

A REVIEW ON *BAUHINIA VARIEGATA* LINNSahu G^{1*}, Gupta PK²¹Department of Pharmacognosy, Bundelkhand University, Jhansi-284128, India²Department of Biotechnology, R.V College of Engineering, Bangalore-560059, India

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*Email: gayatri.sahu03@gmail.com

ABSTRACT

Bauhinia variegata linn. (Kachnar/Raktakanchan) is a medium sized tree with hairy branches belonging to family Leguminosae. The various parts of trees like flowers buds, flowers, stem bark, stem, leaves, seeds and root are popular in various system of medicines like ayurveda, unani and homeopathy in India for the cure of variety of diseases. This is widely used for the manufacture of wood wool board, production of gum and fibers and for a forestation to conserve the nature. Various traditional claims have been made on this tree for curing in number of diseases; considerable efforts have been made by researcher to verify its utility through scientific pharmacological screenings. The reported biological activities are anti-diabetic activity, anti-inflammatory activity, immunomodulatory activity, anti-tumour activity, hepatoprotective activity, antibacterial activity, haemagglutinating activity, haematinic activity, antimicrobial activity, antiulcer activity, anticarcinogenic activity. This review represents a detailed survey of the literature on pharmacognosy, phytochemistry, traditional, medicinal uses and pharmacological activities of *Bauhinia variegata* Linn.

KEYWORDS: *Bauhinia variegata* linn., pharmacognostical approaches, phytochemical properties, pharmacological effects and therapeutic uses

INTRODUCTION

The mountain ebony, *Bauhinia variegata* L. belongs to the family Leguminosae. It is distributed throughout India, ascending to an altitude of 1300 in the Himalayas. It is widely planted in the tropics and warm regions of the world.¹ It belongs to the more than 200 species in the genus *Bauhinia*. It grows best in the full moon or partial shade. It easily propagates easily from seed and by air layering.²

Bauhinia variegata is a medium sized deciduous tree. The genus includes trees, vines and shrubs that are frequently planted for their showy flowers and ornamental foliage. Their whole part is used for pharmacological properties. It is commonly known as Kachnar in hindi, sanskrit and mountain ebony in english.² The bark of the plant is grayish brown externally and pale-pink inside and the external surface is rough because of large number of longitudinal cracks and fissures. The leaves are 10-15 cm long and broad, subcoriaceous and deeply cordate. The flowers are large, fragrant, white or purplish, appearing when the tree is leafless. The pods are 15-30 by 1.8-2.5 cm hard, flat, dehiscent and 10-15 seeded.^{3,4}

The various parts of the plant are used in traditional system of medicines for the cure of variety of diseases. Following a large number of claims on curable properties of *B. variegata*, effort has been made by researcher to justify its efficacy as a curative agent through pharmacological investigations. The aim of present review article is to explain the traditional uses, pharmacognostical studies, phytochemical properties and pharmacological investigations which were carried out on the plant.

Pharmacognostical Studies

Microscopic study of flower covering trichomes showed uni to multicellular broad at the base and pointed at the apex with thin walled multicellular balloon shaped glandular trichomes. Pollen grains are spheroidal and equatorial view, tricolporate, broadly opened with large thickened and circular pores.⁵ Transverse section of the leaf petiole shows single layered epidermis covered with thin cuticle. Epidermis is made up of thin walled rectangular cells. Some of the cells show abundant solitary calcium oxalate crystals. Vascular bundles

are present in prominent numbers. Xylem and phloem are well developed. Lamina of leaves shows upper and lower epidermis covered by thin cuticle and made up of thin walled rectangular cells. In the mesophyll tissue vascular bundles of the veins are vertically transparent. Midrib of leaves shows upper and lower epidermis with well developed thin cuticle. Both the epidermal cells are rectangular. Almost all cells are loaded with abundant solitary crystals of calcium oxalate and clustered crystals.⁶ The powder microscopy of leaves shows the presence of parenchyma cells with calcium oxalate crystals, vessels with helical to spiral thickening abundant crystals which are solitary and prism shaped, epidermal cells with anomocytic stomata.⁶

Traditional Uses

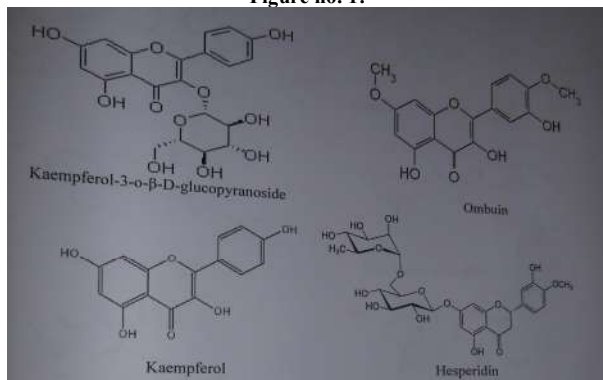
In medicines, The leaves are rich in reducing sugar and have good nutritive value for the healthy development of tasar silk worms. The leaves are used for the preparation of biddies. The root is carminative and used in dyspepsia and flatulence and as an antidote to snake poison.¹ The bark is astringent, tonic, anthelmintic, scrofula and skin diseases. The flowers and flower buds are used as a vegetables and laxative. The juice of flower is used to treat diarrhea, dysentery and other stomach disorders. The dried buds are used for the treatment of diarrhea and dysentery, worms, piles and tumours.²

In Ayurveda, Ayurvedic literature claim the plant is reported to have Kasaya rasa, Ruksha guna, Shita virya and Katu vipaka. The stem bark of *B. variegata* is used in the treatment of krinnroga (worm infection), gandamala (scrofula), apaci (cervical lymphadenitis) and vrna (wounds).³

Phytochemical Studies

Non woody aerial parts: Phytochemical analysis of non woody aerial parts yielded 6 flavonoids, namely kaempferol, ombuin, kaempferol 7,4'-dimethylether-3-o-β-D-glucopyranoside, kaempferol-3-o-β-D-glucopyranoside, isorhamnetin-3-o-β-D-glucopyranoside & hesperidin together with one triterpene caffeate, 3β trans-(3,4 dihydroxycinnamoyloxy) olean-12-en-28-oic acid.⁸

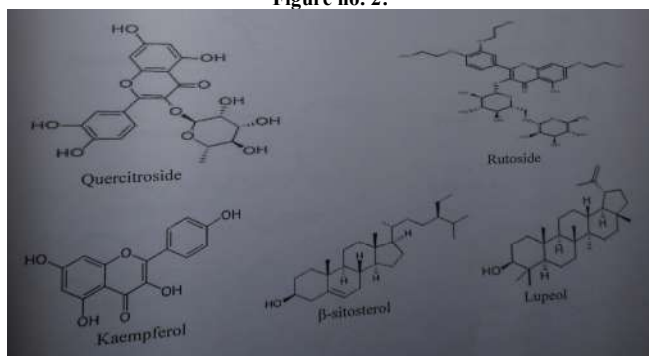
Figure no. 1:



Root: Phytochemical analysis of root yielded a novel flavonol glycosides 5,7,3,4 tetrahydroxy-3-methoxy-7-O-α-L-rhamnopyranosyl (1→3)-O-β-D-galactopyranoside. Their structures are identified by spectral analysis and chemical degradations.⁸ Phytochemical analysis of root bark yielded new flavonone (2S)-5, 7-dimethoxy-3,4 methylenedioxyflavonone and new dihydrodibenzoxepin, 5,6b dihydro-1,7-dihydro-1,7-dihydroxy-3,4-dimethoxy-2-methyldibenz (b,f) oxepin, together with three known flavonoids. The structure was determined on the basis of spectral studies.⁹

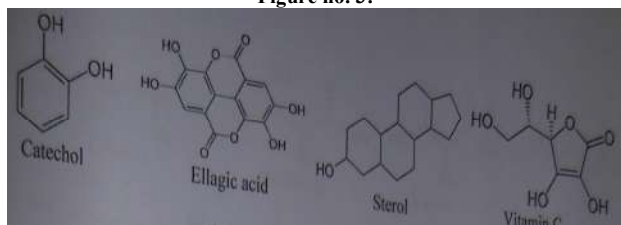
Stem: The main chemical compounds isolated from the bark of *B. variegata* are quercitroside, isoquercitroside, rutoside, myricitol glycoside and kaempferol glycoside.¹⁰ Phytochemical study of stem shows β-sitosterol, lupeol and an unknown compound naringenin 5, 7 dimethyl ether 4 – rhamnoglucoside. A new phenanthraquinone named Bauhinione has been isolated from *B. variegata* L. and its structure has been elucidated as 2,7-dimethoxy-3-methyl-9,10 dihydrophenanthrene-1,4-dione on the basis of spectral analysis.¹¹

Figure no. 2:



Leaves: Two new long chain compounds heptatriacontane-12, 13-diol 7 dotetracont-15-en-9-ol have been isolated from leaves of *B. variegata*. Catechol, tannins, ellagic acid and sterol are also present in leaves of *B. variegata*.¹² Leaves are also rich in Vitamin C (146mg %) and rich in reducing sugar.⁴

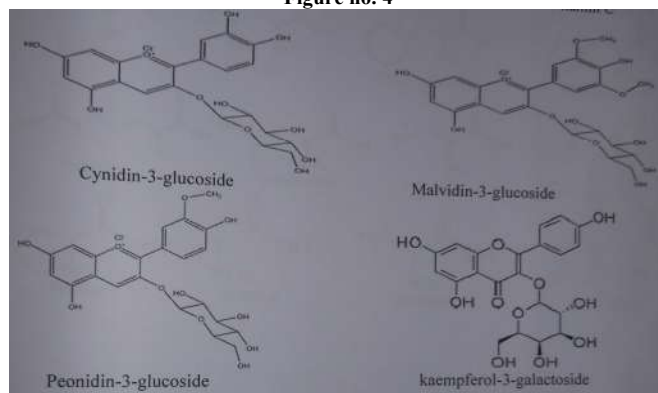
Figure no. 3:



Flowers: The pale-violet flowers contain cynidin-3-glucoside, malvidin-3-glucoside, malvidin-3-diglucoside,

peonidin-3-glucoside and peonidin-3-diglucoside. The white flowers contain kaempferol-3-galactoside and kaempferol-3-rhamnoglucoside.⁴

Figure no. 4



Seed: On extraction with petroleum ether gave 16.5% of pale yellow fatty oil but only 6.1% when expressed in a hydraulic press. The fatty acid composition of the oil is as follows: myristic (1%), palmitic (17%), stearic (13.4%), lignoceric, behenic and arachidic (1%), oleic (31.8%) and linoleic acid (35.9%). It also contains myricetal glycosides.¹ Phytochemical study shows the presence of all essential amino acids such as lysine, threonine, valine, methionine, isoleucine, leucine and phenylalanine. They also contain semi essential ones histidine and arginine. The other amino acids found are aspartic acid, serine, glutamic acid, proline, glycine, alanine and tyrosine.¹³

Figure no. 5: Structure of Fatty acids

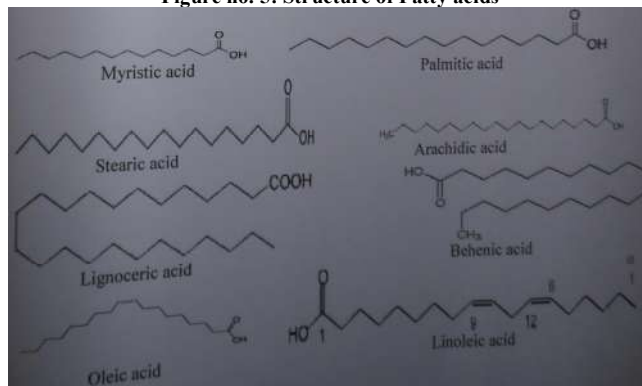
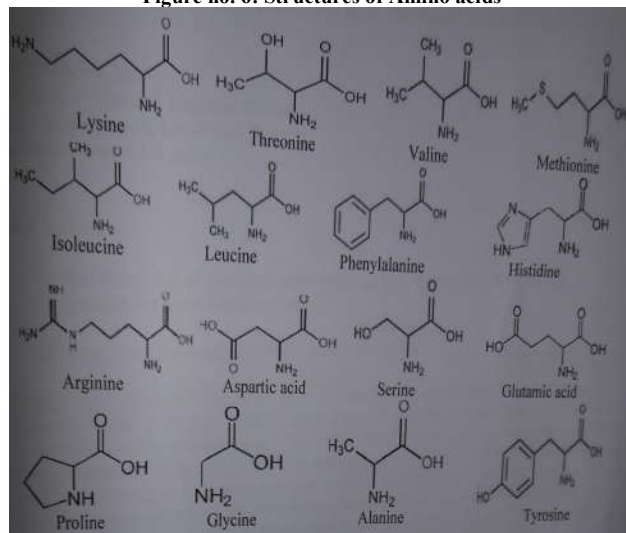


Figure no. 6: Structures of Amino acids



Pharmacological Studies

Antidiabetic activity: Ethanol extract of leaves of *B. variegata* shows the hypoglycemic activity in 100, 86, 92, 67mg/100ml respectively with percentage reduction of 9, 21.8, 16.3 and 39.¹⁴

Anti-inflammatory activity: Phytochemical analysis of non woody aerial parts yielded 6 flavonoids, namely kaempferol, ombuin, kaempferol 7,4'-dimethylether-3-o-β-D-glucopyranoside, kaempferol-3-o-β-D-glucopyranoside, isorhamnetin-3-o-β-D-glucopyranoside and hesperidin together with one triterpene caffeate, 3β trans-(3,4 dihydroxycinnamoyloxy) olean-12-en-28-oic acid. These seven compounds from non-woody aerial parts show the anti-inflammatory activity against inhibiting the lipopolysaccharides and interferon γ induced nitric oxide (NO) and cytokines.⁷

A novel flavonol glycoside 5,7,3',4' tetrahydroxy-3-methoxy-7-o-α-L-rhamnopyranosyl (1→3) -o-β-d-galactopyranoside has been isolated from the ethanolic extract of root of *B. variegata* which shows the anti-inflammatory activity by non-immunological carrageenan induced hind paw oedema method.⁸

Immuno-modulatory activity: Ethanolic extract of the stem bark of *B. variegata* shows the immunomodulatory activity on the primary and secondary antibody responses by humoral antibody response for specific immune response. Phagocytic activity test and neutrophil activation test were evaluated by the carbon clearance and neutrophil adhesion test for a nonspecific immune response respectively. Increase in phagocytic index and percentage neutrophil adhesion at the doses of 250 and 500mg/kg/p.o. has been found.⁴

Anti-tumour activity: Anti-tumour activity on the ethanolic extract of the stem of *B. variegata* has been evaluated against Dalton's ascetic lymphoma (DAL) on Swiss albino mice. This ethanolic treatment enhance the peritoneal cell counts which during the presence of tumour. The average number of peritoneal exudates cells per normal mouse was found to be $5.8 \pm 4 \times 10^6$. ethanolic *B. variegata* (250mg/kg) single treatment enhance the peritoneal cells to $8.6 \pm 1 \times 10^6$ while two consecutive treatment enhanced the number to $9.7 \pm 1.2 \times 10^6$.^{6,15}

Ethanolic extract of the stem of *B. variegata* shows chemoprevention and cytotoxic effect against N-nitrosodiethylamine induced experimental liver tumour in rats and human cancer cell lines at a dose of 200mg/kg. Oral administration of ethanolic extract of *B. variegata* effectively suppressed liver tumour induced by N-nitrosodiethylamine as revealed by decrease in N-nitrosodiethylamine induced elevated level of serum glutamate pyruvate transaminase (SGPT), serum glutamate oxaloacetate transaminase (SGOT),

alkaline phosphatase (ALP), total bilirubin, gamma glutamate transpeptidase (GGTP), lipid peroxidase (LPO), glutathione peroxidase (GPX), glutathione-s-transferase (GST). Ethanolic extract was found to be cytotoxic against human epithelial larynx cancer and human breast cancer (HBL-100) cells.¹⁶

Hepatoprotective activity: Ethanolic extract of the stem bark of *B. variegata* shows hepatoprotective activity against carbon tetra chloride induced hepatotoxicity in Sprague-Dawley rats at the dose of 100 and 200 mg/kg. Oral administration of ethanolic extract decrease the level of AST, ALT, ALP, GGT, total lipids & increase the level of total protein which increase during the hepatotoxicity and decrease the level of total proteins.¹⁷

Antibacterial activity: Methanolic and aqueous extract of stem bark of *B. variegata* shows antibacterial activity by both agar disc diffusion method and agar well diffusion method against five bacterial strains viz. *Bacillus cereus*, *Staphylococcus aureus*, *Klebsiella pneumonia*, *Escherichia coli*, *Pseudomonas pseudoalcaligenes*. Antibacterial activity in methanolic extract is more potent than aqueous extract. *B. variegata* L. exhibited remarkable antibacterial activity.¹⁸

Haemagglutinating activity: Crude seed protein of *B. variegata* shows haemagglutinating activity.¹⁹

Haematinic activity: Ethanolic extract of the stem bark of *B. variegata* shows haematinic activity on haemolytic anaemic rats.²⁰

Antimicrobial activity: Ethanolic extract of the stem bark of *B. variegata* was found to have antimicrobial activity against *B. subtilis*, *P. aeruginosa*, *S. typhi*, *S. dysenteriae*, *S. aureus* and *Vibrio cholerae*. For this organism the minimum bacterial concentration (MBC) of crude extract was 0.39mg/ml. The ethanolic extract was found to be more effective against gram positive than gram negative bacteria.²¹

Antiulcer activity: Ethanolic extract of the stem of *B. variegata* shows the antiulcer activity against gastric ulcer induced by pyloric ligation and aspirin induced ulcer model in rats. Ethanolic extract decrease the volume of gastric secretion, total, free acidity and ulcer index with respect to control which increase during ulcer.²²

Anticarcinogenic activity: Methanolic extract of stem bark of *B. variegata* shows anticarcinogenic activity using two stage protocol in skin papilloma model in swiss albino mice against 7, 12- dimethylbenz (a) anthracene (DMBA) and croton oil induced skin carcinogenesis in mice. Methanolic extract at a dose of 500 and 1000 mg/kg body weight was found to be effective in decreasing the rate of tumour incidence in comparison to control and cumulative number of papillomas, tumour yield and tumour burden were also found to be reduced. The depleted level of glutathione was restored in *B. variegata* bark extract treated groups.²³

Table no. 1: Table shows the reported activity and Model used

Sr. no.	Reported activity	Author	Parts to be used	Model used
1.	Anti-diabetic	Wahab Abd Ei et.al.	Leaves	Glucose induced diabetes
2.	Anti-inflammatory	Rao et.al.	Non woody aerial parts	Carrageenan induced hind paw edema
3.	Immuno-modulatory	Ghaisas MM et.al.	Stem bark	
4.	Anti-tumour	Raj Kapoor B et.al.	Stem	Produce Dalton's ascetic lymphoma
5.	Chemoprevention & Cytotoxic effects	Raj Kapoor B	Stem	N-nitrosodiethylamine induced experimental liver tumour in rats
6.	Hepatoprotective	Bodakhe Surendra H et.al.	Stem bark	CCl ₄ induced hepatotoxicity
7.	Anti-bacterial	Parekh Jigna et.al.	Stem bark	Against bacterial strains
8.	Haemagglutinating	Wassel et.al.	Crude seed	
9.	Haematinic	Dhonde SM et.al.	Stem Bark	Phenylhydrazine administration
10.	Anti-microbial	Pokhrel NabuRaj et.al.	Stem Bark	Against Bacterial strains
11.	Anti-Ulcer	Raj Kapoor B et.al.	Stem	Gastric ulcer induced by pyloric ligation & aspirin induced ulcer model
12.	Anti-carcinogenic	Pandey Sonam et.al.	Stem Bark	DMBA & croton oil induced skin carcinogenesis in mice

SUMMARY AND CONCLUSION

In the present article, we had a review on the relevant properties such as pharmacognostical, phytochemical and pharmacological information on the *B. variegata*. A critical analysis of the literature revealed that this plant contains different constituents which are responsible for various activities. The present review of literature revealed that the plant is having antidiabetic, anti-inflammatory, immunomodulatory, antitumour, hepatoprotective, antibacterial, haemagglutinating, haematinic, antimicrobial, antiulcer and antitumour activities.

REFERENCES

1. The Wealth of India Raw Material: A Dictionary of Indian Raw Material and Industrial Products, Council of Scientific Indian Research New Delhi, 1952; 2: 56-57.
2. Ghaisas MM, Shaikh SA, Deshpande AD., Evaluation of immunomodulatory activity of ethanolic extract of the stem bark of *Bauhinia variegata* Linn. Int. J. of Green Pharmacy 2009; 70-74.
3. The Ayurvedic Pharmacopeia of India: Government of India Ministry of Health & Family Welfare, Department of Ayush, 1(1): 73-74.
4. Kirtikar KR, Basu BD, Indian Medicinal Plants, 3rd ed., 1991; 898-900.
5. Mali Ravindra G, Mahajan Shailaja G, Mehta Anita A., Plant review Rakta Kanchan (*Bauhinia variegata*): Chemistry, Traditional and Medicinal uses-a review. Pharmacognosy Review 2007; 1(2): 314-319.
6. Gupta Rajesh, Paarakh Padmaa M, Gavani Usha., Pharmacognostical & phytochemical screening of *Bauhinia variegata* Linn. Leaves. Journal of Pharmacy Research 2009; 2(7): 1196 -1198.
7. Rao, Yerra Koteswara, Fang Shih-Hua, Tzeng Yew-Min., Anti-inflammatory activity of flavanoids and a triterpene caffeate isolated from *Bauhinia variegata*. Phytotherapy Research 2008; 22: 957-962.
8. Yadava RN, Reddy Madhusudhan., Anti-inflammatory activity of a novel flavonol glycosides from *Bauhinia variegata* Linn. Natural Product Research 2002; 17(3): 165-169.
9. Reddy Mopuru VB, Reddy Muntha K, Gunasekar Duvvuru, Caux Cristelle, Bodo Bernard., A flavanone & a dihydrodibenzoxepin from *Bauhinia variegata*. Phytochemistry 2003; 64: 879-882.
10. Gupta AK, Vidyapati TJ, Chauhan JS., Chemical examination of the stem of *Bauhinia variegata*. Planta Medica 1980; 38: 174-176.
11. Zhao YY, Cui CB, Cai B, Han B, Sun QS., A new phenanthraquinone from the stem of *Bauhinia variegata* L. Journal of Asian Natural Products Research 2005; 7(6): 835-838.
12. Singh RS, Pandey HS, Ghanshyam., Two new long chain compounds from *Bauhinia variegata* linn. Indian Journal of Chemistry 2006; 45B: 2151-2153.
13. Nageshwar G, Radhakrishnaiah M, Narayana LL., Numerical chemotaxonomy of *Bauhinia*. Indian Acad. Sci. (plant Sci.) 1984; 93(6): 621-627.
14. Wahab Abd Ei, Wassel SM, Ammar GM, Hanna NM., Flavonoids constituents in different organs of selected *Bauhinia* species & their effect on blood glucose. Herba Hungarica 1987; 26(1): 27-39.
15. Raj Kapoor B, Jayakar B, Muruges N., Antitumour activity of *Bauhinia variegata* on Dalton's ascetic lymphoma. Journal of Ethanopharmacology 2003; 89: 107-109.
16. Raj Kapoor B, Jayakar B, Muruges N, Sakthisekaran D., Chemoprevention and cytotoxic effect of *Bauhinia variegata* against N-nitrosodiethylamine induced liver tumours & human cancer cell lines. Journal of Ethanopharmacology 2006; 104: 407-409.
17. Bodakhe Surendra H, Ram Alpana., Hepatoprotective properties of *Bauhinia variegata* bark extract. The Pharmaceutical Society of Japan 2007; 127(9): 1503-1507.
18. Parekh Jigna, Karathia Nehal, Chanda Sumitra., Screening of some traditionally used medicinal plants for potential antibacterial activity. Indian journal of Pharmaceutical Science 2006; 68(6): 832-834.
19. Wassel, Wahab GEL, Ammar SA., Seed proteins of selected *Bauhinia* species & their haemagglutinating effect. Herba Hungarica 1989; 23(1-2): 123-125.
20. Dhonde SM, Siraskar BD, Kulkarni AV, Kulkarni AS, Bingi SS., Haematinic activity of ethanolic extract of stem bark of *Bauhinia variegata* Linn. International Journal of Green Pharmacy 2007; 1(3-4): 28-33.
21. Pokhrel NabuRaj, Adhikari RP, B aral., In vitro evaluation of antimicrobial activity *Bauhinia variegata*, locally known as Koiralo. World Journal of Microbiology & Biotechnology 2002; 18: 69-71.
22. Raj Kapoor B, Jayakar B, Anandar R, Kavimani S., Antiulcer effect of *Bauhinia variegata* Linn. in rats. Journal of Natural Remedies 2003; 3(2): 215-217.
23. Pandey Sonam, Agrawal RC., Effects of *Bauhinia variegata* bark extract on DMBA induced mouse skin carcinogenesis: A preliminary study. Global Journal of Pharmacology 2009; 3(3): 158-162.