 2008; 51(5):937-947.
10. Husain S R, Cillard J and Cillard P. Hydroxyl radical scavenging activity of flavonoids. Phytochemistry, 26:1987; 2489-2497.
11. Morel I, Lescoat G, Cillard P, Cillard J. Role of flavonoids and iron chelation in antioxidant action. Methods. Enzymol, 1994; 43: 437-443.
12. Moran J F, Klucas RV, Grayer R J, Abian J, Becana M: Complexes of iron with phenolic compounds from soybean nodules and other legume tissues: prooxidant and antioxidant properties, Free Rad Biol Med, 1997; 22, 861–870.
13. Hertog M G L, Feskens E J M, Kromhout D, Hollman P C H, Katan M B: Dietary antioxidant flavonoids and risk of coronary heart disease: the Zutphen elderly study, Lancet, 1993; 342, 1007– 1011.
14. Rao Y K, Fang S H, Tzeng Y M. Antiinflammatory activities of flavonoids and a triterpene caffeate isolated from *Bauhinia variegata*. Phytother Res, 2008; 22: 957-962.
15. Pratt D E, Hudson B J F. Natural antioxidants not exploited commercially. First ed. In: Hudson B J F, editor. Food Antioxidants. Elsevier, Amsterdam: 1990. p. 171 -192.

16. Rice-Evans C A, Miller N J, Paganga, G: Structure – antioxidant activity relationships of flavonoids and phenolic acids, *Free Radic Biol Med*, 1996; 20, 933– 956.
17. Sonam Pandey, R. C. Agrawal and S. Maheshwari In-Vitro Antioxidant and Free Radical Scavenging Activity of *Bauhinia Variegata* Linn. *International Journal of Scientific and Research Publications*, February 2012; Volume 2, Issue 2.
18. Al-Snafi A E, The pharmacological importance of *Bauhinia variegata*. A review. *Int J Pharma Sci Res*, 2013; 4(12):160-4.
19. Mopuru V B, Muntha K, Gunasekar D, Cauxb C, Bodob B. A flavanone and a dihydrodibenzoxepin from *Bauhinia variegata*. *Phytochemistry*, 2003; 64, 879-882.
20. R. N. Yadava & V. Madhu Sudhan Reddy. Anti-Inflammatory Activity of a Novel Flavonol Glycoside from the *Bauhinia Variegata* Linn. *Natural Product Research*, 2003; Volume 17, - Issue 3.
21. R S Singh, H S Pandey and Ghanshyam. Two new long chain compounds from *Bauhinia Variegata* Linn. *Indian Journal of Chemistry*, Sep 2006; Vol 45B, pp.2151-2153.
22. Joaquim M Duarte-Almeida, Giuseppina Negri, Antonio Salatino, Volatile oils in leaves of *Bauhinia* (Fabaceae Caesalpinioideae). *Biochemical Systematics and Ecology*. August 2004; Volume 32, Issue 8, Pages 747–753.
23. Yogesh A Kulkarni, *J Diabetes Metab* 2014; 5:10
24. Patel D K, Kumar R, Prasad S K, Sairam K, Hemalatha S. Antidiabetic and in vitro antioxidant potential of *Hybanthus ennea spermus* (Linn) F. Muell in streptozotocin-induced diabetic rats. *Asian Pac J Trop Biomed*. 2011; 1(4): 316-322.
25. C.R. Azevedo¹, F.M. Maciel, L.B. Silva, A.T.S. Ferreira, M. da Cunha, O.L.T. Machado, K.V.S. Fernandes, A.E.A. Oliveira¹ and J. Xavier-Filho. Isolation and intracellular localization of insulin-like proteins from leaves of *Bauhinia variegata*. *Brazilian Journal of Medical and Biological Research*, 2006; 39: 1435-1444.
26. D. Mukherjee and M. M. Laloraya. Keto acids and free amino acids during leaf growth in *Bauhinia purpurea* L. *Experientia*, March 1977; Volume 33, Issue 3, pp 304–305.
27. Prakash A, Khosa R L. Chemical studies on *Bauhinia variegata*. *Curr Sci*, 1976; 45:705.
28. Prakash A and Khosa R L. Neutral constituents of *Bauhinia variegata*. *J. Res. Indian. Med Yoga Homeopath*, 1978; 13: 96-97.
29. Gupta A K, Vidyapati T J and Chauhan J S. 5, 7-dihydroxyflavonone-4 -O - α -L - rhamnopyranosyl- β -D- glucopyranoside from the stem of *Bauhinia variegata*. *Ind. J. Chem*, 1979; 18: 85-86.

30. Duret S and Paris R R. The flavonoids of several species of *Bauhinia*. Plant Med Phytother, 1977; 11: 213-15.
31. Gupta A K, Vidyapati T J and Chauhan J S. Chemical examination of the stem of *Bauhinia variegata*. Planta Med, 1980; 38: 174-176.
32. Gupta A K and Chauhan J S. Constituents from the stem of *Bauhinia variegata*. Natl Acad Sci Lett, 1984; 7: 174-76.
33. Zhao Y Y, Cui C B, Cai B, Han B and Sun Q S. A new phenanthraquinone from the stems of *Bauhinia variegata* Linn. J.Asian Nat.Prod.Res, 2005; 7(6): 835-38.
34. Ravindra G Mali and Avinash S Dhake. *Bauhinia variegata* Linn. (Mountain Ebony): a review on ethnobotany, phytochemistry and pharmacology. Oriental Pharmacy and Experimental Medicine, 2009; 9(3), 207-216.
35. Chowdhury A R, Banerji R, Misra G, Nigam S K. Fatty acid composition and mineral composition of the seeds of some species of *Bauhinia*. Feete Seifen Anstrichmittel, 1984; 86:237-9.
36. Saleh N. A. M and Ishak M. S. Anthocyanins of some leguminosae flowers and their effect on colour variation. Phytochemistry, 1976; 15, 835-836.
37. Abdel-Wahab, S.M., Wassel, G.M., Al-Okbi, S.Y. and Ammar, N.M., J. Drug Res., Egypt, 1989; 18(1-2), 53-61.
38. R N Yadava & V M S Reddy. A New Flavone Glycoside, 5-Hydroxy 7,3',4',5'-Tetra-Methoxyflavone 5-O- β -D-Xylopyranosyl-(1 \rightarrow 2)- α -L-Rhamnopyranoside from *Bauhinia Variegata* Linn. Journal of Asian Natural Products Research , 2001; Volume 3- Issue 4
39. Bopanna K N, Kannan J, Sushma G, Balaraman R and Rathod, S P. Antidiabetic and antihyperlipaemic effects of neem seed kernel powder on alloxan diabetic rabbits. Indian Journal of Pharmacology, 1997; 29(3): 162-167.
40. Khare C P, Indian Medicinal Plants: An Illustrated Dictionary. Springer-Verlag Berlin/ Heidelberg 2007.
41. G. Balamurugan and P. Muralidharan. Antiobesity effect of *Bauhinia variegata* bark extract on female rats fed on hypercaloric diet. Bangladesh J Pharmacol, 2010; 5: 8-12
42. Neha Sharma, Renu Bhardwaj, Subodh Kumar and Satwinderjeet Kaur. Evaluation of *Bauhinia variegata* L. bark fractions for *in vitro* antioxidant potential and protective effect against H₂O₂-induced oxidative damage to pBR322 DNA. African Journal of Pharmacy and Pharmacology, 2011; Vol. 5(12), pp. 1494-1500.

43. S. K. Jash, R. Roy, D. Gorai. Bioactive constituents from *Bauhinia variegata* Linn. Int J Pharm Biomed Res, 2014; 5(2), 51-54
44. Saradha Jyoti Koonan et al. Plant Insulin :An in silico approach..International Journal of Diabetes in developing Countries October-December 2010; Volume 30 issue 4.
45. Tewari Ramesh Chandra, Chaubey Suresh, Dash Sanghamitra, Kour Gagan Deep, Gautam Rajnish Kumar. *Kanchnara (Bauhinia Variegata Linn.): A Critical Review IJAPR*, July 2015; Vol 3 Issue 7 39.
46. Bhagya Bhaskar. Free radical scavenging activity of bark extracts of *Bauhinia variegata* L. Pharmacognosy Journal, 2011; Volume 3, Issue 24, Pages 45–49.
47. Parveen Kumar, Shailesh Baraiya, S N Gaidhani, M D Gupta, Manish M Wanjari. Antidiabetic activity of stem bark of *Bauhinia variegata* in alloxan-induced hyperglycemic rats. Research Letter, 2012; Vol 3 Issue 1, Page 64-66.
48. Baraiya S, Gaidhani S N, Gupta M D, Wanjari M M, Kumar P. Antidiabetic activity of stem bark of *Bauhinia variegata* in alloxan –induced hyperglycemic rats. Journal of Pharmacology & Pharmacotherapy, 2012, 3(1) 64-66.
49. Parveen Kumar, Shailesh Baraiya, S. N. Gaidhani, M. D. Gupta, and Manish M. Wanjari. Antidiabetic activity of stem bark of *Bauhinia variegata* in alloxan-induced hyperglycemic rats. J Pharmacol Pharmacother, 2012; Jan-Mar; 3(1): 64–66.
50. Frankish N, De Sousa Menezes F, Mills C, Sheridan H. Enhancement of insulin release from the beta-cell line INS-1 by an ethanolic extract of *Bauhinia variegata* and its major constituent roseoside. Planta Medica, 2010; 76(10):995-997 .
51. Thiruvenkatasubramaniam R and Jayakar B. Anti-Hyperglycemic and Anti-Hyperlipidaemic Activities of *Bauhinia variegata* L on Streptozotocin Induced Diabetic Rats. Scholars Research Library. Der Pharmacia Lettre, 2010; 2(5): 330-334.
52. Arvind Negi, Nimisha Sharma¹, Mamta F. Singh. Spectrum of Pharmacological Activities from *Bauhinia variegata*: A Review. Journal of Pharmacy Research 2012; 5(2),792-797.

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