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Plant Chemistry and Pharmacological applications of *Bauhinia variegata Linn.* (Camel foot tree): A Review

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ABSTRACT

Bauhinia variegata Linn. (Camel foot tree) is an average sized deciduous tree. It is commonly known as "kachnar". It belongs to the most nascent family "caesalpiniaceae". It is a medicinal plant and widely used by the Indian tribes in the form of extract of leaves, buds, flowers, stem bark, stem, root bark, root and seeds. Mountain ebony is popular in Unani, Ayurveda and Homeopathy system of medicine for curing different types of disease. All crudes have been evaluated (alcoholic and aqueous extract) of aerial parts of *B. variegate Linn.* for *in-vitro* and *in-vivo* activity. Various chemical constituents have been isolated from plant parts like flavonoids, glycoside, steroids, tannins and reducing sugar. The numerous prominent pharmacological activities have been also reported like antioxidant, antimicrobial, antitumor, anti-diabetic, anti-inflammatory, anti-ulcer, nephroprotective action, immunomodulatory and wound healing effect. In this review, a detail inclusive screening study of chemical constituents of *B. variegata Linn.* and their pharmacological importance are discussed.

Key words: Mountain Ebony, phytochemical screening, aerial plant parts, Kachnar, Pharmacological activity.

1. INTRODUCTION

Bauhinia variegata Linn. is deciduous tree of innate to tropical and temperate areas. This is small to average sized tree and belongs to family "caesalpiniaceae". It is recognized as "mountain ebony" herb in english and "kachnar" in hindi and also popular by other names like orchid tree or camel foot tree. Historically, *B. variegata Linn.* is inborn to the tropical and temperate indian subcontinents (India, Bhutan, Pakistan, and Nepal), Southeastern Asia (Laos, Myanmar, Vietnam and Thailand) [1]. In India, *B. variegata Linn.* is scattered in sub-himalayan and outer himalayan areas of the Sikkim and Punjab state and it also found in Burma and China. As per the botanical description of plant, it is a small size plant having 10-12 meters in length and 4-5 meters in width. The leaves are 10-12 cm wide and 5-6 cm long (1 folicale, 2 lobed) called as camel foot leaves. The bark is brownish and grey in color. The flowers are pink color, sessile, conspicuous and fragrant with five petals and pods are flat soften compressed and descent in appearance. Seeds are brown in colour, round in shape and pods are 10-15 mm in size. The taxonomical classification of plant is shown in figure 1. This herbal plant is used in traditional medicines for the treatment of different diseases like diabetes, pain, inflammation, wound healing and various infections. The natural chemical moieties isolated from the plants are flavonoids, steroids [2] tannins, carbohydrate, amides [3] reducing sugar, kaempfored -3, glucoside, vitamin C, crude proteins [4] quercetin, rutin, quercetin [5] apigenin, apigenin- 7-o-glucoside, [6] heptatriacontan-12,13- diol and dotetracontan-15-en-9-ol [7] etc.

Individual parts of *B. variegata Linn.* like leaf, stem, bark, bud, flower and root shows significant *in-vitro* and *in-vivo* activity against diarrhea, dysentery, hemorrhoids, odema, laxative, skin disease and snake bite. The alcoholic extract of (1kg stem, 1.2kg leaves and 1.2kg flowers) aerial parts of plant of *B. variegata Linn.* act as an effective measure against antibacterial or antimicrobial effect. The polyphenols present in plant have strong antioxidant property which defends the cell parts from oxidative injury, thus avoiding the harmful effects on proteins, nuclei materials and lipids present in the cells. The flavonoids present in the plant is widely focussed polyphenols act as an antioxidant due to their high ability towards scavenge free radicals. Flavonoids prevent hydroxyl radical induced damage by giving an electron to deactivate the species [1,2].

Figure 1: Taxonomical classification of *B. variegata Linn*

This review concluded that the *B. variegata Linn.* is a medicinal plant used in preparation of traditional medicine for the treatment of numerous diseases. The chemical constituents obtained from different parts of this plant are used as a traditional medicine for the treatment of various kinds of pathological conditions like, diabetes, microbial infections, skin infections, tumors, nephrotoxicity, wound healing and inflammation.

2. PLANT CHEMISTRY

The individual part of the plant *B. variegata Linn.* contains different chemical constituents which are extracted by different solvent system. The presence of different chemical moieties in root, stem, bark, flowers, leaves, buds are shown in figure 2. There are various types of solvent used for the extraction of different chemical constituents from individual parts of *B. variegata Linn.* was shown in table 1.

Table 1: Solvent used for the extraction of different chemical constituents from individual parts of plant

S.No.	Plant part	Solvent used for extraction	Chemical constituents	Reference
1.	Stem bark and stem	Petroleum ether Benzene & chloroform Chloroform & methanol Petroleum ether & benzene	Heptatricon tan-12, 13-diol Friedelin Docosanoic acid n-Hexadecanoic acid, Lupeol, Quercetin	24
2.	Leaves	Petroleum ether Benzene Chloroform Ethyl acetate Ethyl alcohol	Flavonoids Terpenoids Phenolic Saponins Tannins, Alkaloids, steroids, Glycoside	25,26
3.	Flowers/ Buds	Alcohol	Beta-sitosterol Kaempferol-3 Glucoside Tannins Amides	27
4.	Seeds	Ethanol	Flavone glycoside	21
5.	Root & Root bark	Ethanol	Flavonoids flavonoid glycoside	23,22

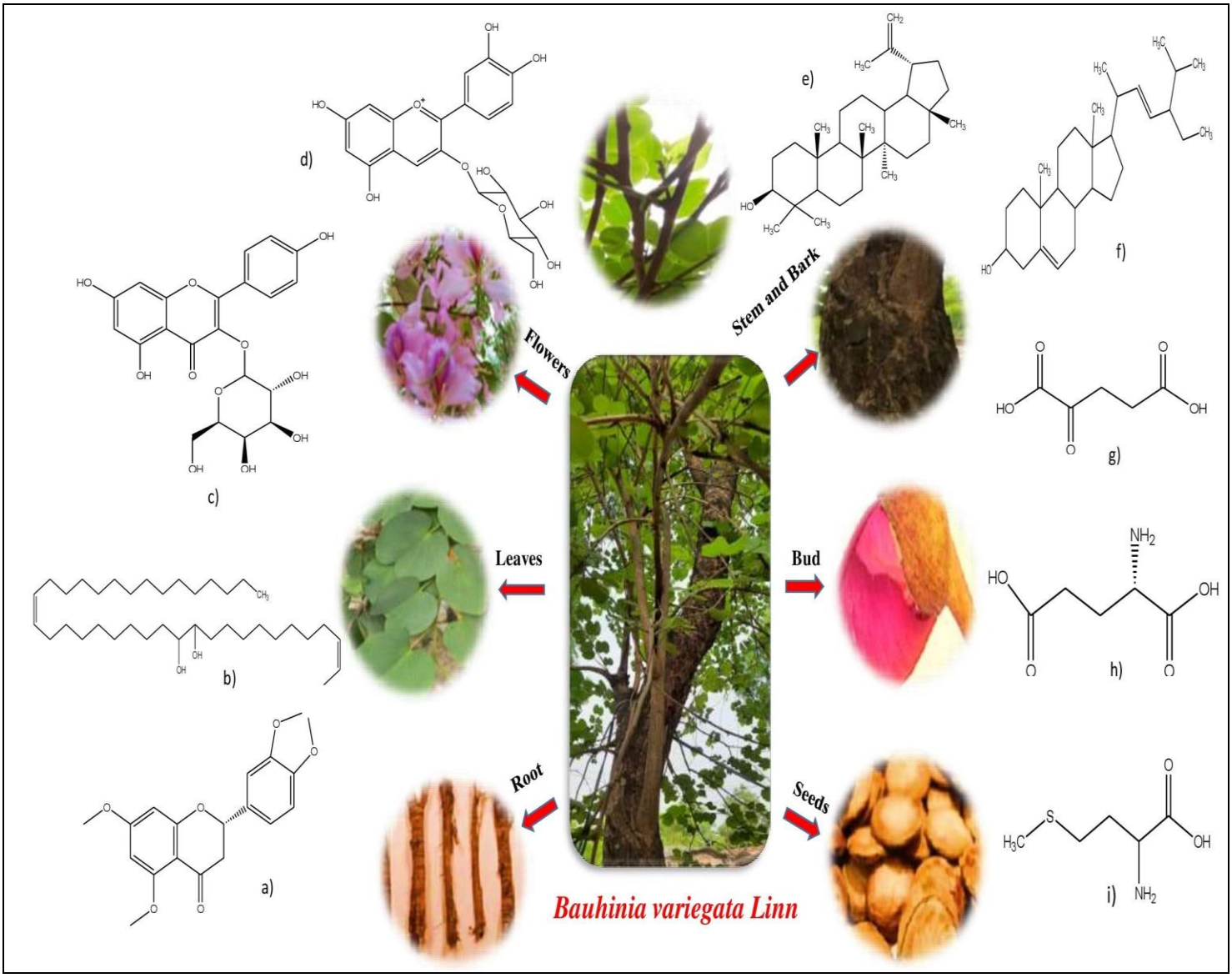
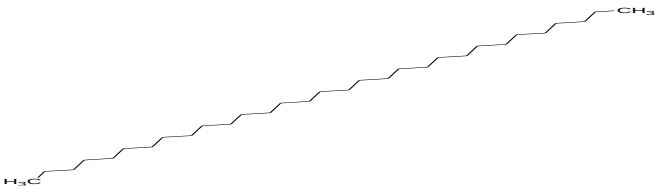


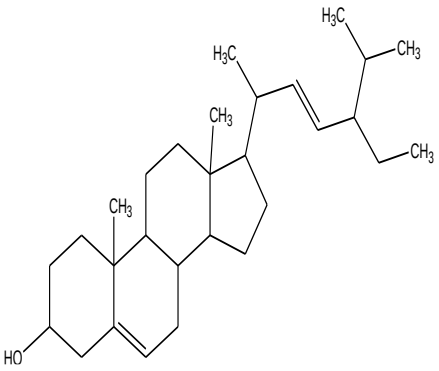
Figure 2: Different parts and various chemical constituents present in the *B. variegata Linn.* Plant. a) (2s)-5,7-dimethoxy-3,'4-methyleene dioxyflavonone, b) Heptatatriacontan-12,13-diol, c) kaemferol-3-galactoside, d) cynidin-3-glucoside, e) Lupeol, f) Stigmasterol, g) alpha- Ketoglutaric acid, h) Glutamic acid, i) Threonine

2.1 Stem Bark and Stem

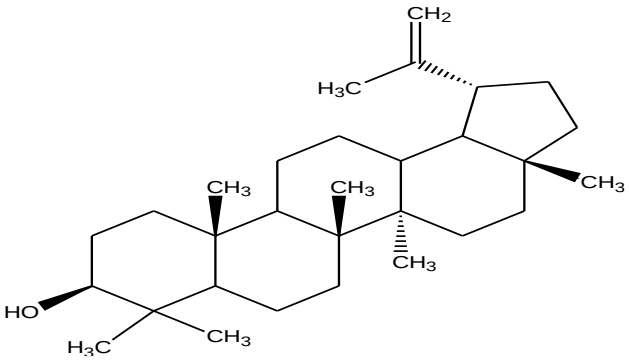
The ethanolic and methanolic extract of stem bark contains various chemical constituents like 5,7-dihydroxyflanone, 4–o-alpha–L–rhanmopyranoside,[8] hentriacontane, Stigmasterol,[9] sterols, glycosides, reducing sugar and nitrogenous substances all are obtained by preliminary phytochemical screening [10]. It is also containing 5,7-dimethoxyflavonone – 4– rhamnopyranosyl–Beta-D glucopyranoside lupeol [11] and kaempferol glucosides [12]. A new phenanthraquinine named as bauhinione, its structure modified chemically as 2,7-dimithoxy-3-methyl-9,10-dihydrophenanthrene-1,4-dione [13]. The alcoholic extract contains the 5, 7-dihydroxyflavanone-4-o-a-L-rhamnopyranosyl-b-D-glucopyrannoside [14], neringeni-5,7-dimethylether- 4-rhamnoglucoside and lupeol [11], 5,7,3,4-tetrahydroxy-3-methoxy-7-o-alpha-L-rhamnopyranosyl-o-b- glucopyranoside respectively [15].



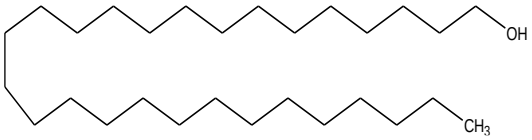
Hentriacontane



Stigmasterol



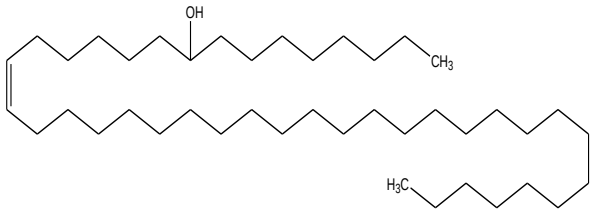
Lupeol



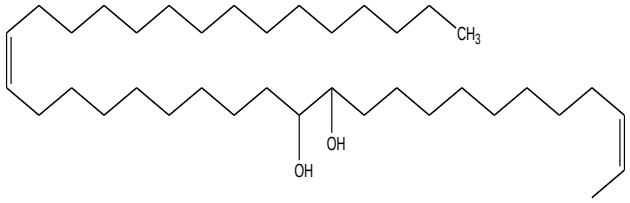
Octacosanol

2.2 Leaves

The ethanolic and methanolic extract of leaves contains two novel compounds, heptatriacontan – 12,13-diol and dotetracont -15–en -9-ol [16] and other likes flavonoids as quercetin, rutin, kaempferol that have significant effect on blood glucose level. The *B. variegata Linn* is effectively decrease the elevated plasma glucose level and its chemical molecule phytochemidiline used in the treatment of diabetes type-I [17] and effective against insulin in concentration (0.48 mg/kg) towards serum glucose level, this study has been performed in 4 weeks old swiss albino mice and marketable swine insulin used as a control in the research protocol. Further analysis was done by RP-HPLC chromatographic technique to proof its antidiabetic activity. Immuno-localization of the insulin-like protein in the plant leaf was performed by transmission electron microscopy (TEM) through "polyclonal anti-insulin antibody of human". The structure of leaf blades revealed that this wonderful protein specially found in chloroplast region where it is associated with calcium oxalate crystals. The existence of this protein in chloroplast may shows its activity in metabolism of carbohydrate [18].



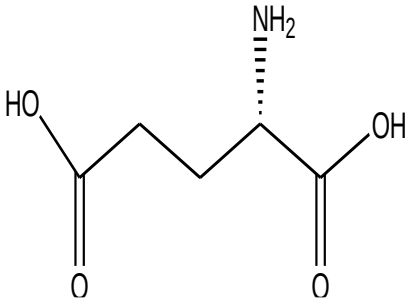
Dotetracont-15-en-9-ol



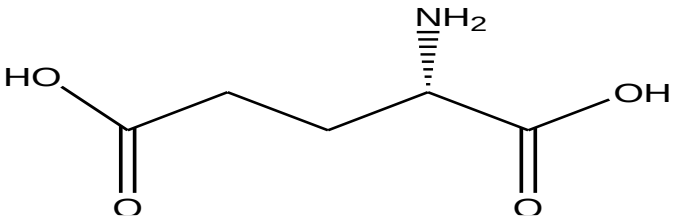
Heptatatriacontan-12,13-diol

2.3 Buds

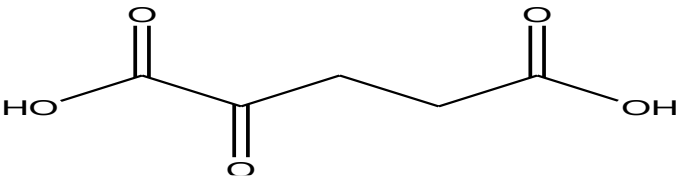
The phytochemical investigation of alcohol based extract of plant buds showed the presence of various amino acid (AA) and amides. It consists of four types AA such as α –alanine, aspartin acid, pyruvic acid, phosphoenol type amino acids, oxaloacetic acid and α –keto glutaric acid looked in advanced steps of the experimental research. The absence of oxaloacetic acid and α –keto glutaric acid in initial stages is credited to their fast consumption in floral bud growth [19].



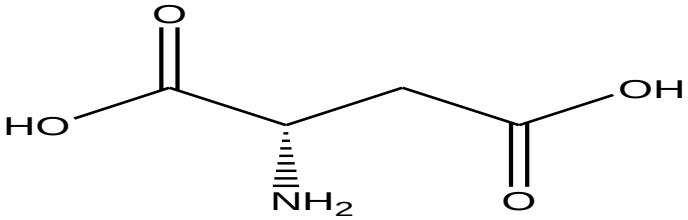
Glutamic acid



Glutamic acid



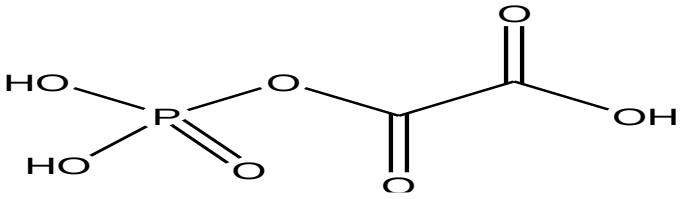
alpha- Ketoglutaric acid



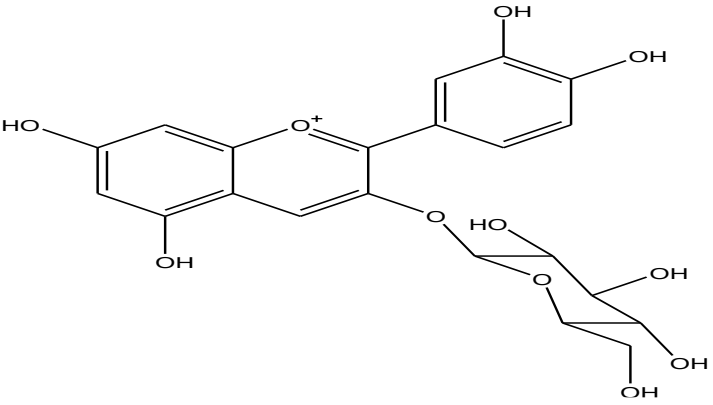
Aspartic acid

2.4 Flowers

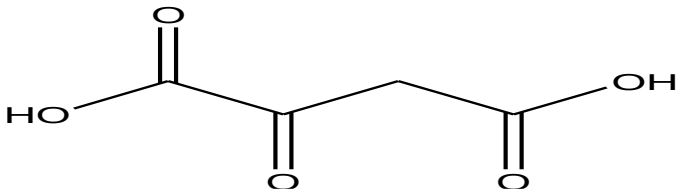
The alcoholic extract of *B. variegata Linn* flowers shows the existence of various chemical compounds like malvidin-3-glucoside, malvidin-3-diglucoside, peonidin-3-glucoside, 3-galactoside, 3-rhamnoglucoside of kaempferol [20], quercitroside, isoquercitroside, rutoside [11], glutamic, keto acid, amino acid, Asparatic acid [14] and cyaniding-3-glucoside [20]. These chemical compounds were separated and analyzed by different chromatographic techniques.



Phosphoenol pyruvic acid

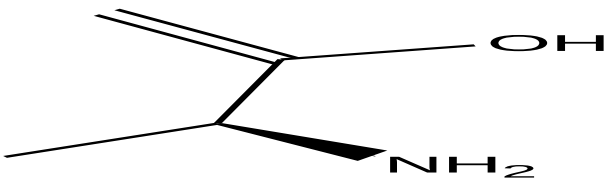


cynidin-3-glucoside

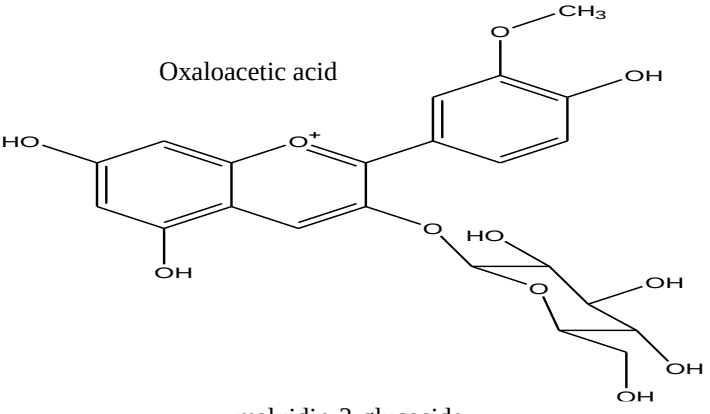


Oxaloacetic acid

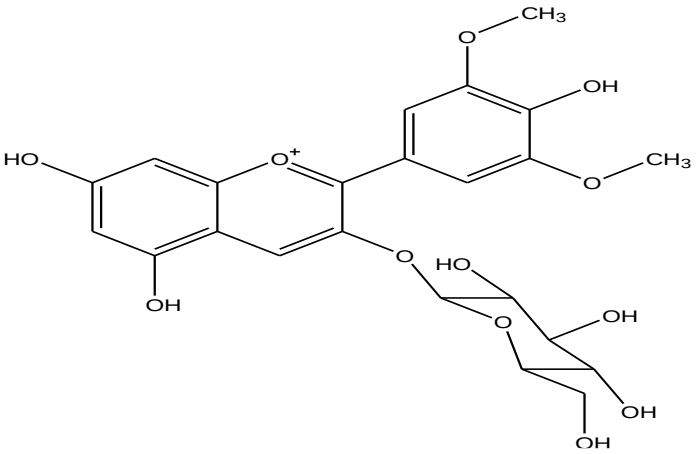
Oxaloacetic acid



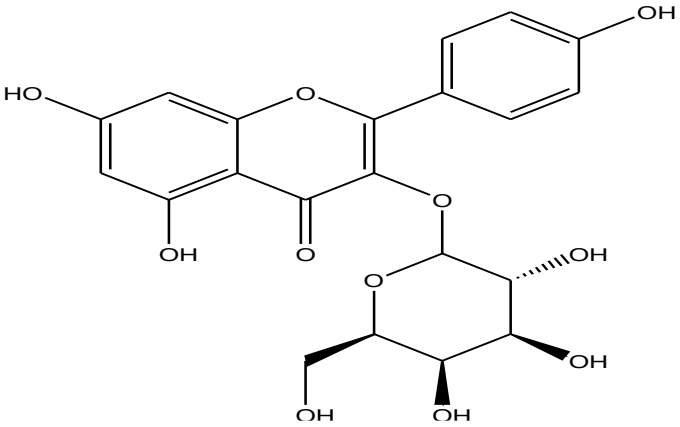
Alanine



malvidin-3-glucoside



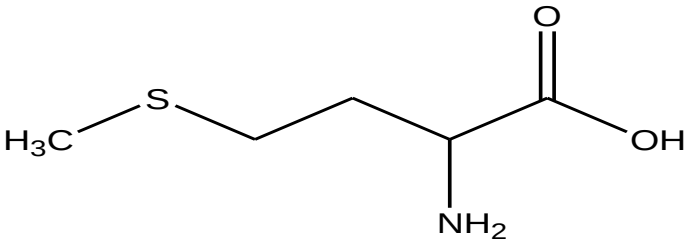
Peonidin-3-glucoside

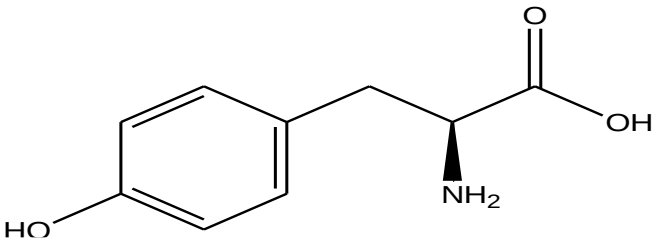


kaemferol-3-galactoside

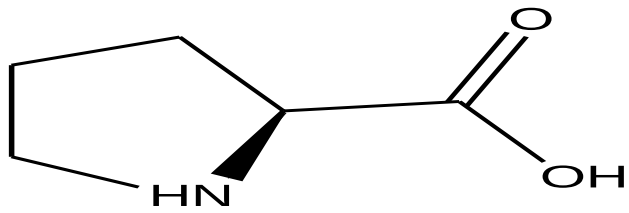
2.5 Seeds

The alcoholic extract of seed bark and seed of *B. variegata Linn.* showed presence of various chemical constituents like, flavone glycoside (5-hydroxyl-,7,3,5-tetra-methoxyflavonon-5-o-β–D-xylopyronosyl-α–L-rhamnopyronoside)[21],tyrosine, valine, threonine, serine, proline, phenylalanine, alkaloids, flavonoids, amino acids, ascorbic acid, glutamic acid, aspartic acid, lucoanthacyanines, arginine, methionine, isoleucine lysine, histidine, glycine, protein carbohydrates [2].

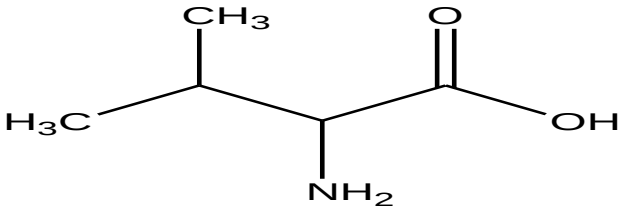




Threonine

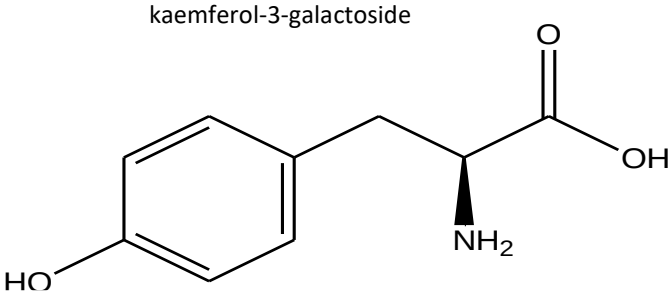


proline



Valine

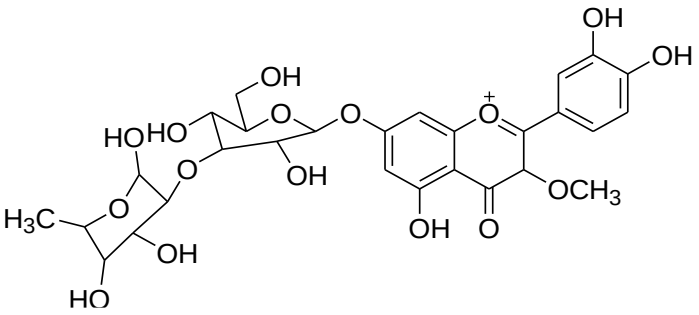
kaemferol-3-galactoside



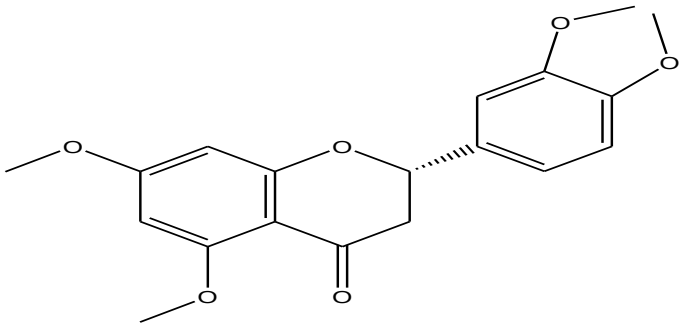
Tyrosine

2.6 Root and Root Bark

The ethanolic extract of root bark and root of *B. variegata Linn* contains different chemical constituents such as flavonoids (2s)-5,7-Dimethoxy-3, 4-methylene dioxyflavonone, 5,6-dihydro-1,7dihydroxy-3,4-dimethoxy-2- methyl di benzo -xepin, flavonone dihydro dibenzoepin flavonol glycoside [22,23] and novel flavonoid glycoside 5,7,3,4-terahydroxyl-3-methoxy–o-7-α-L-rhamnopyranosyl-(1-3)-o–β- glucopyranoside and its chemical structure was further identified by spectroscopic techniques [22].



a) 5,7,3'4'- tetrahydroxy-3-methoxy-7-O-α-L-Rhamnopyranosyl (1-3)-o-β-glucopyranoside



b) 2s)-5,7-dimethoxy-3,'4-methyleenedioxyflavonone

3. PHARMACOLOGICAL ACTIVITIES OF B. *VARIEGATA LINN.*

There are various pharmacological activity of *B. variegata Linn.* in different types of diseases. Herbal therapy produces less side effects and rare toxic effects during treatment. So, on the basis of literature available of mountain ebony plant, it produces different pharmacological activity as shown in figure-3.

3.1 Anti-Cancer Activity

The pharmacological activity of plant was confirmed the indication of apoptosis by flavonoids fraction of *B. variegata Linn.* in cytotoxic compound and it can produce significant effect towards the sensitivity of the cell and Microculture tetrazolium test (MTT) assay to clarify the cytotoxicity in HeLa cell line. 3,4,5 dimethyl thiazole -2-y-2,5 diphenyl tetrazolium bromide and double staining result increased number of apoptotic cell necrotic nuclei [28].

The plant is more effective towards carcinogenic effect and were observed by skin papilloma model in swiss albino mice. The crude liquid of *B. variegata Linn.* bark was evaluated through different stage protocol by "skin papilloma model" in swiss albino mice and melanoma model in (C57B1) tumor observed in mice. The extract treated mice, tumor was reduced to 30% - 40% as compared to 134% in untreated control mice. The anticancer activity is identifying on the basis of preliminary screening in anti-carcinogenic activity on the behalf of chemo preventing rate [29].

The mechanism of action of *B. variegata Linn* is the protection against carcinogen is the reduction in glutathione level in the organs, which has been facilitated through the variation of cellular antioxidant and chemopreventive rate for controlling the process of cancer [30].

The hydro alcoholic extract of plant parts (leaves, stem, bark and flowers) was used in the evaluation of anticancer activity. The extract dose was 500 and 750 mg/kg body wt. along with cyclophosphamide were given orally up to forty days for evaluate anticancer action against melanoma cancer cell line (B16F10) in C57BL mice. Inhibition of tumor multiplication, upgrade the existence time of mice with treatment and were calculated by histopathological data. The result showed substantial effect of the plant extract in inhibiting melanoma cancer by B16F10 cell line in C57BL/6 mice. On comparing the result of measured parameters with the tumor control group, a significant change was found particularly in the group which received crude extract of plant along with anti-cancer drug (cyclophosphamide). The result was estimated by observing different parameters like, inhibition rate, life span period, tumor volume and antioxidant parameter of extract. The combine treatment of cancer by anticancer agent and plant extract indicated more noticeable effect through synergistic action [31].

3.2 Anti-microbial Activity

The alcohol based extract of *B. variegata Linn.* have shown significant antimicrobial effect against (gram +ve and gram -ve) bacteria and other species like *Escherichia coli*, *Enterobacter aerogenes*, *klebsiella*, *Streptococcus pneumoniae*, *Bacillus subtilis* and *Staphylococcus aureus* [32]. The *B. variegata Linn.* elevated clear report that it inhibits the growth of microbes in the concentration range of 50 to 300 ug/ml in agar diffusion method [33].

According to the research investigation done on ethanolic extract of *B. variegata Linn* leaves (EBV) revealed that this plant was therapeutically active against various pathogenic fungi. The results concluded that inhibition % after 48 hrs was greater towards "*Aspergillus niger* followed by *Fusarium oxysporum*, *Trichophyton rubrum* and *Trichophyton mentagrophytes"*. Though, *Mucor hiemalis* was having least inhibition % after 48 hrs. The inhibition % increases when incubated for 72 hrs. Hence, this study concluded that EBV

could be a potential source for the treatment of pathogenic fungi [34].

3.3 Anti-Inflammatory Activity

The ethanolic extract of non woody aerial parts of *B. variegata Linn* was reported as an anti-inflammatory action due to procurement of a new flavonol glycoside. It is isolated from the ethyl acetate soluble fraction of ethanolic extract of non woody aerial parts in different forms of novel compounds. This extract produces six phytochemical constituents such as ombuin, kaempferol,7-4-dimethyl ether 3-o-β–D–glucopyranoside, kaemferol-3-o-β–D-glucopyranoside, isorhamnetin-3-o-β-D-glucopyranoside and hesperidin, with a triterpene moieties named as caffeate, 3–β–trans– (3,4-Dihydroxy cinnamoxloxy) olean-12-en-28–oic acid [35]. This six compounds including triterpenes inhibits the interferon (IFN) alpha induced nitic oxide (NO), lipopolysaccharide and interleukin (IL) -12 [36].

3.4 Wound Healing Activity

Recently, through the wound curative action, the plant extract has been used in excision and incision wound model in albino rats. The dose of the extract for wound healing action was 200-400 mg/kg. The aqueous and ethanolic extract of *B. variegata Linn.* at both doses showed a significant wound curative action by "excision and incision wound model" which was compared with the standard (framycitin) in comparative study [37].

3.5 Anti-Ulcer Activity

The alcohol based extraction of the stembark and stem of *B. variegata Linn* produce positive effect as an anti-ulcer action towards stomach ulcer induced by "pyloric ligation and NSAIDs (aspirin) induced model". The crude liquid of plant (oral administration) decreased the bulk of acid secretion, total, free acidity and acid index as compare with control group. This study concluded that alcohol based extract of *B. variegate Linn*. produced significant (P< 0.001) stomach acid protective action [38].

3.6 Nephroprotective Activity

The alcoholic and aqueous extract of root bark and root of plant mountain ebony showed nephroprotective activity in nephrotoxicity model in wistar rats induced by gentamicin and cisplatin drug. The toxicity in nephron was induced by intraperitoneal administration drug (gentamicin and cisplatin) in concentration of 100 mg / kg /day for 8 days. The extract dose is 200-400 mg/kg according to body weight. The decrease in nephrotoxicity was measured by the value of serum urea, blood urea nitrogen (BUN) and serum creatinine which was further clarified from the histopathological studies [38]. Both alcoholic and aqueous based crude liquid exhibited nephroprotective action in gentamicin as well as cisplatin induced nephrotoxicity models. The result concluded as evident by reduction in serum urea, BUN levels and serum creatinine. After intake of root extract along with gentamicin produced more effective treatment in nephron protection and the result showed by decreased in epithelial desquamation accumulation of inflammatory cells, glomerular congestion, blood vessel congestion and necrosis of the kidney cell [39].

3.7 Immunomodulatory Activity

As per the literature survey this plant also produces the immunomodulator activity. The ethanol based extract of *B. variegata Linn*. stem bark was showed immunomodulatory action in primary and secondary antibody response. The effect of extract was evaluated by carbon clearance test for phagocytic activity and neutrophil adhesion test for neutrophil activity [40].

3.8 Hypolipidemic Activity

The Hypolipidemic action of *B. variegata Linn.* stem bark alcoholic extract was reported after examined female rats fed with hyper caloric diet. The extract of stem bark was given in treatment of obese animals with displayed a high brain serotonin level and high density lipoprotein (HDL) with a concentration reduction in cholesterol triglycerides and low density lipoprotein (LDL). Thus anti-obesity action of methanol extract of *B. variegata Linn.* can be a good option for decrease in lipid level and initiate the brain serotonin concentration [41].

3.9 Anti-Oxidant Activity

The extract and fraction of *B. variegata Linn.* were used for the evaluation of antioxidant prospective. The antioxidant action was performed by1,2-diphenyl-1-2 picrylhydrazyl (DPPH) radical screening test. The methanol, hexane and ethyl acetate fraction show sensible scavenging action as compared quercetin act as a standard [42]. The ethanolic extract shows more anti-oxidant property as compare to other extracts of the plant. The antioxidant action (*in-vitro*) was confirmed by various parameters like reducing power, presence of free radicals such as DPPH, superoxide, nitric acid and hydrogen peroxide and all parameters result were found to be significant (p>0.01) in antioxidant action [43]. In 2009, researchers detected antioxidant action by blocking of thio-barbituric acid reactive substances (TBARS) and reported a significant free radical scavenging *activity* (FRSA) and hydroxyl radical scavenging *in vitro* activity by methanolic extract of plant [44,45]. The significant correlation between antioxidant potential and the total phenolic/flavonoids data was also observed [46,47]. The plant extract also isolated four led bioactive chemical constituents like lupeol, beta- sitosterol, kaempferol and quercetin respectively [48]. The investigator observed antioxidant activity by inhibiting of

Thiobarbituric Acid Reactive Substances (TBARS) and reported a significant FRSA, antioxidant activity and hydroxyl radical scavenging *in vitro* by the *B. variegata Linn.* methanolic extract [46].

3.10 Anti-Diabetic Activity

The ethanol based extract of leaves and stem bark of *B. variegata Linn* also show anti-diabetic action which was investigated through *in-vitro* study. The orally administrated dose is 200 – 400mg/kg in streptozotocin (STZ) and alloxan induced diabetic rat model. The extract of plant decreased the high blood glucose amount by enhancing glucose metabolism [49]. The phytochemical screening and free radical savenging activity of scavenge DPPH, nitro oxide, hydroxyl radical and reducing sugar was also performed in the experimental model. It has been also revealed that insulin type of proteins present in leaf of kachnar are responsible for glucose metabolism. On increasing the discharge of insulin in beta cell line, INS-1 cell line the conjugation with the chloroplast protein improve the overall anti-diabetic properties [50,51].

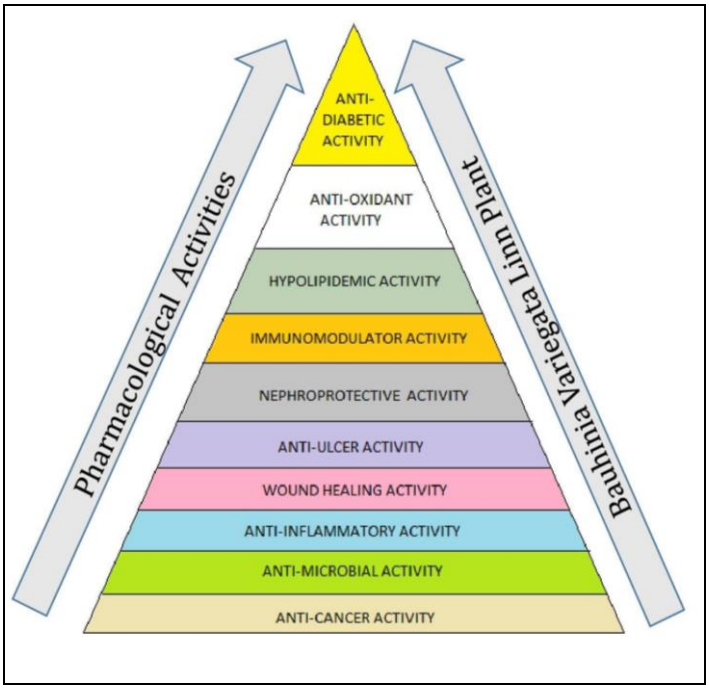


Figure 3: Pharmacological activities of *B. variegata Linn***.**

4. CONCLUSION

From the above literature we concluded that the plant *B. variegata Linn*. is noted as a traditional remedy for the treatment of various types of aliments such as diabetes, microbial infections, skin infections, tumors, nephrotoxicity, ulcer, wound healing and inflammation. Due to the wonderful welfares of the plant towards human beings it can be supported as a significant remedial plant for the treatment without producing any toxic effect. So, more attention is mandatory to found the chemical constituents from different parts of the plant which is responsible for the therapeutic activity in different alignments as future prospective as well.

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REFERENCES

1. Sahu G, Gupta PK. A review on Bauhinia Variegata. Linn. Int. Res. J. Pharm. 2012; 3:48-51.
2. Gamble JS. Flora of the Presidency of Madras, Vol.2. Botanical Survey of India, Calcutta.1956.
3. Negi A, Sharma N, Pant R, Singh MF. Determination of total phenol content of the stem bark of B.V. linn. An approach to standardization. The pharma Research. 2012; 7:16-22.
4. Kumar V, Eswarappa B, Yadav DB, Jayadevaiah KV, Basavaraja HS. Isolation of photo-constituents from the stem of B.V. linn. Pharma tutor Magazine 2014; 2:1-10.
5. Rice –Evans R. Flavonoids antioxidant, Current Medicinal Chemistry.2001; 8:797- 807
6. Mack M, Ndhlala AR, Finnie JF, Staden JV. Phenolic composition, antioxidant and acetylcholinesterase inhibitory activities of Sclerocarya birrea and Harpephyllum caffrum (Anacardiaceae) extract. Food Chemistry. 2010;123: 69-76.
7. Hakkim F, Lukmanul C, Shankar G, Girija S. Chemical composition and antioxidant property of holy basil (Ocimum sanctum L.) Leaves, stems, and inflorescence and there *in vitro* callus cultures. J. Agricultural and food chemistry. 2009; 55(22): 9109-9117.
8. Gupta AK, Vidyapati T, Chauhan JS. 5, 7 – Dihydroxyflavonone -4 - o-A –L- rhanmopyranosyl – β – D- glucopyranoside from the stem of Bauhinia Variegata. Ind. J. Chem. 1979; 18:85-86
9. Prakash A, khosa RL. Chemical studies on Bauhinia Variegata.

Curr.Sci.1976; 45:705-13.

10. Prakash A, Khosa RL. Netuera constituents of BahiniaVariegata. J Res Indian Med Yoga Homeopath, 1978; 13:96-97.
11. Duret S, Paris RR. The flavonoid of several species of Bauhinia. Plant Medicinal Phytotherapy. 1977; 11: 213-216.
12. Gupta AK, Chauhan JS. Constituents from the stem of Bauhinia Variegate. Nat. Acad. Sci. let. 1984; 7:174-76.
13. Ravindra G, Dhake AS. Bauhinia variegata Linn. (Mountain Ebony): A review on ethnobotany, phytochemistry and pharmacology. Oriental Pharmacy and Experimental Medicine. 2009; 9(3): 207-216.
14. Cechinel FV. Chemical composition and biological potential of plants from the genus Bauhinia." Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2009;23(10): 1347-1354.
15. Yadav RN, Reddy VMS. A New Flavone Glycoside, 5- hydroxyl 7,3',4',5'- Tatra Methoxyflavone 5-o- β – D- xylopyranosyl– (1-2) –α – L –Rhamnopyranoside from Bauhinia Variegata Linn. J Asian Nat prods Res 2001; 3: 1-11.
16. Singh RS, Pandey HS, Ghanshyam. Two new long chain compound from Bauhinia Variegata linn. Ind. J chem. 2006; 45:2151-2153.
17. Singh KL, Singh DK, Singh VK. Multidimensional Uses of Medicinal Plant Kachnar (Bauhinia variegata Linn.). Am. J. Phyto. Clin. Ther. 2016; 4: 58-72.
18. Azevedol CR, Maciel FM, Silva LB, Ferreira ATS, etal. Isolation and intracellular localization of insulin like protein from leaves of Bauhinia Variegata linn. Brazilian J. Med. Biol. Res. 2006; 39: 1435-1444.
19. Mukherjee D, Laloraya MM. Keto acids and free amino acids during leaf growth in Bauhinia purpurea L. Experientia. 1977; 33: 304-305.
20. Saleh NAM, Ishak MS. Anthocynanis of some leguminosae flowers and their effect on colour variation. Phytochemistry. 1976; 15: 835 – 836
21. Chan YS, Ng TB. Bauhinia variegata var. variegata lectin: isolation, characterization, and comparison. Appl. Biochem. Biotechnol. 2015; 175:75-84.
22. Kumar YR, Rajani GP. Analgesic and anti-ulcer activities of ethanol and aqueous extracts of roots of *Bauhinia variegata* Linn, Int. J. Pharm. 2011; 7(5):616–622
23. Reddy-Mopuru VB, Reddy MK, Gunasekar D, Caux C. et.al. A flavanone and a dihydrodibenzoxepin from Bauhinia variegata." *Phytochemistry*. 2003; 64(4): 879-882.
24. MMJ VK, et.al. Isolation of phytoconstituents from the stem bark of Bauhinia variegata Linn, Pharma tutor pharmacy infused, 2014; 2:2347-7881.
25. Mishra A, Sharma AK, Kumar S, Saxena AK, Pandey AK. Bauhinia variegata leaf extracts exhibit considerable antibacterial, antioxidant, and anticancer activities. BioMed. Res. Int. 2013; http://dx.doi.org/10.1155/2013/915436:1-10.
26. Mishra AK, Mishra A, Kehri HK, Sharma B, Pandey AK. Inhibitory activity of Indian spice plant Cinnamomum zeylanicum extracts against Alternaria solani and Curvularia lunata, the pathogenic dematiaceous moulds. Annals. Clin. Microbio. Antimicro. 2009;8(1): 1-7.
27. Kew KSM, Neivashini XC, Nabila OP, Khan NH. Qualitative study on the phytochemical constituents of the flower buds of Bauhinia variegata. J. Pharma. Res. 2018;2(1): 47-51.
28. Kumar SB, Bhat I. Apoptosis and flow cytometric studies of Bauhinia Variegata bark extract. A. J. Pharma clin. Res.2014; 7: 1-11.
29. Agrawal RC, Pandey S. Evaluation of Anticarcinogenic and Antimutagenic Potential of Bauhinia variegate Extract in Swiss Albino Mice. Asian Pacific journal of cancer prevention. 2009; 10: 1-9.
30. Pandey S, Agrawal RC. Chemopreventive potential of Bauhinia variegata flower extract against DMBA-induced skin papilloma genesis in mice" Pharmacology online.2010;1: 39-46.
31. Pandey S. *In vivo* antitumor potential of extracts from different parts of Bauhinia variegata linn. Against b16f10 melanoma tumour model in c57bl/6 mice. Appl. Cancer Res.2017;37(1): 1-14.
32. Kanak S, Verma AK. Evaluation of antimicrobial and anticancer activities of menthol extract of in vivo and vitro grown Bauhinia Variegata Linn, Int. Res. J. Bio. Sci. 2012; 16:26-30.
33. Mali RG, et al. Evaluation of Bauhinia Variegata linn stem bark for anthelmintic and antimicrobial properties; J Nat Rem. 2008; 8:39-43.
34. Gayathri G, Saraswathy A, Krishnamurthy V. Antimicrobial activity of medicinal plant Bauhinia variegata Linn. Int. J. Pharm. Biol. Sci. 2011;1(4): 400-408.

35. Koteswara RY, Fang SH, Tzeng YM. Anti-inflammatory activities of flavonoids and a triterpene caffeate isolated from Bauhinia variegata." Phytotherapy research. 2008;22(7): 957-962.
36. Negi A, Sharma N, Singh MF. "Spectrum of pharmacological activities from Bauhinia variegata: a review." Journal of Pharmacy Research.2012;5(2): 792-797.
37. Sharma RK. Pharmacological evaluation of Bauhinia Variegate linn for wound healing and nephroprotective activity. MSC thesis, Rajiv Gandhi University of health Science, Karnataka 2010.
38. Kapoor R et al. Anti-ulcer effect of Bauhinia variegates linn. in rats. J. Nat. Rem. 2003; 3: 215-217.
39. Sharma RK, Rajani GP, Sharma V, Komala N. "Effect of ethanolic and aqueous extracts of Bauhinia variegata Linn. on gentamicin-induced nephrotoxicity in rats." Ind. J. Pharm. Edu. Res. 20011; 45(2): 192-198.
40. Ghaisas MM, et al. Evaluation of the immunomodulatory activity of ethanolic extract of the stem bark of Bauhinia variegate Linn. Int. J. Pharm. 2009; DOI:10.4103/0973-8258.49379
41. Al Snafi AE. The Pharmalcogical Importance of Bauhinia variegates. A Review IJPSR 2013; 4: 160-164.
42. Ghias U, Sattar S, Rauf A. Preliminary phytochemical, in vitro pharmacological study of Bauhinia alba and Bauhinia variegata flower. Middle-East J. Med. Plants Res.2012; 4:75-79.
43. Rajani GP, Purnima A. In vitro antioxidant and antihyperlipidemic activities of Bauhinia variegata Linn. Ind. J. Pharmacology. 2009;41(5): 227-37.
44. Bopanna KNJ, Sushma KG, Balaraman R, Rathod SP. Antidiabetic and anti-hyperlipidemia effects of neem seed kernel powder on alloxan diabetic rabbits. Indian journal of Pharmacology.1997;29(3): 162-.
45. Khare, Chandrama P. Indian medicinal plants: an illustrated dictionary. Springer Science & Business Media, 2008.
46. Pandey S, Agrawal RC, Maheshwari S. In-vitro antioxidant and free radical scavenging activity of Bauhinia variegata Linn" International Journal of Scientific and Research Publications. 2012,2(2): 1-5.
47. Sharma N, Bhardwaj R, Kumar S, Kaur S. Evaluation of Bauhinia variegates linn. Bark fractions for in vitro antioxidant potential and protective effect against H_2O_2 –induced oxidation damage to Pbr322 DNA. African J Pharm Pharmacology. 2011; 5: 1494-1500.
48. Jash SK, Roy R, Gorai D. Bioactive constituents from Bauhinia variegata Linn." *I*nt J Pharm Biomed Res.2014; 5(2): 51-54.
49. Chandra, RT, Chaubey S, Dash S, Kumar GR. Kanchnara (Bauhinia variegata linn): a critical review. Int J Ayurveda Pharm Res. 2015;3(7): 39-46.
50. Bhaskar B. Free radical scavenging activity of bark extract of Bauhinia variegates L. Pharmacognosy Journal. 2011; 3:64-66
51. Negi A, Sharma N, Singh MF. Spectrum of pharmacological activities from Bauhinia variegata: a review." Journal of Pharmacy Research. 2012;5(2): 792-797.