Review Article

Historical aspects, Medicinal uses, Phytochemistry and Pharmacological review of *Bauhinia variegata*

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Abstract

Bauhinia variegata Linn (Mountain Ebony) belongs to the family Leguminosae (Caesalpinioideae). It is a medium-sized, deciduous tree, ascending to an altitude of 1,300 m in the Himalayas. The reported biological activities are anthelmintic, antiulcer, antitumour, antimicrobial, antileprosy, antidiabetic, anti-inflammatory, antigoitrogenic, hepatoprotective and haemagglutination. The plant is widely used by the tribals throughout India and popular in various indigenous systems of medicine like Ayurveda, Unani and Homoeopathy. Carbohydrates, tannins, alkaloids, flavonoids are the important constituents of Kachnar. Maharishi *Charaka* and *Sushruta* have mentioned the properties of *Kovidara* and *Karbudara* in their *Samhitas* (Treatise). Both flower and bark of *Kanchnara* are used as medicine because of the presence of hentriacontane, octacosanol, β-sitasterol, stigmasterol, lupeol and amino acids. *Kanchanara* is one of the major ingredients of many important formulations used in Ayurveda system of medicine such as *Kanchanara guggulu, Kanchan gutika, Gulkand kanchanara and Kanchanaradi kwatha, Ushirasava, Chandanasava, Kanchanara drava*. In this review article, we discussed about synonyms, botanical description, phytochemicals, pharmacological activity and medicinal uses of Kachnar.

Keywords: *Bauhinia variegata*, Kachnar, flavonoids

Introduction

For humans, the most important necessities are food, clothes, shelter and good health. For good health, nature is full of remedies which help in curing various pathological disorders. From ancient time, herbs are being constantly used for the cure of various disorders as it has been observed that natural therapy is most efficacious than the synthetic one.

Bauhinia variegata is a small to medium-sized tree. It grows to a height of about 10-12 m and is deciduous. It is mostly grown in tropical region. The genus Bauhinia includes about 600 species including shrubs, trees and vines. It is generally planted as an ornamental plant. It grows throughout India and China. It is a reliable greenhouse species which grows at an altitude of 1800 m in Himalayas (Deswal et al., 2015). *Bauhinia variegata* belongs to family Leguminosae (Caesalpinioideae) is also called Mountain Ebony (English), Rakta kanchan (Marathi), Kachnar (Hindi). It is a medium-sized, deciduous tree found throughout India, at an altitude of 1800m in Himalayas. Leaves are broader, rigidly sub-coriaceous, deeply cordate with two leaflets, connate for about two-thirds up, leaflets are ovate, rounded at apex, 10-15cm long, pubescent beneath when young. Flowers are variously colored, lateral, sessile, stamens 5, staminodes absent, fruits flat; hard glabrous dehiscent pods, 10-15 seeded (Patil et al., 2012). The genus *Bauhinia* Linn. consists of shrubs or trees, distributed throughout the tropical regions of the world. In India, about 15 species of this genus are found. Bauhinias are mostly propagated from seeds. Tannins, fibre, gum and oil are procured from Bauhinia species which are useful in industries. The plants bear fragrant and beautiful flowers. They are grown as ornamental plants. *B tomentosa* Linn, *B racemosa* Lam, *B retusa* Roxb, *B purpurea* Linn, *B variegata* Linn and *B malabarica* Roxb. are widely used in the traditional systems of medicine(Mali et al., 2009).

Bauhinia variegata Linn. is traditionally used in bronchitis, leprosy, inflammation, bacterial infection, liver disorders, diarrhoea, dysentery, skin disease, leprosy, intestinal worms,

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Figure 1.(a) Leaves and flowers of *Bauhinia variegata* (b) Pods, flowers & leaves of *Bauhinia variegata*

wounds, ulcer, fungal infection, ulcers and tumors (Prashar et al., 2010; Yadava et al., 2003; Sinha et al., 2012). The stem bark is used as astringent, alliterative, antidiabetic, antitumor, tonic and anthelmintic, obesity and washing ulcers. (Ambasta, 1998; Ram et al., 1980; Rajkapoor et al., 2003; Rajkapoor et al., 2006; Sinha et al., 2012; Prashar et al., 2010). Infusion of the leaves is used as a laxative and for treating piles. Dried buds are used in the treatment of worms, tumors, diarrhea, dysentery and piles (Asima, 1992). *Bauhinia variegata* Linn. is also useful as antibacterial, antifungal, antiulcer, and hepatoprotective (Bodakhe et al., 2007). Its root has Flavanone glycoside which is responsible for its anti-inflammatory activity (Yadava et al., 2003). It is used in obesity, hyperphagia, hyperglycaemia and hyperlipidaemia (Prashar et al., 2010). The stem bark consists of 5, 7 dihydroxy and 5, 7 dimethoxy flavanone-4-O-L rhamnopyrosyl-D-glycopyranosides, Kaempferol-3-glucoside, lupeol, and betasitosterol. Seeds contain protein, fatty oil-containing oleic acid, linoleic acid, palmitic acid, and stearic acid. Flowers contain cyanidin, malvidin, peonidin, and kaempferol. Root contains flavanol glycosides (Rajani et al., 2009).

Taxonomic Classification

Kingdom	Plantae
Sub Division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Sub Class	Rosidae
Order	Fabales
Family	Caesalpiniaceae
Genus	*Bauhinia*
Species	*Variegata*

Common names

Various common names of *Bauhinia variegata* are: Phalgu in Sanskrit; kachnar in hindi; Adavimandaramu, Devakanchanamu in telugu; Kattaki, Kanjani in tamil; Kachan, Borada, Kosonara in odia; Chuvannamandaram, Mandaramu in Malayalam; Kanchanal, Kovidara, Kolar in Punjabi; Kanchavala, Bilimandar in kannada; Kanchnal, Bwechin in urdu; Kanchana, Raktakancana in Marathi; Kalad in kashmiri; Champakati, Kanchnar in gujarati; Kanchana in Bengali; Kancan, Kanchan, Shonapushpaka in assamese; Mountain ebony, Orchid tree, Poor man's orchid, Camel's foot in English (Sudheerkumar et al., 2015).

Synonyms

Kanakarak, kantar, kanchnar, kanchana, kanthapushpa. Common names are Mountain ebony, kachnar, kanchan, kulada (Chandra et al., 2007).

Habitat

Bauhinia variegata is widely distributed in tropical regions and found throughout India especially in Punjab, central and south India. It is widely found in sub Himalayan tract and outer Himalaya's up to an altitude of 1300 meters. It is also found in China (Sudheerkumar et al., 2015).

List of *Bauhinia variegata* species

Bauhinia is a large genus under which about 250 species are present. *Bauhinia variegata* is also known as Butterfly tree as its leaves are in the shape of "butterfly" which is common to many Bauhinia species. The genus was named after Bauhin brothers, Swiss-French botanists. The leaves share the double-leaf configuration of a heart, or more popularly, that of a butterfly. *Bauhinia blakeana* is the Hongkong orchid tree which is named after British Governors of Hongkong, Sir Henry Blake, 1898-1903 and is now the floral emblem of Hongkong. It is named "Orchid tree" as the flower looks like an orchid. It is usually sterile and is considered as the hybrid origin between *Bauhinia variegata* and *Bauhinia purpurea*. In Bauhinia about 15 species occur in India like *Bauhinia variegata, Bauhinia purpurea, Bauhinia acuminate, Bauhinia blakeana, Bauhinia corymbosa, Bauhinia galpinii, Bauhinia monandra, Bauhinia tomentosa, Bauhinia malabarica.*

The accepted species are:

1. *Bauhinia accrescens* Killip and J.F.Macbr.
2. *Bauhinia acreana* Harms
3. *Bauhinia aculeata* L.
4. *Bauhinia aculeata* subsp. Grandifolia Wunderlin
5. *Bauhinia acuminata* L.
6. *Bauhinia acuruana* Moric.
7. *Bauhinia aherniana* Perkins
8. *Bauhinia aherniana* var. subglabra K. and SS. Larsen
9. *Bauhinia alata* Ducke
10. *Bauhinia altiscandens* Ducke
11. *Bauhinia amambayensis* Fortunato
12. *Bauhinia ampla* Span.
13. *Bauhinia ampla* schlechteri K. Larsen and Sunarno
14. *Bauhinia anamesa* J.F.Macbr.

15. *Bauhinia anatomica* Link
16. *Bauhinia andersonii* K. Larsen and S.S.Larsen
17. *Bauhinia anrdrieuxii* Hemsl.
18. *Bauhinia angulicaulis* Harms
19. *Bauhinia angulosa* Vogel
20. *Bauhinia angulosa* var. meridionalis Vaz.
21. *Bauhinia ankarafantsikae* Du Puy and R. Rabev
22. *Bauhinia anomala* Hassl.
23. *Bauhinia apertilobata* Merr. and F.P.Metcalf
24. *Bauhinia argentinensis* Burkart
25. *Bauhinia argentinensis* var. megasiphon Fortunato
26. *Bauhinia armatta* otto
27. *Bauhinia aromatic* Ducke
28. *Bauhinia augustii* Harms
29. *Bauhinia aurantiata* Bojer
30. *Bauhinia aurea* H.Lev.
31. *Bauhinia aureifolia* K. Larsen and S.S.Larsen
32. *Bauhinia aureopunctata* Ducke
33. *Bauhinia baina* J.F.Macbr.
34. *Bauhinia bartletti* B.L.Turner
35. *Bauhinia bassacensis* Gagnep.
36. *Bauhinia bauhinioides* J.F.Macbr.
37. *Bauhinia begunotti* Cufod.
38. *Bauhinia begunotti* var. gorgonae Wunderlin
39. *Bauhinia bicolor* D. Dietr.
40. *Bauhinia bidentata* Jack
41. *Bauhinia bidentata* subsp. bicornuta K. Larsen and S.S.Larsen
42. *Bauhinia bidentata* var. breviflora K. Larsen and S.S.Larsen
43. *Bauhinia binata* Blanco
44. *Bauhinia blakeana* Dunn
45. *Bauhinia bohniana* L.Chen.
46. *Bauhinia bombaciflora* Ducke
47. *Bauhinia bowkeri* Harv.
48. *Bauhinia brachycalyx* Ducke
49. *Bauhinia brachycarpa* Benth
50. *Bauhinia bracteata* Baker
51. *Bauhinia brasiliensis* Vogel
52. *Bauhinia bravicalyx* Du. Puy and R.Rabev
53. *Bauhinia brevipedicellata* Jarvie
54. *Bauhinia brevipes* Vogel
55. *Bauhinia burbidgei* Stapf
56. *Bauhinia burchellii* Benth
57. *Bauhinia buscalionii Mattei*
58. *Bauhinia calciphila* D.X. Zhang and T.C. Chen
59. *Bauhinia calliandroides* Rusby
60. *Bauhinia caloneura* Malme
61. *Bauhinia calycina* Gagnep
62. *Bauhinia campanulata* S.S.Larsen
63. *Bauhinia campestris* Malme
64. *Bauhinia candelabriformis* Cowan
65. *Bauhinia capuronii* Du. Puy and R.Rabev
66. *Bauhinia carcinophylla* Merr.
67. *Bauhinia cardinalis Gagnep*
68 *Bauhinia carronii* F.Muell.
69 *Bauhinia carvalhoi* Vaz
70 *Bauhinia cataholo* Hoehne
71 *Bauhinia catingae* Harms
72 *Bauhinia cercidifolia* D.X. Zhang
73 *Bauhinia chalcophylla* L.Chen
74 *Bauhinia chalkos* Cowan
75 *Bauhinia championii* (Benth.) Benth.
76 *Bauhinia chapadensis* Malme
77 *Bauhinia chapulhuacania* Wunderlin
78 *Bauhinia cheilantha* (Bong.) Steud.
79 *Bauhinia cinnamomea* DC.
80 *Bauhinia claviflora* L.Chen
81 *Bauhinia clemensiorum* Merr.
82 *Bauhinia damiaoshanensis* T.Chen
83 *Bauhinia decandra* Du Puy & R.Rabev.
84 *Bauhinia delavayi* Franch.
85 *Bauhinia didyma* L.Chen
86 *Bauhinia dipetala* Hemsl.
87 *Bauhinia diphylla* Buch.-Ham.
88 *Bauhinia eilertsii* Pulle
89 *Bauhinia ellenbeckii* Harms
90 *Bauhinia elongipes* R.S. Cowan
91 *Bauhinia erythrocalyx* Wunderlin
92 *Bauhinia exellii* Torre & Hillc.
93 *Bauhinia fabrilis* (de Wit) K. & S.S.Larsen
94 *Bauhinia farek* Desv.
95 *Bauhinia ferruginea* Roxb.
96 *Bauhinia finlaysoniana* (Benth.) Baker
97 *Bauhinia flagelliflora* Wunderlin
98 *Bauhinia foveolata* Dalzell
99 *Bauhinia fulva* Korth.
100 *Bauhinia galpinii* N.E.Br.
101 *Bauhinia geminata* Vogel
102 *Bauhinia gilva* (Bailey) Govaerts
103 *Bauhinia glabra* Jacq.
104 *Bauhinia glabrifolia* (Benth.) Baker
105 *Bauhinia glauca* (Benth.) Benth.
106 *Bauhinia guianensis* Aubl.
107 *Bauhinia hagenbeckii* Harms
108 *Bauhinia harmsiana* Hosseus
109 *Bauhinia haughtii* Wunderlin
110 *Bauhinia havilandii* Merr.
111 *Bauhinia hiemalis* Malme
112 *Bauhinia hookeri* F.Muell.

113 *Bauhinia integerrima* Benth.
114 *Bauhinia integrifolia* subsp. *cumingiana* (Benth.) K.Larsen & S. S. Larsen
115 *Bauhinia involucellata* Kurz
116 *Bauhinia involucrans* Gagnep.
117 *Bauhinia japonica* Maxim.
118 *Bauhinia jenningsii* P.Wilson
119 *Bauhinia jucunda* Brandegee
120 *Bauhinia kalantha* Harms
121 *Bauhinia khasiana* Baker
122 *Bauhinia kingii* Prain
123 *Bauhinia kleiniana* Burkart
124 *Bauhinia krugii* Urb.
125 *Bauhinia kunthiana* Vogel
126 *Bauhinia lambiana* Baker f.
127 *Bauhinia lamprophylla* Harms
128 *Bauhinia leiopetala* Benth.
129 *Bauhinia leptantha* Malme
130 *Bauhinia lingua* DC.
131 *Bauhinia loeseneriana* Harms
132 *Bauhinia longiseta* Ducke
133 *Bauhinia lorantha* Gagnep.
134 *Bauhinia macranthera* Hemsl.
135 *Bauhinia macrophylla* Poir.
136 *Bauhinia madagascariensis* Desv.
137 *Bauhinia malabarica* Roxb.
138 *Bauhinia malacotricha* Harms
139 *Bauhinia malacotrichoides* Cowan
140 *Bauhinia marginata* D.Dietr.
141 *Bauhinia maximilianii* Benth.
142 *Bauhinia meeboldii* Craib
143 *Bauhinia melastomatoidea* R. Torres
144 *Bauhinia membranacea* Benth.
145 *Bauhinia merrilliana* Perkins
146 *Bauhinia miriamae* R. Torres
147 *Bauhinia mollis* (Bong.) D.Dietr.
148 *Bauhinia mombassae* Vatke
149 *Bauhinia monandra* Kurz
150 *Bauhinia multinervia* (Kunth) DC.
151 *Bauhinia natalensis* Hook.
152 *Bauhinia nervosa* (Benth.) Baker
153 *Bauhinia nitida* Benth.
154 *Bauhinia obtusata* Vogel
155 *Bauhinia ombrophila* Du Puy & R.Rabev.
156 *Bauhinia ornata* Kurz
157 *Bauhinia ovata* Vogel
158 *Bauhinia ovatifolia* T.Chen
159 *Bauhinia oxysepala* Gagnep.
160 *Bauhinia pachyphylla* Merr.
161 *Bauhinia pansamalana* Donn.Sm.
162 *Bauhinia pauciflora* Merr.
163 *Bauhinia paucinervata* T.Chen
164 *Bauhinia pauletia* Pers.
165 *Bauhinia penicilliloba* Gagnep.
166 *Bauhinia pervilleana* Baill.
167 *Bauhinia pes-caprae* Cav.
168 *Bauhinia petersiana* Bolle
169 *Bauhinia petiolata* (DC.) Hook.
170 *Bauhinia phoenicea* Wight & Arn.
171 *Bauhinia picta* (Kunth) DC.
172 *Bauhinia pinheiroi* Wunderlin
173 *Bauhinia platycalyx* Benth.
174 *Bauhinia platypetala* Benth.
175 *Bauhinia podopetala* Baker
176 *Bauhinia poiteauana* Vogel
177 *Bauhinia posthumi* (de Wit) Cusset
178 *Bauhinia pottingeri* Prain
179 *Bauhinia pottsii* G.Don
180 *Bauhinia praesignis* Ridl.
181 *Bauhinia prainiana* Craib
182 *Bauhinia pterocalyx* Ducke
183 *Bauhinia pulchella* Benth.
184 *Bauhinia pulla* Craib
185 *Bauhinia purpurea* L.
186 *Bauhinia pyrrhoclada* Drake
187 *Bauhinia pyrrhoneura* Korth.
188 *Bauhinia quinanensis* T.Chen
189 *Bauhinia racemosa* Lam.
190 *Bauhinia radiata* Vell.
191 *Bauhinia rahmatii* Merr.
192 *Bauhinia ramirezii* Reynoso
193 *Bauhinia ramosissima* Hemsl.
194 *Bauhinia reflexa* Schery
195 *Bauhinia reticulata* DC.
196 *Bauhinia rhodacantha* Desv.
197 *Bauhinia richardiana* DC.
198 *Bauhinia ridleyi* Prain
199 *Bauhinia riedeliana* Bong.
200 *Bauhinia roxburghiana* Voigt
201 *Bauhinia rufa* (Bong.) Steud.
202 *Bauhinia rufescens* Lam.
203 *Bauhinia rusbyi* Britton
204 *Bauhinia rutenbergiana* Vatke
205 *Bauhinia rutilans* Benth.
206 *Bauhinia saccocalyx* Pierre
207 *Bauhinia saigonensis* Gagnep.
208 *Bauhinia scala-simiae* Sandwith
209 *Bauhinia scandens* L.
210 *Bauhinia seleriana* Harms
211 *Bauhinia semibifida* Roxb.
212 *Bauhinia seminarioi* Eggers
213 *Bauhinia semla* Wunderlin
214 *Bauhinia sessilifolia* (DC.) Quinones
215 *Bauhinia similis* Craib
216 *Bauhinia siqueiraei* Ducke
217 *Bauhinia smilacifolia* Benth.
218 *Bauhinia smilacina* (Schott) Steud.
219 *Bauhinia somalensis* Pic.Serm. & Roti Mich.
220 *Bauhinia sprucei* Benth.
221 *Bauhinia steenisii* K.Larsen & S.S.Larsen
222 *Bauhinia stenantha* Diels
223 *Bauhinia stenocardia* Standl.
224 *Bauhinia stenopetala* Ducke
225 *Bauhinia stipularis* Korth.
226 *Bauhinia strychnifolia* Craib
227 *Bauhinia strychnoidea* Prain
228 *Bauhinia subclavata* Benth.
229 *Bauhinia subrotundifolia* Cav.
230 *Bauhinia surinamensis* Amshoff
231 *Bauhinia sylvani* (de Wit) Cusset
232 *Bauhinia taitensis* Taub.
233 *Bauhinia tarapotensis* Benth.
234 *Bauhinia tenella* Benth.
235 *Bauhinia tessmannii* Harms
236 *Bauhinia thonningii* Schum.
237 *Bauhinia tomentosa* L.
238 *Bauhinia tortuosa* Collett & Hemsl.

239 *Bauhinia touranensis* Gagnep.
240 *Bauhinia tubicalyx* Craib
241 *Bauhinia tumupasensis* Rusby
242 *Bauhinia uleana* Harms
243 *Bauhinia ungulata* L.
244 *Bauhinia urbaniana* Schinz
245 *Bauhinia urocalyx* Harms
246 *Bauhinia uruguayensis* Benth.
247 *Bauhinia vahlii* Wight & Arn.
248 *Bauhinia variegata* L.
249 *Bauhinia variegata* var. *candida* Voigt
250 *Bauhinia venustula* T.Chen
251 *Bauhinia verrucosa* Vogel
252 *Bauhinia vespertilio* S.Moore
253 *Bauhinia vestita* (Benth.) J.F.Macbr.
254 *Bauhinia viorna* J.F.Macbr.
255 *Bauhinia viridescens* Desv.
256 *Bauhinia viridescens* var. *laui* (Merr.) T.Chen
257 *Bauhinia viscidula* Harms
258 *Bauhinia vulpina* Rusby
259 *Bauhinia wallichii* J.F.Macbr.
260 *Bauhinia weberbaueri* Harms
261 *Bauhinia williamsii* F.Muell.
262 *Bauhinia winitii* Craib
263 *Bauhinia wrayi* Prain
264 *Bauhinia wunderlinii* R. Torres
265 *Bauhinia wuzhengyii* S. S. Larsen
266 *Bauhinia xerophyta* Du Puy & R.Rabev.
267 *Bauhinia yunnanensis* Franch.

Historical aspect

Vedic Period

- During vedic and samhita period, Kanchanara was originally named as Kovidara.
- Literatures of kodivara flowers are observed in ayodhyakanda, sundara kanda, yuddakanda of Valmiki Ramayana of the Rig Veda.
- In Varivamsa kodivara, *Bauhinia variegata* is described as a tree with beautiful flowers.
- Vedic literature considers it is a stem as forbidden for rituals.

Charaka samhita

- Kodivara was mentioned in vamanapoga desaimani, in sutrastana.
- Kodivara is also mentioned in samhitas and chakrapani. It was quoted that kodivara flowering occurs in sarat rutu.

Susruta samhita

- Kodivara was mentioned in kashaya varga and urdwa bhagaharangana.
- Kodivara leaves are used in raktapitta chikitsa.
- In kalpastana, devakanchanara was mentioned for sarpa visha chikitsa. He also prescribed kodivara flowers for internal hemorrhage.
- Dalhana treated karbudhara as a variety of kanchanara or slesmataka.
- Leaves and flowers of Karbudhara i.e. kanchanara and kodivara are used as vegetables.

Astanga hrudaya

- Root powder of kovidara was used for arsha chikitsa.
- Rectal prolapsed was treated by Kovidara picchabasti.
- The decoction of kovidara flowers was utilized for the treatment of fever, anorexia, goiter, malignant tumors and enlargement of abdomen.

Sarangadara samhita

- Kanchanara guggulu was indicated for treating diseases like apachi, grandhi, gulma, kushta.

Nigantu period

- Dhanvantari nigantu, raja nigantu, bhavaprakasa nigantu, kaiyadeva nigantu illustrated in detail about the guna karmas of kanchanara.

Dhanvantari nigantu

- Svetapushpa was said as kanchanara and rakta pushpa as kovidara.

Bhavaprakasa nigantu

- Bhavamisra has described this in guduchyadivarga and described kanchanara and kovidara.

Modern period

- Kanchanara is found in many books of this period. Botanists studied the chemical nature of the various compounds present in the drug.
- Ayurveda acharya of 20th century Yadavji, Trikamji, Viswanath Dwivedi, Priyavarat Sharma etc. has discussed this drug in various books.
- In modern days, kanchanara is not only used for therapeutic purposes, but also for various domestic purposes.
- Ayurveda, allopathic, unani, siddha systems of medicine are using either the raw drug or its extracts for various therapeutic purposes.

History speaks for kanchanara as a drug with good medicinal value (Duvvuru, 2013).

Bauhinia is small evergreen medicinal tree consisting of 300 species which are cultivated all over the world in the tropical regions. The trees are cultivated in plain and sub-mountainous tracks in Pakistan. *Bauhinia* has been widely planted in garden, park as ornamental plant. Leaves were used as fodder for sheep, goats and cattle. In the native countries, the mature seeds and young pods of *Bauhinia* are eaten, cooked and pickled. The extract of *Bauhinia* leaves are utilized due to their anti-inflammatory, antifungal, antipyretic, analgesic, antispasmodic, antitumor and antimicrobial properties. The stems, roots and leaves are also useful for the cure of pain, diabetes, infections, ulcer, jaundice, leprosy (Arain et al., 2012).

According to ayurvedic literature, *Bauhinia variegata* is named as Kanchnar, Gandari, Yugmapatra and Karbudara. It has been reported that *Bauhinia variegata* posseses Kasaya rasa, Ruksha guna, Shita virya and Katu vipaka. Krimiroga (worm infestation), gandamala (scrofula), apaci (cervical lymphadenitis) and vrana (wounds) can be cured by using stem bark of *Bauhinia variegata* (Ayurvedic Pharmacopoeia, 1990; Kapoor, 2007). The powder of bark of *Bauhinia variegata* has been used in combination with other drugs by ayuredic practitioners for the cure of many disorders. It is used for the treatment of gynaecological conditions in combination with myrrh (*Commiphora molmol* Engler), turmeric (*Curcuma domestica* Linn.) and ashoka (*Saraca indica* Linn.). It is used for the treatment of lymphatic swelling in combination with guggulu (*Commiphora weightii* Linn.), punarnava (*Boerhaavia diffusa* Linn.) and triphala (equal parts of *Terminalia belerica* Linn., *Terminalia chebula* Retz. and *Emblica officinalis* Gaerth). It is used for the treatment of osteoporosis in combination with ashwagandha (Withania somnifera (Linn.) Dunal), bakuchi (*Mimusops elengi* Linn.), ginger (*Zingiber officinale* Roscoe.) and guggulu. Diarrhoea is treated in combination with kutki (*Picrorrhiza kurroa* Linn.) and bibhitaki (*Terminalia belerica* Linn.) (Sebastian, 2006).

Cultivation and collection

Bauhinia variegata can be naturally propagated through the seeds when provided with favorable conditions, whereas artificial propagation is carried out by stump planting i.e. direct sowing of seeds. Branch cuttings normally root with difficulty, but these root well in August, November and February with the application of auxins. Direct sowing can be done in lines, spaced about 3 m apart. Germination starts in about a week after the onset of monsoon rains ensuring good soaking of soil. The entire plants have to be transplanted with the ball of soil. For planting out in July-August, previous year's seeds are sowed in March-April (Mali et al., 2009).

The ornamental plant is propagated with seeds, stem planting and branch cutting. Seeds are sown in March-April. The seedlings are then transplanted in July-August. Their germination takes place on the onset of monsoon. In vitro regeneration of *Bauhinia variegata* was observed in nodal explants from mature trees. Optimal shooting was obtained on media supplemented with 13.3 micrometre IBA within 15-20 days. Single shoots with 3-4 nodes initiates rooting when transferred to MS medium with 4.9 micrometre IBA within 45 days (Chandra et al., 2007).

Flowers: vasantha rutu.

Flowering: February-april.

Fruiting: May-june (Chandra et al., 2007).

DOSAGE

Twakchurnam- 4 grams

Pushpachurnam- 2 grams

Decoction- 50-100 ml (Chandra et al., 2007).

Stem bark powder- 3-6 grams

Decoction- 40-80 ml

Flower juice- 10-20 ml

Flower juice for decoction- 20-30 ml (Chandra et al., 2007).

Kanchanara guggulu- ½ Tula (Khare, 2007).

Bark powder- 2-4 masha.

Pushppa powder- 1-2 masha (Kumar, 2013).

Plant description and distribution

Bauhinia variegata is widely distributed throughout India especially in areas about 1800 meters altitude. It is also distributed throughout tropical regions of the world (Sudheerkumar et al., 2015). *Bauhinia variegata* is known as Mountain Ebony in English. In Sanskrit the word Kanchnar stands “A glowing beautiful lady”. A freshly collected bark of the plant is greyish brown externally and cream colored internally. Its internal surface slowly turns red and on drying becomes brown and smooth. The external surface remains greyish brown and rough due to large number of exfoliations, transverse cracks and fissures. The bark becomes curved and channeled on drying. Leaves are 10-15 cm in length, rigidly subcoriaceous and deeply cordate. The flowers are bisexual, irregular and light magenta in color. The pods are long, hard, flat, and dehiscent and 10-15 seeded. The various parts of the plant viz., flower buds, flowers, stem, stem bark, leaves, seeds and roots are used in the formulation of medicine and in curing a variety of diseases (Mali et al., 2009). Kachnar is a flowering plant that grows well in parts of Southeast Asia and is native to India, Pakistan, Nepal, Burma and Sri

Lanka. It is cultivated as an ornamental tree and famous for its scented flowers. Kachnar is crucial part of cuisine in several Nepali, Pakistani and Indian dishes (Sayago et al., 2013). The tree is found in Sub Himalayan tract from the Indus eastward and throughout the forests of India and Burma. It is also grown for its scented flowers and also used as food item in South Asian cuisine (Tewari et al., 2015).

Botanical description

Bark-The bark is light brownish grey, smooth to slightly fissured and scaly. Inner bark is pinkish, fibrous and bitter. The twigs are slender, zigzag; when young, light green, slightly hairy, and angled, becoming brownish grey.

Leaves-Leaves have minute stipules 1-2 mm, early caducous; petiole puberulous to glabrous, 3-4 cm; lamina broadly ovate to circular, often broader than long, 6-16 cm diameter; 11-13 nerved; tips of lobes broadly rounded, base cordate; upper surface glabrous, lower glaucous but glabrous when fully grown.

Flower-Flower clusters (racemes) are unbranched at ends of twigs. The few flowers have short, stout stalks and a stalk-like, green, narrow basal tube (hypanthium). The light green, fairly hairy calyx forms a pointed 5- angled bud and splits open on 1 side, remaining attached; petals 5, slightly unequal, wavy margined and narrowed to the base; 5 curved stamens; very slender, stalked, curved pistil, with narrow, green, 1-celled ovary, style and dot like stigma.

Seeds- Pods dehiscent, strap-shaped, obliquely striate, 20-30 by 2-25 cm; long, hard, flat with 10-15 seeds in each; seeds brown, flat, nearly circular with coriaceus testa (Deswal et al., 2015).

A study was conducted in which the buds and flowers of kachnar were dehydrated. The buds and flowers were divided into two parts. One part was dipped in 2% potassium metabisulphite solution overnight and the other part was blanched for 2-3 minutes. The treated buds and flowers were dried in tray drier at 50°C, 55°C and 60°C; in solar drier and sun until a uniform weight was obtained. It was concluded that samples dried at 60°C took minimum time for drying and were low in moisture content. The samples which were blanched had high moisture content in comparison to the sulphur treated samples and they took more time to dry. It was also reported that the sulphur treated *Kachnar* samples which were dried at 50°C in tray drier rehydrated much better than others whereas, the rehydration of blanched samples dried at other temperatures was comparatively lower. The drying of *Kachnar* ensures its better availability and utilization throughout the year (Verma et al., 2010). *Bauhinia variegata* bark has been studied for dyeing of fabrics like silk. Silk is popular due to its luster, durability and dye capability and it renders colour in a different way. Now-a-days there is a trend of using natural dyes due to many merits. The silk fabric was degummed before dying in order to remove the impurities. The fabric was dried and then treated with maganesium chloride, ferrous sulphate, pomegranate and arjun. The dyed samples were analyzed for their colour fastness against washing, rubbing, perspiration and sunlight. *Kachnar* dye gave a colour series of pinkish brown colour on silk using different mordants and mordanting methods with varying concentration levels. It was reported that fastness properties enhanced after post mordanting method and colour adherence to fabric was good. It was concluded that the Kachnar dyed silk samples mordanted with different mordants when evaluated visually showed improvement in appearance over the control sample (Yadav et al., 2014).

Chemical constituents (Bansal et al., 2014)

Flavonoids like flavanone, 5, 7-dimethoxy-30, 40-methylenedioxyflavanone and a new dihydrodibenzoxepin, 5, 6-dihydro-1, 7-dihydroxy-3, 4-dimethoxy-methyldibenz oxepin were reported to be present in the roots of *Bauhinia variegata* (Reddy et al., 2003). The novel flavonol glycoside 5, 7, 3', 4'- tetrahydroxy-3-methoxy-7-O-alpharhamnopyranosyl (1-->3) - O-beta-galactopyranoside were obtained from the roots of *Bauhinia variegata*. Triterpene saponin was isolated from the *Bauhinia variegata Linn.* leaves which was responsible for the anti-inflammatory and antinociceptive activities (Mohamed et al., 2009). A phenanthraquinone, named bauhinione has been isolated from *Bauhinia variegata* (Zhao et al., 2005).

Roots: The root bark constitutes (2S)-5, 7-dimethoxy-3', 4'-methylenedioxy flavanone and 5,6-dihydro-1,7-dihydroxy-3,4-dimethoxy-2-methyldibenzoxepin;5,7,3',4'-tetrahydroxy-3-methoxy-7-O- -L-rhamnopyranosyl (1 3)-O- -D-glucopyranoside. Hentriacontane, 5,7,3',4'-tetrahydroxy-3-methoxy-7-O- -L-rhamno pyranosyl (13)-O-galactopyranoside5,6-dihydro-1,7-dihydroxy-3,4-dimethoxy-2-Methyldibenzoxepins(2S)-5,7-dimethoxy-3',4'-methylenedioxyflavanone, flavanone (2S)-5,7-dimethoxy- 3',4'-methylenedioxyflavanone and a new dihydrodibenzoxepin, '5-hydroxy7,3',4',5'-tetra-methoxyflavone5-O-beta-Dxylopyranosyl-(1-2)-alpha-L-rhamnopyranoside. Bauhinione, a new phenanthraquinone was isolated from *Bauhinia variegata* and its structure was 2, 7-dimethoxy-3-methyl-9, 10- dihydrophenanthrene-1, 4-dione analyzed by the spectroscopic analysis (Patil et al., 2010). The qualitative chemical test of *Bauhinia variegata* root powder showed the presence of carbohydrates, glycosides, flavonoids, tannins, phenolic compounds, proteins, gums and mucilages (Deswal et al., 2015; Patil et al., 2010).

Stems: The stem bark constitutes hentriacontane, octacosanol and stigmasterol; 5, 7-dihydroxyflavanone-4'-O--L-rhamnopyranosyl--D-glucopyranoside; -sitosterol, lupeol and kaempferol-3-glucoside; 2, 7-dimethoxy-3-

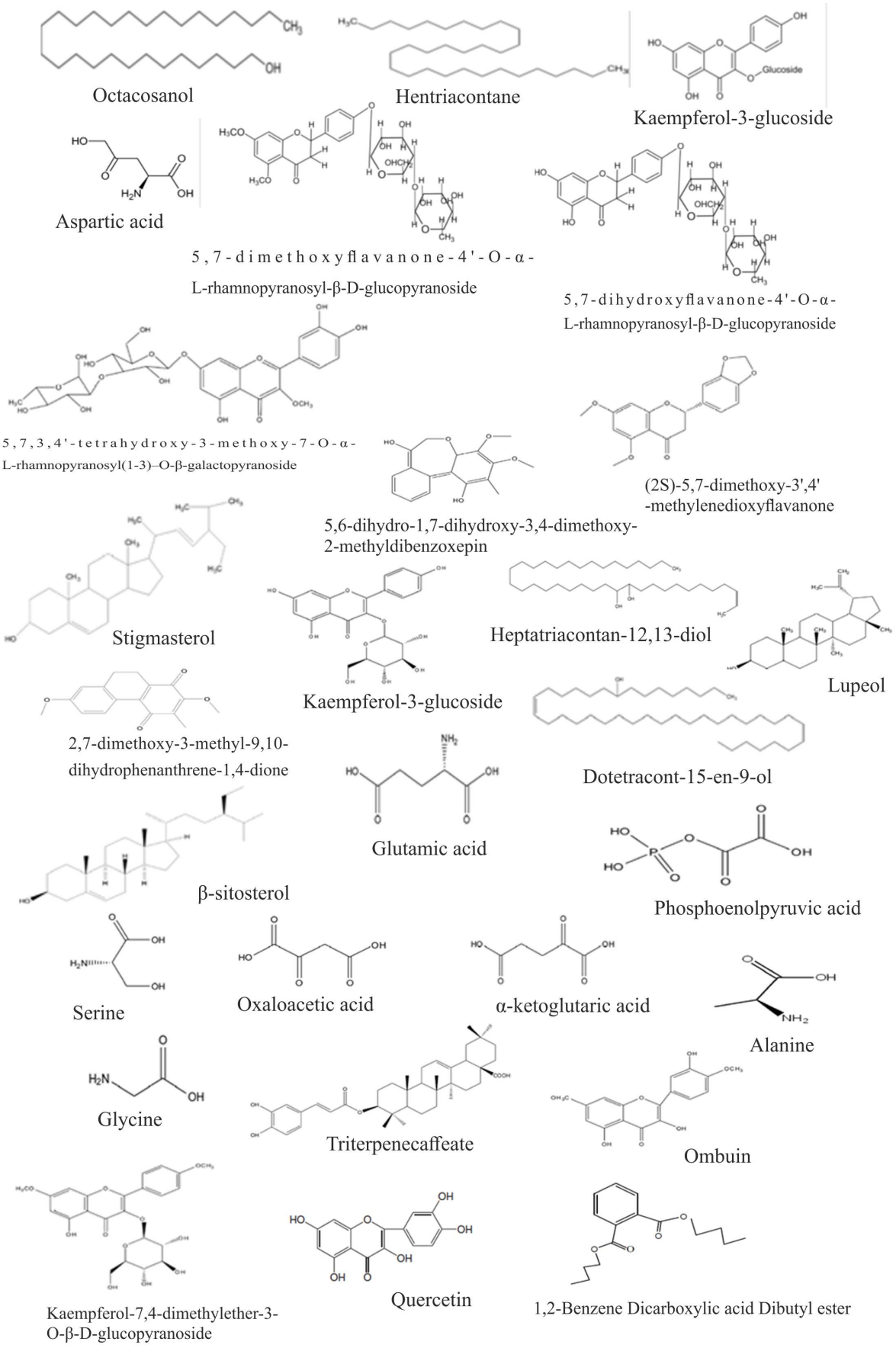

Figure 2. Chemical constituents of *Bauhinia variegata*

methyl-9, 10-dihydro phenanthrene-1, 4-dione on the basis of spectroscopic analysis. It also shows the presence of glycosides, reducing sugars, nitrogenous substances. The stem bark of *Bauhinia variegata* was reported to be composed of tannins which are responsible for the immunomodulatory activity (Patil et al., 2010).

Leaves: Leaves consisted of heptatriacontan-12,13-diol and dotetracont-15-en-9-ol. The phytoconstituents of leaves of *Bauhinia variegata* leaves are tannins, alkaloids, cardiac glycosides, flavanoids i.e quercetin, rutin, quercetin, apigenin and apigenin 7-O-glucoside. *Bauhinia variegata* has similar composition, with germacrene D, spathulenol, δ-cadinine (Deswal et al., 2015).

Buds: Buds consist of alanine, aspartic acid, glycine, serine, glutamic acid, phosphoenolpyruvic acid, oxaloacetic acid and ketoglutaric acid (Bansal et al., 2014).

Flowers: Quercitroside. Isoquercitroside, rutoside, taxifoline rhamnoside, kaempferol-3-glucoside, myricetol glycoside, apigenin-7-O-glucoside, quercetin, rutin, quercetrin, apigenin, ascorbic, aspartic, glutamic, octadecanoic acid, keto acids, amino acid, tannins, cyaniding-3-glucoside, malvidin-3-glucoside, malvidin-3-diglucoside, peonidin-3-glucoside, peonidin-3-diglucoside, 3-galactoside and 3-rhamnoglucoside of kaempferol.

Seed: 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, valine, 5-hydroxy7,3',4',5'-tetra-methoxyflavone-5-O-beta-D-xylopyranosyl-(l~->2)-alpha-L-rhamnopyranoside (Tewari et al., 2003). The seeds yield fatty oil containing linolinic acid, oleic, steric, palmitic and myristic acid (Deswal et al., 2015).

Bark: The bark yields fibre and tannins. Seven flavonoids, namely kaempferol, ombuin, kaempferol-7,4′-dimethyl-ether-3-O-β-D-glucopyranoside, kaempferol-3-O-β-D-glucopyranoside, isorhamnetin-3-O-β-Dglucopyranoside and hesperidin, together with one triterpene caffeate, 3β-trans-(3,4-dihydro xycinnamoyloxy) olean-12-en-28-oic acid were isolated from the non-woody aerial parts of *Bauhinia variegata*. Phytochemical analysis of the root bark of *Bauhinia variegata* Linn yielded a new flavanone, (2S)-5,7-dimethoxy-30,40-methylenedioxyflavanone and a new dihydrodibenzoxepin, 5,6-dihydro-1,7-dihydroxy-3,4-dimethoxy-2-methyldibenz[b,f]oxepin together with three known flavonoids. The structures of the new compounds were determined on the basis of spectral studies (Deswal et al., 2015).

Medicinal uses

In Ayurvedic literature *Bauhinia variegata* is known by Kanchnar, Gandari, Yugmapatra and Karbudara. The plant is full of Kasaya rasa, Ruksha guna, Shita virya and Katu vipaka. The stem bark of *Bauhinia variegata* is utilised in the cure of krimiroga (worm infestation), gandamala (scrofula), apaci (cervical lymphadenitis) and vrana (wounds). The bark powder of *Bauhinia variegata* can be used in combination with myrrh (*Commiphora molmol* Engler), turmeric (*Curcuma domestica* Linn.) and ashoka (*Saraca indica* Linn.) to treat gynaecological conditions. It is administered in combination with guggulu (*Commiphora weightii* Linn.), punarnava (*Boerhaavia diffusa* Linn.) and triphala (equal parts of *Terminalia belerica* Linn., *Terminalia chebula* Retz. and *Emblica officinalis* Gaerth) for the treatment of lymphatic swelling. *Bauhinia variegata* is administered with ashwagandha (*Withania somnifera* (Linn.) Dunal), bakuchi (*Mimusops elengi* Linn.), ginger (*Zingiber officinale* Roscoe.) and guggulu for the treatment of osteoporosis. *Bauhinia variegata* can be used in combination with kutki (*Picrorrhiza kurroa* Linn.) and bibhitaki (*Terminalia belerica* Linn.) for treating diarrhoea.

In Unani system of medicine, bark is used as astringent to the bowels and tonic to the liver. It is reported to be useful in treatment of leucoderma, leprosy, menorrhagia, asthma, wounds and ulcers. The flower buds are useful in the treatment of piles, cough, eye diseases, and liver complaints and as styptic in haematuria and menorrhagia (Mali et al., 2009).

Bauhinia variegata is widely used in as an antidiabetic agent, because insulin-like protein was present in its leaves (Azevedo et al., 2006). A new lectin from seeds of the *Bauhinia variegata* candida was obtained which showed hemagglutination activity of BvcL (Silva et al., 2007). The plant was proved to have antitumour activity in Dalton's ascitic lymphoma**,** N-nitrosodiethylamine-induced liver tumors and human cancer cell lines. It also possess the anti-inflammatory activity due to flavonol glycoside 5,7,3',4'-tetrahydroxy-3-methoxy-7-O-alpha-l-rhamnopyranosyl(1-->3)-O-beta-galactopyranoside (Patil et al., 2015).

Bauhinia variegata is also useful in the preparation of ayurvedic medicines for diarrhoea, dysentery, goitre, lymphadenitis, worm infestation, rectal prolapse and as depurative (blood purifier). It also enhances the detoxifying function of liver. This plant also possesses antimicrobial, anti-inflammatory, analgesic, cytotoxic, antiobesity and nephroprotective effect (Manoj et al., 2013). Root decoction is administered for reducing corpulence (Tomar et al., 2009). The bark, leaves and flowers of *Bauhinia variegata* is useful in the cure of gall bladder, kidney stones and piles (Singh et al., 2013).

Pharmacological Activities

Antipathogenic activity

Bauhinia variegata is widely distributed throughout India especially in areas about 1800 meters altitude (Sudheerkumar et al., 2015). *Bauhinia variegata* Linn. is traditionally used in bronchitis, leprosy, inflammation, bacterial infection, liver disorders, diarrhoea, dysentery, skin disease, leprosy, intestinal worms, wounds, ulcer, fungal infection, ulcers and tumors (Prashar et al., 2010; Yadava et al., 2003; Sinha et al., 2012). The aqueous extract of leaves from *Bauhinia variegata* was used in barley plant to protect against *Bipolaris sorokiniana*. The result of research work lead to conclusion that Barley plants pretreated with an extract from *Bauhinia variegata* and later challenged with conidia from *Bipolaris sorokiniana*, demonstrated protection against the pathogen that correlated with increased PAL and β-1, 3-glucanase enzyme activities and the presence of coumaric acid (Bach et al., 2012).

Anthelmintic Activity

The stem bark of *Bauhinia variegata* is used as astringent, alliterative, antidiabetic, antitumor, tonic and anthelmintic, obesity and washing ulcers (Ambasta, 1998; Ram et al., 1980; Rajkapoor et al., 2003; Rajkapoor et al., 2006; Sinha et al., 2012; Prashar et al., 2010). Synergistic anthelmintic activity of panchagavya was reported with ethanolic extract of *Bauhinia variegata* Linn (EEBV). The presence of PG could potentiate binding of free protein in GIT of host animal and causes death (Kumar et al., 2014).

Antioxidant and DNA protective activity

Infusion of the leaves is used as a laxative and for treating piles. Dried buds are used in the treatment of worms, tumors, diarrhea, dysentery and piles (Asima, 1992). The methanolic extract of *Bauhinia variegata* bark (MEB) possess in vitro antioxidant and DNA protective activity against H_2O_2–induced oxidative damage to pBR322 DNA. The results of the research work lead to the conclusion that MEB and its polar sub-fractions (EAB, NBB and REB) have significant antioxidant activity and potential to prevent H_2O_2-induced oxidative damage to pBR322 DNA. The potent antioxidant activity and DNA protection ability of *Bauhinia variegata* bark extract/fractions may be attributed to their richness in phenolic/flavonoid compounds (Sharma et al., 2011)**.**

Antihyperlipidemic

Bauhinia variegata Linn. is used as antibacterial, antifungal, antiulcer, and hepatoprotective (Bodakhe et al., 2007). The methanolic extract of *Bauhinia variegata* (Linn) leaves is evaluated for the presence of antihyperlipidemic activity in Triton WR-1339 (tyloxapol) induced hyperlipidemic rats. The research work concluded that Butanol fraction of *B. variegata* not only resulted in significant reduction in cholesterol, triglyceride, LDL, VLDL, level but also increases the HDL level (Kumar et al., 2011).

Nephroprotective activity

The roots of *Bauhinia variegata* possess flavanone glycoside which is responsible for its anti-inflammatory activity (Yadava et al., 2003). The ethanolic extract of *Bauhinia variegata* Linn. whole stem is evaluated for nephroprotective activity against cisplatin-induced nephropathy. It was investigated by an in vivo method in rats and *Bauhinia variegata* whole stem was found to have potent activity against cisplatin- induced nephropathy (Pani et al., 2011).

Immunomodulatory activity

Kachnar is used in the treatment of obesity, hyperphagia, hyperglycaemia and hyperlipidaemia (Prashar et al., 2010). Patil et al (2010) reported the In-vitro immunomodulatory activity of extracts of *Bauhinia variegata* Linn stem bark on human neutrophils. *Bauhinia variegata* Linn stem bark significantly increased the phagocytic function of human neutrophils when compared with control, indicating the possible immunostimulating effect. The *Bauhinia variegata* Linn stem bark extracts significantly increased the neutrophil chemotactic movement as indicated by the increase in number of cells reached the lower surface of filter; thereby *Bauhinia variegata* Linn stem bark extracts acts as chemo-attractant (Patil et al., 2010).

Antifungal and antibacterial activity

Bauhinia variegata is a small to medium-sized tree. It grows to a height of about 10-12 m and is deciduous. It is mostly grown in tropical region. It is a reliable greenhouse species which grows at an altitude of 1800 m in Himalayas (Deswal et al., 2015). *Bauhinia variegata* is evaluated for the presence of antibacterial and antifungal activity of 50 mg/ml, 100 mg/ml and 200 mg/ml petroleum ether, chloroform, acetone-water, water extract by using cup-plate method. The antibacterial activity was evaluated against *Staphylococcus aureus* (Gram positive) and *Escherichia coli* (Gram negative). The antifungal activity was evaluated against *Candida albicans* and *Aspergillus niger.* It was concluded from the study that *Bauhinia variegata* exhibited potent antibacterial and antifungal activity (Patil et al., 2015).

Antimicrobial activity

Tannins, fibre, gum and oil are procured from Bauhinia species which are useful in industries. The plants bear fragrant and beautiful flowers. They are grown as ornamental plants. *B tomentosa* Linn, *B racemosa* Lam, *B retusa* Roxb, *B purpurea* Linn, *B variegata* Linn and *B malabarica* Roxb. are widely used in the traditional

systems of medicine (Mali et al., 2009). In a study the antimicrobial effect of methanolic extract of flower of *Bauhinia variegate* Linn was estimated by using gram positive *B.subtilus, S. aureaus, S. epidermis* and gram negative *E. coli, S. flexineria, P. auriginosa*. Study shows that methanolic extract of flower of *Bauhinia variegata* Linn inhibited the growth of micro-organisms dose dependently (Kulshrestha et al., 2011).

Adjunct therapy in chronic *Staphylococcus aureus* mastitis in goat

Kachnar is used in the cure of obesity, hyperphagia, hyperglycaemia and hyperlipidaemia (Prashar et al., 2010). Jeevan Ranjan Dash studied the effect of *Bauhinia variegata* L. stem bark powder as adjunct therapy in chronic *Staphylococcus aureus* mastitis in goat. Mastitis was induced by intracisternal inoculation of coagulase positive *S. aureus* (J638) at the concentration of 2000 colony forming units. A marked reduction in polymorphonuclear cells and fibrous tissue was observed indicating antifibrotic property of *Bauhinia variegata* L (Dash et al., 2014).

Molluscicidal activity

Bauhinia variegata is widely distributed in tropical regions and found throughout India especially in Punjab, central and south India (Sudheerkumar et al., 2015). A study using binary combination of *Bauhinia variegata* and *Mimusops elengi* with other plant molluscicides *Saraca asoca* and *Thuja orientalis* against snail *Lymnaea acuminata*. It was reported that toxicity of binary combinations of plant molluscicides with other plant molluscicides was toxic against fresh water snail *L. acuminate* (Singh et al., 2012).

Adulticidal activity

Bauhinia variegata can be naturally propagated through the seeds when provided with favorable conditions, whereas artificial propagation is carried out by stump planting i.e. direct sowing of seeds. Branch cuttings normally root with difficulty, but these root well in August, November and February with the application of auxins (Mali et al., 2009). A study on seven medicinal plants to check their activity against adult worms of *Haemonchus contortus*. The plants used for the study were *Chenopodium album*, *Chrysanthemum cinerariifolium*, *Bauhinia variegata*, *Cuscutta reflexa*, *Ailenthus excelsa*, *Calotropis gigantea* and *Annona squamosa.* All these plants were dried in shade and grinded to form a coarse powder, then this coarse powder is extracted by soxhlet apparatus, followed by concentration by rotatory evaporator. *In vitro* adulticidal activity was analyzed. Then the data obtained was analyzed statistically to find LC50. The result concluded that out of the seven test plants, *Calotorpis procera* showed significant adulticidal activity after 1 hour, while *Chrysanthemum indicum* leaves extract after 2 hours. All other five plants took about 4 hours to show the adulticidal activity (Yadav et al., 2009).

Larvicidal activity

Kachnar is a flowering plant that grows well in parts of Southeast Asia and is native to India, Pakistan, Nepal, Burma and Sri Lanka. It is cultivated as an ornamental tree and famous for its scented flowers. Kachnar is crucial part of cuisine in several Nepali, Pakistani and Indian dishes (Sayago et al., 2013). A study proceeded with the investigation of the larvicidal activity of *Bauhinia variegata* and *Croton sparsiflorus* plant powders for the *Aedes aegypti* larvae. Concentrations of 100, 120, 140, 160, 180, and 200 mg/100 ml leaf powder of *Bauhinia variegata* and *C. sparsiflorus* were tested against the larvae of *A. aegypti* up to 24 hr. LC50 value of 122.73 mg/100 ml and LC90 value of 180.04 mg/100 ml was observed for *C. sparsiflorus* leaf powder. LC50 value of 142.47 mg/100 ml and LC90 value of 210.16 mg/100 ml was observed for *Bauhinia variegata* leaf powder. It was proved from the study that *C. sparsiflorus* leaf powder caused 100% mortality which was followed by the leaf powder of *Bauhinia variegata* against *A. aegypti* (Shanmugapriya et al., 2016).

Treatment of Urinary tract infection (UTI)

Kachnar is grown for its scented flowers and also used as food item in South Asian cuisine (Tewari et al., 2015). *Bauhinia variegata* can be used for the treatment of urinary tract infection. 9 tropical flowering plants (*Anogeissus acuminata*, Azadirachta indica, *Bauhinia variegata*, *Boerhaavia diffusa*, *Punica granatum*, *Soymida febrifuga*, *Terminalia chebula*, *Tinospora cordifolia* and *Tribulus terrestris*) have been studied for possible use as source of antimicrobials for multidrug resistant (MDR) bacteria, along with main-stream antibiotics. Pathogenic bacteria were isolated from urine samples of patients attending and admitted in the hospital. Antibiograms of 11 isolated bacteria (*Enterococcus faecalis* and *Staphylococcus aureus*; and GNs, *Acinetobacter baumannii*, *Citrobacter freundii*, *Enterobacter aerogenes*, *Escherichia coli*, *Klebsiella oxytoca*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Proteus vulgaris* and *Pseudomonas aeruginosa*) were ascertained by the disc-diffusion method, and antibacterial activity of plant extracts was monitored by the agar-well diffusion method. It was noticed that *Bauhinia variegata* was one of the plant active against urinary tract infection (Mishra et al., 2015).

Anti-carcinogenic and Anti-mutagenic potential

Flavonoids like flavanone, 5, 7-dimethoxy-30, 40-methylenedioxyflavanone and a new

dihydrodibenzoxepin, 5, 6-dihydro-1, 7-dihydroxy-3, 4-dimethoxy-methyldibenz oxepin were reported to be present in the roots of *Bauhinia variegata* (Reddy et al, 2003). The topical application of the Kachanar leaves extract at the pre promotion phase showed a significant reduction in tumor incidence, tumor burden, tumor weight, tumor size, cumulative number of papillomas, in Kachanar treated groups as compared to the carcinogen treated control. The antitumor activity of ethanolic extract of *Bauhinia variegata* was reported in Dalton's ascetic lymphoma (DAL) in swiss albino mice and in liver tumor in rats (Agrawal et al., 2009). Mishra et al investigated the antimicrobial, antioxidant, and anticancer activities of *Bauhinia variegata* leaf extracts against *Klebsiella pneumonia*, *E. coli*, *Proteus* spp. and *Pseudomonas* spp. It produced significant antioxidant acitvity in beta carotene bleaching assay. Ethyl acetate fraction was used to produce cytotoxicity against MCF-7 and THP-1 cell lines (Mishra et al., 2013).

Anti-tumour activity

Bauhinia variegata is widely used in as an antidiabetic agent, because insulin-like protein was present in its leaves (Azevedo et al., 2006). The ethanolic extract of *Bauhinia variegate* possess potent cytotoxic activity against Ehrlich ascites carcinoma in Swiss albino mice. Oral administration of ethanolic extract of *Bauhinia variegata* was effective in reducing solid tumor mass development induced by EAC cells (Rajkapoor et al., 2003 and Rajkapoor et al., 2006).

Rajkapoor B. et al reported chemopreventive and cytotoxic effect of ethanol extract of *Bauhinia variegata.* The chemopreventive and cytotoxic effect was against induced DEN liver tumor and human cancer lines (Rajkapoor et al., 2006).

Anti-inflammatory

The flower buds of *Bauhinia variegata* are used in the treatment of piles, cough, eye diseases, and liver complaints and as styptic in haematuria and menorrhagia (Mali et al., 2009). A study was performed regarding the investigation of the anti-inflammatory activity of the ethanolic extract of the roots of *Bauhinia variegata* in albino rats by carrageenan induced hind paw edema method. The plant extract produced moderate anti-inflammatory activity (Bansal et al., 2014). Gayathri G. et al reported the anti-inflammatory activity of *Bauhinia variegata* Linn. leaf. The study included the search of COX-2 and iNOS inhibiting compounds from *Bauhinia variegata* Linn. 3D structures of compounds reported from GCMS analysis. The phytochemicals of *Bauhinia variegata* leaf was found to have appreciable anti-inflammatory activity (Gunalan et al., 2014).

Antipyretic activity

Bauhinia variegata is also useful in the preparation of ayurvedic medicines for diarrhoea, dysentery, goitre, lymphadenitis, worm infestation, rectal prolapse and as depurative (blood purifier) (Manoj et al., 2013). The ethanolic extracts of *Bauhinia variegata* and *Glycosmis pentaphylla* were evaluated for antipyretic activity in Brewer's yeast induced pyrexia in rats. Activity was due to inhibition of prostaglandin synthesis in the hypothalamus (Mandal et al., 2011).

Wound healing activity

The bark, leaves and flowers of *Bauhinia variegata* is useful in the cure of gall bladder, kidney stones and piles (Singh et al., 2013). A polyherbal ointment of Napalese medicinal plants made up of methanolic extracts of *Bauhinia variegata, Rhododendron arboreum,* and *Myrica esculenta* was evaluated for antioxidant and wound healing activities. The antioxidant activity was investigated for *Bauhinia variegata, Myrica esculenta, Rhododendron arboreum, Pyrus pashia* and *Psidium guajava* by using DPPH assay. The ointment was prepared by using *Bauhinia variegata, Rhododendron arboreum,* and *Myrica esculenta* into 10% w/w ointment in the ratio of 1:1:2. It was observed that herbal ointment treated rats were totally healed in excision wound model in comparison to the Framycetin treated, blank and control group of rats where 2.72%, 4.5%, and 5.73% wound area was found remaining (Gyawali et al., 2016).

Antidiabetic Activity

Bauhinia variegata helps in the treatment of gynaecological conditions (Mali et al., 2009). A study was conducted to investigate the antidiabetic property of *Bauhinia purpurea* extract against alloxan induced diabetes in mice by glucometer method, with 50 mg/kg, 100 mg/kg and 200 mg/kg (Meshram et al., 2013).

Anti-Eosinophilic activity

Bauhinia variegata **is** widely used in as an antidiabetic agent, because insulin-like protein was present in its leaves (Azevedo et al., 2006). The response of aqueous and ethanolic extracts of *Bauhinia variegata* was evaluated against milk-induced leucocytosis and eosinophilic in mice and found significant dose-dependent reduction in total leucocyte and eosinophil (Mali et al., 2011).

Antidepressant effect

Khare P. et al reported the antidepressant activity of *Bauhinia variegata* using Tail suspension test (TST), Forced swim test (FST). The study revealed that *Bauhinia variegata* methanolic extract produced significant antidepressant like effect at dose of 100 & 200 mg/kg administered for 7 & 14 consecutive days as indicated by reduction in immobility times of mice in TST & FST ($P<0.05$). *Bauhinia variegata* methanolic extract produced significant antidepressant activity compared to that of imipramine (Khare et al., 2015).

Antianxiety activity

Kachnar was proved to have antitumour activity in Dalton's ascitic lymphoma**,** N-nitrosodiethylamine-induced liver tumors and human cancer cell lines. It also possess the anti-inflammatory activity due to flavonol glycoside 5,7,3',4'-tetrahydroxy-3-methoxy-7-O-alpha-l-rhamnopyranosyl(1-->3)-O-beta-galactopyranoside (Patil et al., 2015). The antianxiety activity of the leaves and seeds of *Bauhinia variegata* was investigated. Elevated plus maze (EPM) apparatus was used in swiss albino mice to analyze the antianxiety activity. It was concluded that the methanolic extract (100 mg/kg, p.o.) of leaves and *Bauhinia variegata* seeds (200 mg/kg) significantly increased the time spent in open arms of the EPM. The activity of *Bauhinia variegata* was comparable with buspirone and showed good antianxiety activity (Khare et al., 2016).

Antistress /Adaptogenic Activity

Bauhinia variegata is also useful in the preparation of ayurvedic medicines for diarrhoea, dysentery, goitre, lymphadenitis, worm infestation, rectal prolapse and as depurative (blood purifier). It also enhances the detoxifying function of liver (Manoj et al., 2013). The effect of ethanolic bark extract of *Bauhinia variegata* on oxidative stress induced by cold restraint stress (CRS) and iron overload (IO) oxidative stress was evaluated. They found changes in the antioxidant enzymes like GSH, CAT, SOD and LPO. The extract significantly managed the stress-induced variations in the biochemical levels and antioxidant enzymes in stress models (Marasani et al., 2013).

Nootropic potential

Bauhinia variegata is a small to medium-sized tree. It grows to a height of about 10-12 m and is deciduous. It is mostly grown in tropical region. The genus Bauhinia includes about 600 species including shrubs, trees and vines. It is generally planted as an ornamental plant (Deswal et al., 2015). A research was conducted to evaluate the nootropic potential of *Bauhinia variegata* Linn in rats. Leaves were used for investigation of total flavonoid content. Nootropic activity was determined by diazepam-induced amnesia (Jatav et al., 2014).

Neuroprotective activity

Bauhinia variegata Linn. is traditionally used in bronchitis, leprosy, ulcer, fungal infection, ulcers and tumors (Prashar et al., 2010). The neuroprotective activity of *Bauhinia variegata* acetone soluble leaf extract was investigated in the reserpine induced catalepsy rat model. It was concluded from the results that catalepsy was reduced in the drug treated groups when compared to the disease induced group in comparison to the disease induced group. The biochemical parameters like lipid peroxidation, glutathione (GSH), glutathione peroxidase (GSH-Px) and superoxide dismutase (SOD) were estimated in brain. The extract of *Bauhinia variegata* significantly decreased lipid peroxidation levels and increased antioxidant enzyme levels (Trivedi et al., 2015).

Hepatoprotective activity

Infusion of the leaves is used as a laxative and for treating piles. Dried buds are used in the treatment of worms, tumors, diarrhea, dysentery and piles (Asima, 1992). The ethanolic extract of *Bauhinia variegata* possess hepatoprotective property against carbon tetrachloride induced liver injury in rats. In this study liver injury was induced by carbon tetrachloride 1 ml/kg dissolved in olive oil (1:1) orally. Silymarin (100mg/kg) orally was used as standard drug. Various biochemical parameters were also analysed like aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), total bilirubin, malondialdehyde (MDA), glutathione (GSH), catalase (CAT) followed by histopathology. BVEE (400mg/kg and 600mg/kg) proved to be more potent than BVEE (200mg/kg and 100mg/kg) (Manoj et al., 2013).

Trypsin inhibitory activity: The root of *Bauhinia variegata* consists of flavanone glycoside which is responsible for its anti-inflammatory activity (Yadava et al., 2003). The Camel's foot tree, *Bauhinia variegata* var. *variegate* seeds possess Kunitz-type trypsin inhibitor (termed BvvTI) activity. BvvTI shared the same reactive site residues (Arg, Ser) and exhibited similarity with N-terminal amino acid sequence to other *Bauhinia* protease inhibitors. It showed the highest trypsin inhibitory activity ($_{Ki}$, $0.1 \times 1^{0-9}$ M) among the other species. It was further reported that BvvTI showed anti-HIV-1 reverse transcriptase activity along with diminishing the growth of nasopharyngeal cancer CNE-1 cells. This may be caused due to the stimulation of cytokines and apoptotic bodies (Fang et al., 2010).

Hemagglutinator

It was reported the hemagglutinator activity of the seeds of *Bauhinia variegata*. Melibiose binding lectin was isolated from *Bauhinia variegata* seeds which were responsible for hemagglutinator activity. It was successful in inhibiting the proliferation in hepatoma HepG2 cells, breast cancer MCF7 cells and HIV-1 reverse transcriptase activity (Lin et al., 2008).

Proteinase Inhibitor

Kachnar is used in obesity, hyperphagia, hyperglycaemia and hyperlipidaemia (Prashar et al., 2010). The seeds of *Bauhinia variegata* could be a source of proteinase inhibitors which may be responsible for the inhibition of blood clotting enzymes, serine and cysteine proteinases. According to their study, two varieties *Bauhinia variegata* seeds exhibited Plant Kunitz type inhibitors- *Bauhinia*

variegata trypsin inhibitors, viz. *Bauhinia variegata Candida* trypsin inhibitor and *Bauhinia variegata lilac* trypsin inhibitor are proteins. The complete sequences were estimated by automated Edman degradation of the reduced and carboxymethylated proteins of the peptides caused due to *Staphylococcus aureus* protease and trypsin digestion (Oliva et al., 2009).

Anticataract activity

Flowers of *Bauhinia variegata* contain cyanidin, malvidin, peonidin, and kaempferol. Root contains flavanol glycosides (Rajani et al., 2009). The anticataract activity of stem bark of *Bauhinia variegata* was evaluated on the basis of presence of rhamnocitrin. The anticataract study was conducted on ovine and chick embryo lens model by using a flavonoids rhamnocirin (10, 20, 40 and 80 µg) isolated from stem bark of *Bauhinia variegata*. It was concluded from the study that rhamnocitrin was responsible to prevent the lens against cloudiness induced by hydrogen peroxide and hydrocortisone in a dose dependent manner (Bodakhe et al., 2012).

Antimalarial activity

Bauhinia variegata is widely distributed in tropical regions and found throughout India especially in Punjab, central and south India. It is widely found in sub Himalayan tract and outer Himalaya's up to an altitude of 1300 meters. It is also found in China (Sudheerkumar et al., 2015). The leaves and roots of *Ocimum sanctum* Linn. and *Bauhinia variegata* Linn. possess antimalarial activity which was evaluated against *Plasmodium berghei*. Water and ether soluble extracts were given orally to the mice along with placebo controls. It was observed from the study that on day 4 parasitaemia in control group of mice was 25.20% ± 9.44% while in mice treated with water soluble extracts of leaves and roots of *Ocimum sanctum* showed 2.80% ± 2.17% and 7.60% ± 5.32% infection respectively while in mice treated with water soluble extract of leaves of *Bauhinia variegata* showed 23.60% ± 13.35% infection (Banyal et al., 2015).

Anti-ulcer activity

The stems, roots and leaves are also useful for the cure of pain, diabetes, infections, ulcer, jaundice, leprosy (Arain et al., 2012). *Bauhinia variegata* possess anti-ulcer activity. The anti-ulcer activity of alcoholic extract of *Bauhinia variegata* stem (250 mg/kg) was performed against pylorus ligation-induced and aspirin-induced gastric ulcer in rats. It was concluded that *Bauhinia variegata* stem extract significantly decreased the gastric secretions and hence decreased the ulcer index (Prusty et al., 2011).

***Bauhinia variegata* Marketed Products**

Kanchnar Guggul: is an Ayurvedic formulation consisting of kanchnar bark (10 parts) ginger, black pepper, long pepper, cardamom, cinnamon, tejpatra leaves (*Cassia cinnamon*), triphala (1 part of each of the above herbs) is available in the market for the treatment of TB tumors, ulcers, gonorrhoea, increase white blood cells.

Chandanasava: used as cardiac and digestive tonic

Chitrakadi Taila: Herbal oil used to apply into fistula tract to bring quick healing.

Ushirasava: Used in the treatment of heavy menstrual bleeding, skin diseases.

Gandamala Kandana Rasa: Used in goiter, cervical lymphadenitis.

Mutra Sangrahaniya Kwatha: Used in UTI.

Kanchan gutika

Gulkand Kanchanara

Kanchanaradi Kwatha

Kanchanara drava

Kachnar buds are used in many recipes. The recipes of buds of Kachnar included its treatment with potassium metabisulphite followed by drying in the tray drier at 50°C. This recipe was much better than blanching (Awasthi et al., 2011).

Conclusion

Kanchnara (Bauhinia variegata Linn.) is the medicinal plant with a potential to cure various diseases. We have discussed about the pharmacological activities, traditional, medicinal uses, cultivation, collection, chemical constituents and history of *Bauhinia variegata*. The important chemical constituents present in it are flavonoids, glycosides, alkaloids, tannins and terpenoids which are responsible for different pharmacological properties of *Bauhinia variegata* Linn. *Bauhinia variegata* Linn. act as anti-diabetic, anti-oxidant, anti-ulcer, nephroprotective, anti-microbial, anti-bacterial, anti-cancer and hepatoprotective agent. Further studies on *Bauhinia variegata* should be done for the investigation of the molecular mechanisms of action of various phytoprinciples present in it. A wide variety of biological potential of *Bauhinia variegata* has been proved by the scientific research. This plant can be used in the preparation of various medicines due to its phytochemical and pharmacological properties. A major portion of world population is dependent on plants as the exclusive source of drugs. So, it is very challenging to provide safe, cheap and effective medicines especially to the population belonging to rural area. Investigation should be continued on the chemical constituents, pharmacological activities of *Bauhinia variegata* based on clinical trials. In this review article, we have gathered information to represent the botanical, pharmacognostical, ethnobotanical,

phytochemical and pharmacological literature on *Bauhinia variegata*. It has been reported through this study that this plant exhibit antimicrobial, antiarthritic, antigoitrogenic, anti-inflammatory, anthelmintic, antitumour, cytotoxic, antiulcer, haemagglutination, hepatoprotective and insecticidal activity. There is much more to explore about the benefits of this herbal medicinal plant by clinical and pharmacological screening at molecular level. So, investigations should be done for the standardization of different extracts of *Bauhinia variegata* for preparing herbal formulations, analysing the possible mode of action of isolated active constituents.

Conflicts of interest

There are no conflicts of interest.

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