

***Bauhinia variegata* (Kanchnara), An ornamental Plant with significant value in Ayurvedic and Folk Medicinal system**

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REVIEW ARTICLE

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ABSTRACT

Medicinal plants are important part of traditional medication system. These plants are also the primary source of modern drugs. One such important medicinal plant is *Bauhinia variegata* (orchid tree) commonly called as Kanchanara in Hindi and Mountain Ebony in English. It belongs to Caesalpiniaceae family. It is one of the most common tree species found throughout the India. This tree is known for its beautiful scented and aesthetic white pinkish flowers. It is traditionally used in many folk cultures around the country for various kind of disorders. It is commonly used plant species in Indian cuisine. Its flower buds are commonly used as vegetables in many regions of India. It holds a significant place in Ayurveda for its curative and healing properties in many diseases especially cervical lymphadenitis, hemorrhage, rectal prolapse, menorrhagia, leukoderma etc. It is used in many Ayurvedic polyherbal formulations as a main ingredient like Kanchanara Guggulu, Ushirasava, Vidangarishta etc. It has diverse nature of phytochemical constituents present in it which are responsible for extraordinary therapeutic properties like anti-microbial, anti-tumor, anti-diabetic, hepatoprotective, immunomodulatory, haemagglutination, anti-oxidant, antigoitrogenic, nephroprotective. The aim of present review is to provide information related to phytochemistry, traditional uses in Ayurveda and folk medicinal system and therapeutic properties of *Bauhinia variegata*.

Keywords: *Kanchanara, Rasapanchak, Anti-microbial, Haemagglutination, Antigoitrogenic*

1. Introduction

Mother nature is fulfilling human basic requirements of food, shelter, clothes and medicines since the origin of mankind. Nature has provided a wide range of medicinal plants to us which are being used in traditional practices of medications in Ayurveda, Shiddha, Yunani, Folk, Chinese etc. These plants play a vital role in the health maintenance of the community. Medicinal plants are considered as the general health marker of the ecosystem. The survival of living beings on the earth would be difficult without the plants. The first reported use of medicinal plant for health related issue was recorded 5000 years ago. These are the potent source of many of the modern drugs because the phytochemicals present in these plants are used as the chemical entities for modern drugs. These plant exhibits bioactive properties which are

important from medicinal and clinical point of view. This is why plant kingdom is entitled with “the treasure house of potential drugs”. (1-10) Ayurveda and Chinese medication system are considered as the most ancient systems of medicines in the world. Medicinal plants are the central part of these medication systems. (11) As per the reports, 45000 different plant species are used in India for health maintenance. This is the reason why India is called as the botanical garden of the world which is listed among the world biodiversity centers. (12,13) Medicinal plants are used in almost all the Ayurvedic practices of treating numerous diseases. Ayurvedic polyherbal formulations are well known drugs in Global herbal drug market. (14) Plants are greatly promoted by folk practices of medication in India. There are so many associated ethnobotanical beliefs and customs with

plants in India. (15) The Traditional Chinese Medicines are well considered herbal drugs in the world. Herbal products are being in use in the daily routine of Chinese population from many years. Japan, Hong Kong, Korea and Singapore are known major importers of Traditional Chinese Medicine. (16-18) These traditional systems of medication have shown us that medicinal plants have done favor on humanity by providing various patents of herbal drugs which are being used to treat various kind of diseases and provide relief. (19-21) From the historical reports it has been cleared that Amerindians used a vast variety of plants. Spanish and the Portuguese were the ones who introduced American plant species to the world. In Europe, Balkan Peninsula is the most important biodiversity center which is enriched with 6340 kinds vascular plant species. (22-24) Medicinal plants are not only used in medical/pharmaceutical industry but they also have a great impact on the cosmetic and nutraceutical industry. They play a major role in these industries. Herbal nutraceuticals are associated with the advantages such as maintaining the health and longevity of life. (25,26) Medicinal plants are used in many corners around the world. There are so many important medicinal plants in the world which are of great significant value due to their unique photochemistry and biological activities and one of such plant are *Bauhinia variegata*. It is well known ornamental plant species commonly called as Kanchnara in Hindi and also known by its English name Mountain Ebony around the world. *Bauhinia variegata* belongs to Caesalpinioideae family which consists of shrubs/trees, very rarely climbers. There are almost 300 different species are found under the genus *Bauhinia*. Most of the species of this genus are found in the tropical areas of the world like Africa, Asia and South America. (27) *Bauhinia variegata* is also known as 'Camel's foot tree or Orchid tree' in some corners of the

world. The word Kachnar depicts the meaning "A beautiful glowing lady" in Sanskrit. The plant is deciduous and small to medium sized found growing in the tropical and subtropical region throughout the world. (28) The plant is commonly used as a vegetable in many corners of the country. *Bauhinia variegata* is commonly used in folk system by many cultures and tribes for treating several diseases. (29-33) The description of this important plant species is also mentioned in the Ayurveda, ancient Indian science of life. *Bauhinia variegata* stem bark and flowers are used in many polyherbal formulations of Ayurveda which are being used in treatment of diseases like galaganda (Goiter), gandamala (Lymphadenopathy), ashthila [Benign prostatic hyperplasia (BPH)], kapha-pitta dosha disorders, and arbuda (Tumor), rakta pradara (cures dysfunctional uterine bleeding), pittaghna (balances pitta dosha), kshyaghna (antitubercular), and kaasghna (cures cough) and also used against carcinomas. (34,35) Each part of *Bauhinia variegata* is medically important due to the presence of variety of phytochemical constituents in them like alkaloids, oil, fat glycoside, carbohydrates, phenolics, tannins, lignin, saponins, flavonoids and terpenoids. (36) The biological properties exhibited by this plant are anthelmintic, antitumour, antimicrobial, anti-inflammatory, antigoutogenic, hepatoprotective and haemagglutination etc. (37) Apart from its therapeutic properties, it is used as an ornamental plant due to its fragrant, whitish pink flowers. It is used as fodder to sheep, goats and cattle. The calorific value of *Bauhinia variegata* is 4,800 kcal/kg which makes its use as a fuel. The stem fiber of this plant is used in ropes. The wood is used as timber. The gum obtained from this plant is used as adhesive. The bark tannins are used as dye. (38) *Bauhinia variegata* is popular medicinal plant used for various purposes in different ethnic groups for many years this is why it is entitled by Veda with the name kanchan

which means gold. (39) Vernacular names and taxonomic classification of *Bauhinia*

variegata is given in table 1 and 2 respectively.



Figure 1. *Bauhinia variegata* (Kachnar)

Table 1. Vernacular Names of *Bauhinia variegata* (Kachnar) (40,41)

English	Mountain ebony
Hindi	Barial, Gurial, Gwiar, Kachnar, Kandan, Kaniar, Khairwal, Khawairaal, Koliar, Padrian
Sanskrit	Ashmantaka, Asphota, Chamari, Chamarika, Champavidala, Gandari, Girija, Kanakaprabha, Kanchanala, Kanchana, Kanchanara, Kanchanaraka, Kantar, Karaka, Karbudara, Karbudara, Kovidara, Kuddala, Raktapushpa, Shonapushpaka, Suvarnara, Svalpakkesara, Tamrapushpa, Uddalaka, Yamalachada, Yugapatraka, Yugmapatra
Konkani	Kanchan
Malayalam	Kovidaram, Suvannamandaram, Unna
Marathi	Kanchan, Raktakanchan, Thaur
Mundari	Burju, Buruju
Tamil	Mandarai, Segappumandarai, Semmandarai, Vellaippuvatti
Telugu	Bodanta, Devakanjanamu, Kanjanamu, Mandara, Mandari
Urdu	Kachnal
Uriya	Boroda, Kosonaro, Kanjoni, Ronga-Konjono
Burmese	Bwaycheng, Bwechin
Canarese	Arisinantige, Ayata, Bilikanjivala, Irkubalitu, Kanjivala, Karalabhogi, Kempukanjivala, Kempumandara, Mandara, Ulipe
French	Arbe de saint Thomas, Bauhinie panachee

Table 2. Taxonomy of *Bauhinia variegata* (Kachnar) (42)

Taxonomic Rank	Taxon
Kingdom	Plantae
Class	Dicotyledone
Subclass	Polypetalae
Series	Calyciflorae
Order	Rosales
Family	Caesalpiniaceae

Genus	<i>Bauhinia</i>
Species	<i>variegata</i>
Common Name	Kachnar, Mountain ebony

2. Morphology

Bauhinia variegata commonly known as orchid tree, is small to medium sized deciduous tree which reach upto the height of 15 m and diameter of 50 cm and mainly found at an altitude of 1300metres in Himalayas. The tree has a short ball and spreading crown like appearance. There is a presence of a light brownish grey bark with longitudinal cracks with irregular darker patches. The inner surface of the bark is fibrous, bitter and pale pinkish in color. Slender zigzag twigs are present. Twigs are green when they are young on maturing they become brownish grey. Bifoliate leaves with glabrous surface are present in this plant which are about 16 cm long with the presence of 2 lobbed petioles. Minute stipules of 1-2 mm size are present on leaves. Lamina of the leaves is ovate to circular in shape. Texture is coriaceous, campylodromous venation is present. The leaves have cordate base, emarginated apex. 9 multicostate divergent, stout primary veins are present. While 43 alternate, recurved secondary veins are present. The tips of the leaves are usually rounded. This plant has characteristic partially opened inflorescences. The flowers are usually whitish pink color with specific fragrance and green narrow basal tube. Petals are 5 in number which are slightly unequal with wavy margin and narrow base. The uppermost petals are darker and variegated than the others. Short and sessile pedicels are present. Calyx is hairy and light green having a pointed 5 angled bud and opens on one side while remains attached on another side. 5 stamens are present. The ovary is slender, stalked, curved, narrow, green and 1 celled with a dot like stigma. Fruits are 15-20 /1.2 cm flat with hard dehiscent, dark brown pod and are obliquely striate, 20-30 by 2-25 cm. There is presence of 10-15 seeds in each fruit.

Seeds are usually flat, circular and brown in appearance with coriaceous testa. Flowering begin to appear at the age of 2 or 3 and blooming occurs in the month of January–April in the period of dry summer whereas in period of March–July fruiting occurs. (43-47)

3. Geographical distribution

It is believed that *Bauhinia variegata* has originated in East Indies and it was first naturalized in Jamaica, from where it spread in Texas and Louisiana. It mostly grows at 1300 m of elevation but can also be found growing well in deciduous forests and at an elevation of 900 m it is also found in dry mixed forests. This species profoundly grows in tropical and subtropical countries of the world such as India, China, Pakistan, Burma, North Thailand, North Vietnam, Peoples Democratic republic of Lao, Cambodia and Laos. In India it is found in many states such as Bihar, Delhi, Jammu and Kashmir, Madhya Pradesh, Karnataka, Manipur, Nagaland, Meghalaya, Orissa, Mizoram, Punjab, Pondicherry, Rajasthan, Uttar Pradesh, Tamil Nadu, Tripura, West Bengal, Sikkim and many other places. The climate requirements of this plant are hot, dry summers and mild winters. It requires a profound amount of light and good drainage for its growth. It grows well in gravelly, shallow, rocky soils to sandy loam and loamy soils. (48-51)

4. Phytochemical constituents of *Bauhinia variegata*

Bauhinia variegata is composed of wide variety of phytochemical constituents in it. Each part of the plant consists of wide range of phytochemicals present in it.

Flowers

The flowers of this plant has variety of phytochemicals such as ascorbic acid, aspartic acid, glutamic acid, keto acids,

octadecanoic acid, amino acids, apigenin, tannins, quercitroside isoquercitroside, rutoside, taxifoline rhamnoside, kaempferol-3-glucoside, myricetol glycoside, apigenin-7-O-glucoside, quercetin, rutin, apigenin, malvidin-3-glucoside, malvidin-3-diglucoside, cynidin 3-glucoside, peonidin-3-glucoside, peonidin-3-diglucoside, malvidin-3-glucoside. (51,52)

Leaves

Bauhinia variegata leaves have variety of phytochemical classes present in it such as crude protein, carbohydrates, saponins, fibres, volatile oil, tannins, alkaloids, cardiac glycosides, lignin, fats, phenolics, sterols, catechol, flavonoids, minerals. Leaves are rich source of Vitamin C and (146mg %) and reducing sugar. The main compounds are quercitrin, β -sitosterol, rutin, quercetin, apigenin and apigenin 7-O-glucoside, germacrene D, spathulenol, δ - and γ -cadinene, lupeol, kaempferol-3-glucoside, elagic acid. Two novel compounds named as heptatriacontan-12, 13-diol and dotetracont-15-en-9-ol have been reported from the leaves. Gunalan et al., confirmed the presence of many bioactive compounds in the ethanol extract of the leaves by using Gas chromatography–mass spectrometry (GC-MS) and High-performance thin-layer chromatography (HPTLC) some of them are phenol, 2,4-Bis(1,1-Dimethylethyl), 1-heptadecene, hexadecane, 8-pentadecanone, 1-nonadecene, octadecane, phthalic acid, diisobutyl ester, benzene-O-dicarboxylic acid, Di-N-, Phthalic acid, butyl-2-pentyl ester, α -octadecene, eicosane, butyloctylphthalate, Phytol, Stigmast-5-en-3 β -ol, delta, 4-sitosterol-3-one, cyclohexane, tetradecyl, fumaric acid, 2-dimethylaminoethyl octadecyl ester, octadecanoic acid, methyl ester, methyl palmitate, 1,2-benzenedicarboxylic acid, bis(2-methylpropyl)ester, 4,4,5,8-tetramethyl

chroman-2-ol, phytol, palmitic acid, betamonoglyceride etc. (53-56)

Stem Bark

Bauhinia variegata stem bark contains variety of phytochemical classes like sterols, glycosides, flavonone glycoside, phenanthraquinone, reducing sugars and nitrogenous substances. The main constituents present in the stem are hentriacontane, octacosanol, stigmasterol, 5, 7-dihydroxyflavonone-4-O- α -L-rhamnopyranosyl- β -D-glucopyranoside, β -sitosterol, lupeol, kaempferol-3-glucoside, bauhinione. Rutoside, myricetol glycoside, quercitroside, isoquercitroside, neringenin-5,7-dimethylether-4'-rhamnoglucoside. 5,7,3',4'-Tetrahydroxy-3-methoxy-7-O- α -L-rhamnopyranosyl-O-beta-galactopyranoside are known to be present in the stem bark. (57-60)

Seed

Seed contains oleic acid contains palmitic acid, linoleic acid, stearic acid, aspartic acid, serine, glutamic acid, proline, glycine, alanine, lysine, threonine, valine, methionine, isoleucine, leucine and phenylalanine, histidine and arginine, tyrosine and proteins. (61)

Root

Roots are known to have phytochemical constituents like carbohydrates, glycosides, flavonoids, tannins, phenolic compounds, proteins, gums and mucilages. Novel flavone glycosides namely (2S)-5,7-dimethoxy-30,40-methylenedioxy flavanone and 5,7,3',4'-tetrahydroxy-3-methoxy-7-O- α -L-rhamnopyranosyl (1--3)-O- β -galactopyranoside along with a novel dihydrodibenzoxepin, 5,6-dihydro-1,7-dihydroxy-3,4-dimethoxy-2-methyldibenz b, foxepin have been isolated from the root. (62-65)

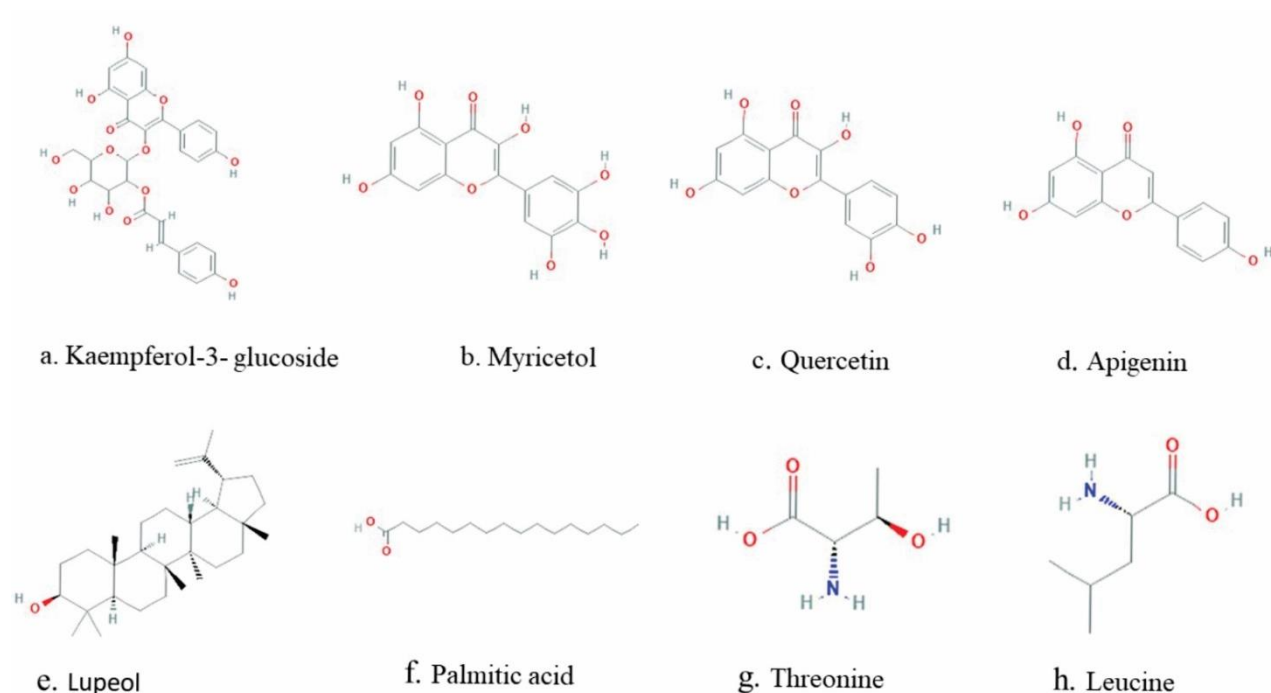


Figure 2. Chemical structures of some of phytochemical constituents of *Bauhinia variegata*

5. Traditional and Modern View of *Bauhinia variegata*

Ayurvedic View

The origin of Ayurveda in India is almost 2500 and 500 BC old. The word Ayurveda indicates the meaning “science of life”. It significantly works on balancing the three body components/doshas of the body i.e. kapha (water & earth), pitta (fire) and vata (space & air). (66-68) *Bauhinia variegata* is an important medicinal plant which is widely used in Ayurvedic practices for treating disorders. This plant is used in many Ayurvedic formulations as a main ingredient. It is mainly used against vitiated pitta and kapha Doshas of the body. *Bauhinia variegata* is described in many books written by Ayurveda Acharya of 20 centuries namely Yadavji, Trikamji, Viswanath Dwivedi, Priyavarat Sharma etc. Grossly Kanchar is categorized into three categories i.e. Red (Rakta), white (Shweta) and Yellow (Peet). Red kanchar is useful in vrana (wound), krumi (worms), gandamala (cervical lymphadenitis), raktapitta (haemorrhage), kushtha (skin

disease), gudabhransha (rectal prolapse), pradar (menorrhagia), kasa (cough), raktavikaras (lood purifier). White kanchar is used against shwas (asthma), kasa (cough), raktavikara (blood purifier), vrana (wound), pradar (menorrhagia) while Peet Kanchar is used to treat mutrakruccha (dysuria). *Bauhinia variegata* is used as a remedy in leucoderma, leprosy, wounds and ulcers, *Bauhinia variegata* is used to treat leucoderma, leprosy, menorrhagia, asthma, wounds and ulcers, Rakta pradaraghna (menstrual disorders), Kaasghna, and Kshyaghna etc. The bark of this plant is used as an anti-diabetic agent in Ayurveda. (69-75) Rasapanchak of *Bauhinia variegata* is given in table 3.

Table 3. Rasapanchak of *Bauhinia variegata* (Kanchar) (76)

Sanskrit/English	Sanskrit/English
Virya/ Potency	Sheeta/Cold
Vipak/Metabolic property	Katu/Pungent

Guna/Physical property	Laghu/Light, Ruksha/Dry
Rasa/Taste	Kashaya/Astringent

6. Properties and Uses of *Bauhinia variegata* (Kanchnar) (77,78)

Sansthanik: It is useful in decoction form to treat wound healing, skin disorders and inflammation. The bark paste is applied in lepa form to treat goiter. It is useful in treating excessive salivation and mouth ulcers. Decoction is used against Rectal prolapse

Abhyantra naadi sansthan: It is useful in treating diarrhoea, dysentery, rectal prolapse, bleeding piles. It is used as anthelmintic. Flower formulations are used as a remedy to constipation.

Raktawah sansthan: Due to its astringent property, it is used to stop bleeding. It is effective against goiter and lymphadenopathy too.

Swasan sansthan: It is used in the treatment of cough.

Mootra wah sansthan: Due to its antidiarrheal property, it is helpful in treating type II diabetes.

Prajannan wah sansthan: Due to its astringent property, it is effective against menorrhagia.

Twacha: It is helpful in treating skin disorders.

Satmikaran: It is effective against obesity by scrapping fats.

7. Ayurvedic Formulations of *Bauhinia variegata* (Kanchnar)

Bauhinia variegata is used in many Ayurvedic formulations such as Kanchanara Guggulu, Kanchan gutika, Gandamala kundana rasa, Kanchanaradi Kwatha, Ushirasava, Chandanasava, Vidangarishta, Kanchanara Varuna Kwatha. Some of them are discussed below:

Kanchanara Guggulu: This polyherbal formulation is made up of *Kanchanara*

(*Bauhinia variegata* L.), *Varuna* (*Crataeva nurvala* Buch.-Ham.), *Triphala*, *Trikatu*, *Trijataka*. It is used as treatment of *Kapha* accumulations in the tissues. It is helpful in enhancing the proper functioning of lymphatic drainage and digestive system. (79) It is also effective in benign prostatic hyperplasia (BPH), a senile disorder. (80-82)

Kanchanaradi Kwatha: This formulation is effective in treating Granthi (cyst). (83)

Vidangarishta: It is effective treatment for indralupta (scalp disease) in which hair loss occurs. (84)

Ushirasava: It is useful in treating Shukra shodhaka (genital issues). (85)

Chandanasava: This important formulation is useful against ulcer. (86)

Folk View

There are many different cultures in the world and each culture has its own ethnobotanical beliefs of utilizing medicinal plants. Ethnobotany is the term related with the association of human cultures with the plants. Medicinal plants are associated with rich ethnobotanical uses. (87) *Bauhinia variegata* is one of the mostly commonly used medicinal plants in the folk practices. It is used for its therapeutic actions and also used as vegetable in some cultures. For instance, it is a very famous tree species in Himachal Pradesh. Kanchnar buds and flowers are eaten by Himachalis (especially in Kangra, Hamirpur, Bilaspur) as a famous dish called "karalen ki sabji". These buds are also eaten as a food in other states like Madhya Pradesh (Dhar District) and some Northeastern part of the country. (88-91) In some areas of Pakistan, and Nepal people use floral buds as a vegetable. (92-94) *Bauhinia variegata* is traditionally used as an anti-bacterial agent. (95) The flowers buds of this plant are traditionally used to treat skin diseases and leprosy. (96) The decoction of tree bark is used to treat leprosy, leucoderma, asthma and

ulcers in Bageshwar district Uttarakhand. (97) In Bhatwari Block, District Uttarkashi, Uttarakhand people use the parts of plant against Heartburn, diarrhea, menorrhagia, obesity, worms, bleeding hemorrhoids. (98) In rural areas of Uttarakhand, flowers are used to treat dysentery and buds are used against diarrhea. (99,100) The Sonaghati tribes of Uttar Pradesh, use *Bauhinia variegata* as treatment remedy for dysentery, and skin related problems such as leprosy, syphilis etc. (101) People use this plant for treating skin related problems and leprosy in Chagharzai valley, District Buner, Pakistan. (102) In Eastern Ghats of Andhra Pradesh, people use flower paste as cure to asthma. (103) In some of the districts of Kolhapur like Ichalkarangi, Kolhapur, Warnanagar people treat diarrhoea, worms, piles, dysentery with the dried buds of *Bauhinia variegata*. (104) In Chitrakoot region of Madhya Pradesh, people use barks, leaves and stem of this plant to treat piles and gall bladder/kidney stone. (105) People from the areas around the Nagzira Wild Life Sanctuary, use bark paste for treating skin diseases and leprosy. (106) Kotli District of Jammu and Kashmir, people use this plant for various purposes like they use bark against skin diseases, floral buds as a saag (a leafy dish), leaves as fodder, wood as fuel. They also use this plant for ornamental purposes. (107) In Arghakhanchi district, Nepal people use paste made up of *Bauhinia variegata* root to take out pus. (108) The bark and stem of this plant is used traditionally as antidote in snake bite whereas bark juice is used against dysentery in Tharu community of Nepal. (109) Diabetes is treated traditionally with the bark of *Bauhinia variegata* in Bishnupur District of Manipur. (110) In Parbat district of Western Nepal, people traditionally use Bark juice as a tonic and blood purifier. They use bark paste as remedy to cuts and wounds while fresh flowers are used as vegetable and pickle. (111) People of Muzaffarabad, use the

bark of this plant as tonic and alliterative and to treat skin related problems and ulcers while dysentery, piles, worms and diarrhoea is treated traditionally by the dried buds of this plant. (112) In Betalghat region, Kumaun Himalaya, people use stem bark extract to get relief from stomachache due to worms. (113) Flower extracts are used traditionally to treat diabetes by Mao-Naga Tribe of Manipur. (114) The root and barks are used traditionally by some areas of Odisha to treat skin diseases, leprosy, intestinal worms, wounds and ulcers. (115) In upper Eastern Himalaya, people use young leaves and flowers as vegetable. (116) Rural population of Haryana, uses stem bark decoction as a remedy to menorrhagia. (117) In Central Haryana, people use tonic made up of bark decoction as a blood purifier which is most effective against skin disorders. (118)

Modern View

The quality of herbal drugs in the present times is in question due to the factors like contamination, adulteration, and misidentification. The most common practice of defaming herbal drugs is species adulteration which is the process of replacing original species with alternative species. As per WHO, adulteration of plant based products is a threat to the consumer health. Adulteration is associated with severe health risks. Adulteration is the burning topic in the Global herbal drug industry. There are many terminologies used for species adulteration such as substitution, fraudulent substitution, admixture, mislabeling, contamination, filler, etc. (119-123) For instance, various species of genus *Bauhinia* such as *B. variegata*, *B. purpurea*, *B. malabarica*, *B. racemosa*, *B. tomentosa* are used as substitutes to each other in the Global as well as domestic markets of herbal drugs. (124) There are proper standardization and quality analysis techniques which can be used effectively to detect these alterations. The guidelines

for standardized of herbal products set up by WHO must be implied for the detection of alterations in the herbal drugs to ensure their quality, safety and efficacy. (125)

8. Therapeutic Properties of *Bauhinia variegata*

Bauhinia variegata is associated with many important therapeutic properties. Some of them are discussed below:

Anti-tumor

Raj Kapoor et al., studied the anti-tumor activity of *Bauhinia variegata* in Swiss albino mice models against Dalton's ascitic lymphoma (DAL). It was observed that ethanol extract of the plant significantly enhanced the mean survival time of the models administered with the extract. It also enhanced the counts of peritoneal cell. It also reversed the haematological parameters, protein and PCV changes. (126) Another study conducted by Raj Kapoor et al., in Swiss albino mice against Ehrlich ascites carcinoma (EAC). The study suggested that ethanol extract of the plant is effective against (EAC) induced changes. (127) As per the reported *in-vivo* study conducted by Sonam Pandey on mice models, hydromethanolic extract exhibits anti-tumor activity. Extract was effective against melanoma tumor by B16F10 cell line in C57BL/6 mice at dosage of 500 and 750 mg/kg b.wt. This study suggested that hydromethanolic extract of *Bauhinia variegata* can be a good source of anti-tumor drugs. (128)

Anti-inflammatory

Saha et al., carried out an *in-vivo* study for the evaluation of anti-inflammatory potential of *Bauhinia variegata*. They use three animal models for the study viz. the carrageenan induced rat paw edema, cotton pellets induced granuloma formation, and adjuvant induced arthritis in rat. Ethanol extract and the petroleum ether fraction were evaluated against all the models. The findings of the study

suggested that both the extract exhibit anti-inflammatory activity but petroleum ether fraction exhibited slightly more potent activity. (129)

Anti-diabetic

Chaudhari et al., investigated the antidiabetic activity of *Bauhinia variegata* in an *in-vitro* study. Petroleum ether and hexane extracts of stem bark were checked for this activity. Both the extracts showed significant antidiabetic activity. The highest concentration of the extract showed maximum activity. (130)

Hepatoprotective

Jadhav et al., carried out a study in female Albino Wistar rats to investigate the hepatoprotective property of *Bauhinia variegata*. Models were administered with carbon tetrachloride (CCl₄) to induce hepatotoxicity. It was observed that aqueous extract of the plant at the dose of 500mg/kg b.w showed hepatoprotective actions against carbon tetrachloride (CCl₄) induced damages which suggests that *Bauhinia variegata* can be used as a hepatoprotective agent. (131)

Anti-microbial

Bauhinia variegata is associated with anti-microbial activities. Pokhrel et al., evaluated this property in an *in-vitro* study. Alcoholic extract of *Bauhinia variegata* was found to be effective against *Bacillus subtilis* (ATCC 6635), *Pseudomonas aeruginosa* (ATCC 27853), *Salmonella typhi*, *Shigella dysenteriae*, *Staphylococcus aureus* (ATCC 29213) and *Vibrio cholera*. The extract showed more potent activity against gram positive bacteria. (132) Sonam Pandey studied anti-microbial activity of *Bauhinia variegata* against gram positive bacteria *Bacillus subtilis*, *Staphylococcus aureus* and *Streptococcus epidermidis* and Gram-negative *Escherichia coli*, *Shigella flexneria*, *Pseudomonas aeruginosa* bacteria. Hydromethanolic extracts of this plant effectively inhibited the growth of

the microorganisms at the dosage of 1 000 mg/mL, 750 mg/mL, 500 mg/mL and 250 mg/mL respectively. (133) This property was also supported by Sharma et al. They conducted an *in-vitro* study to evaluate the anti-microbial activity of the plant. It was observed that the plant extract showed inhibitory actions against *Staphylococcus aureus*, *Salmonella typhi*, *Bacillus subtilis* and *Escherichia coli*. (134) Study reports of Rashid et al., also supports the use of *Bauhinia variegata* as an anti-microbial agent. The crude extract of this plant was found to be more effective than the antibiotic drug ampicillin against two gram positive bacteria *Staphylococcus aureus*, *Streptococcus pyogenes* and two gram-negative bacterial viz. *Escherichia coli*, *Proteus mirabilis*. (135)

Haemagglutination

As per the study reports of Roy et al., the saline extract of seed is associated with haemagglutination property. They evaluated this property on erythrocytes of vertebrates such as man, monkey, rabbit, rat, goat, sheep, cow, buffalo, horse, mule and fowl where saline extract exhibited haemagglutinating activity. (136)

Antigoitrogenic

Veena et al., conducted an *in-vivo* study on rats to evaluate the antigoitrogenic activity of *B.variegata*. They administered neomercazole in rats to induce goiter. It was revealed that this plant has ability to bring the goitrogenic thyroid to normal level at the dosage of 200 mg/ day. (137)

6significant scavenging activity against 1,2-diphenyl-2-picrylhydrazyl (DPPH), super oxide, nitric oxide, and hydrogen peroxide radicals. They concluded that alcoholic and aqueous extracts of the plant have effective anti-oxidant potential. (138)

Nephroprotective

As per the reports of an *in-vivo* study carried out by Pani et al., in rats, ethanol extract of *Bauhinia variegata* is associated

with nephroprotective actions. The study was carried out in cisplatin-induced nephropathy in rat models. The findings revealed that administration of ethanol extract at dosage 400 and 200 mg/kg (b.w.) for 14days significantly reversed the changes induced by cisplatin. At 400 mg/kg dosage level, extract increased the body weight, urine volume output and also it decreased creatinine serum level and urea. (139)

Anti-ulcer

Bauhinia variegata was evaluated for its anti-ulcer potential in an *in-vitro* study conducted by Raj Kapoor et al. on rat models. Pyloric ligation and aspirin were used for inducing gastric ulcer in the models. It was found that ethanolic extract of the plant significantly decreased the gastric secretion volume, total free acidity and ulcer index which shows its effectiveness in the ulcer treatment. (140)

9. Conclusion

The present study is an attempt to provide detailed information about the most common medicinal plant species, *Bauhinia variegata*. Modern pharmacological studies indicated that this plant has extraordinary biological potential. It is strongly believed that the data presented in this review on utilization of *Bauhinia variegata* plant in Ayurveda and folk cultures might draw the attention of researchers to use this plant in modern medicines. The diverse kind of phytochemicals present in this plant can be the promising source of anti-microbial, hepatoprotective, immunomodulatory, haemagglutination, anti-oxidant, antigoitrogenic, nephroprotective drugs.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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