

PHCOG REV. : Review Article

Chemistry and Biological Activities of the Genus *Dalbergia* - A Review

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ABSTRACT

*Dalbergia* is a genus of trees, shrubs and woody climbers widely distributed in tropical and sub-tropical regions. It possesses immense traditional application. Various species are widely used as analgesic, anti-inflammatory, antipyretic, antimicrobial, anti-diarrheal, anti-ulcerogenic, anti-spermicidal, larvicidal and mosquito repellent in the traditional system of medicines. Chemical investigation has resulted in characterization and isolation of various phytoconstituents. This review is compilation of chemical composition and biological activities of the various species of the genus *Dalbergia*.

**KEY WORDS :** Biological activities, *Dalbergia* spp., phytoconstituents, traditional uses.

INTRODUCTION

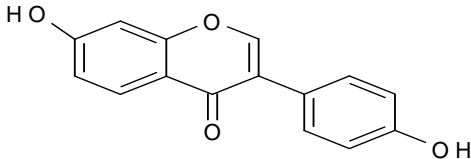
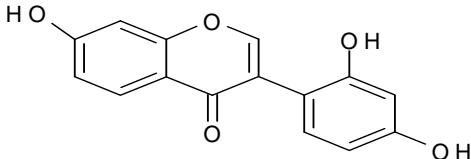
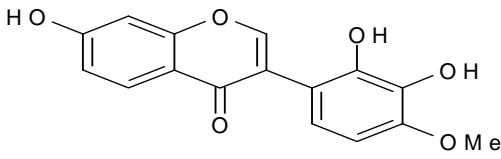
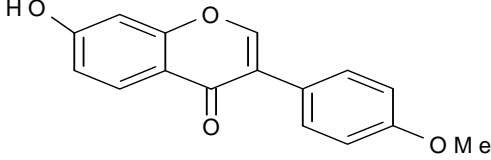
The genus consists of 300 species and about 25 species occur in India. Many species of *Dalbergia* are important timber trees, valued for their decorative and often fragrant wood, rich in aromatic oils (1,2). Traditionally various species are reported to be used as aphrodisiac, abortifacient, expectorant, anthelmintic, antipyretic, appetizer, allays thirst, vomiting, burning sensation, cures skin diseases, ulcers, diseases of the blood, reduces obesity, used in leucoderma, dyspepsia, dysentery, for diseases of the eye and nose, syphilis, stomach

troubles, leprosy, leucoderma, scabies and ringworm (3,4). The present paper is compilation of the phytoconstituents that have been identified in this genus and the traditional and reported biological activities.

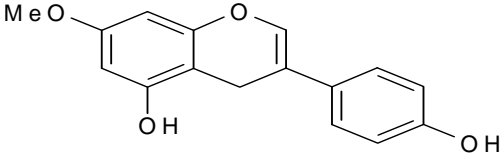
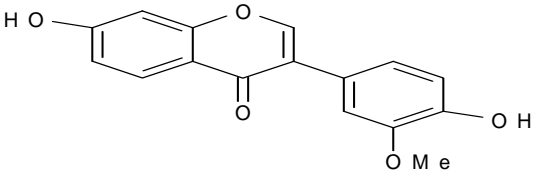
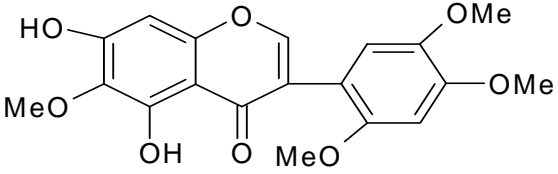
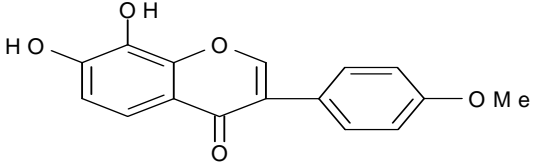
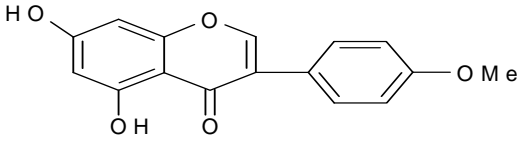
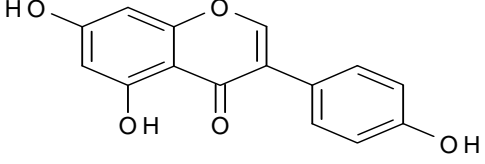
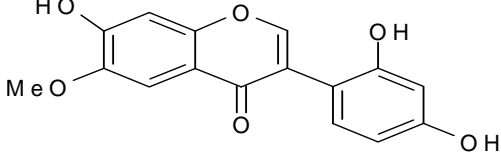
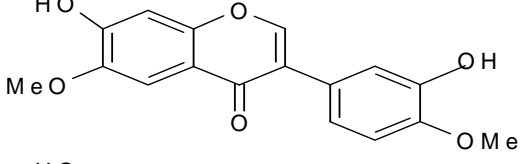
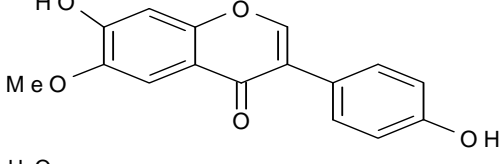
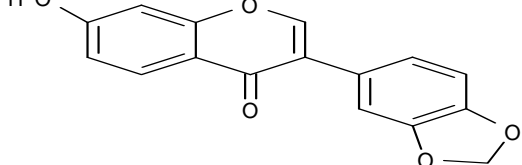
**Phytoconstituents identified in the genus *dalbergia*.**

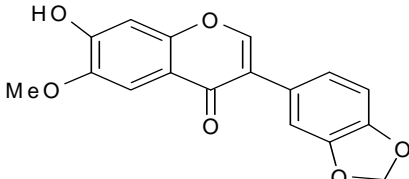
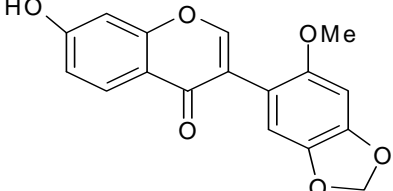
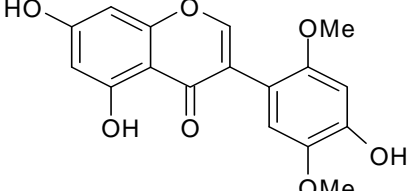
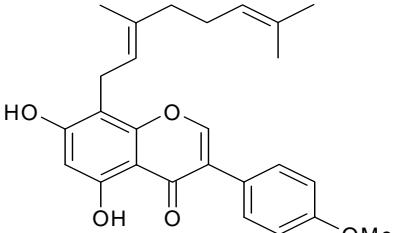
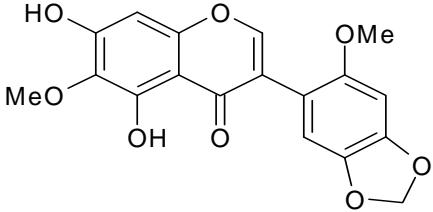
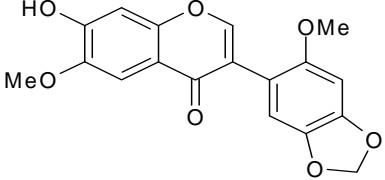
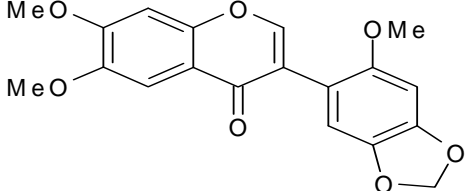
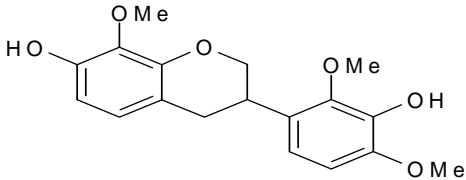
A number of phytoconstituents namely flavonoids, isoflavonoids, glycosides, steroids, quinines etc., have been isolated from the various species of the genus. Phytoconstituents isolated from the genus *Dalbergia* are tabulated in the Table 1.

Table 1: List of various Phytoconstituents in *Dalbergia* genus reported in literature

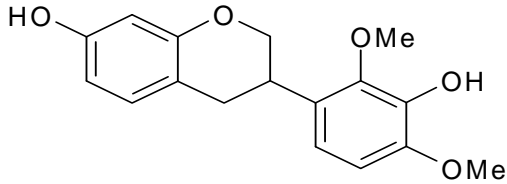
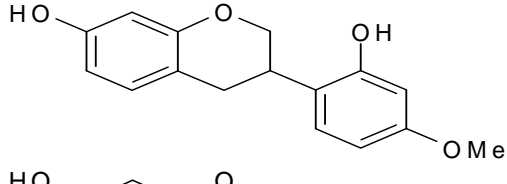
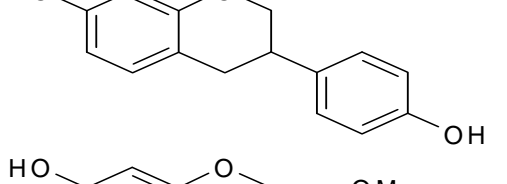
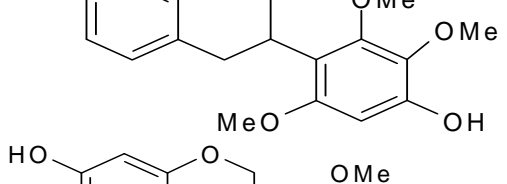
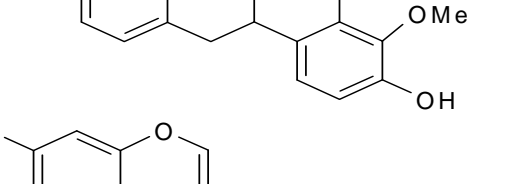
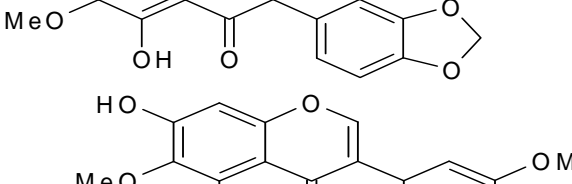
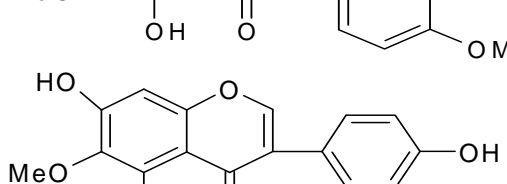
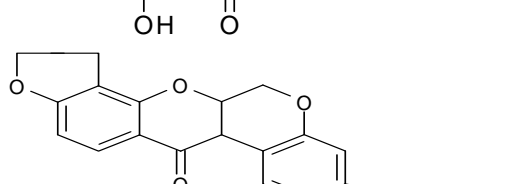
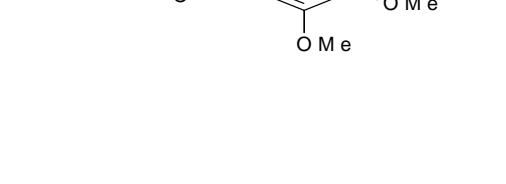
CONSTITUENTS	SPECIES	PART / EXTRACT	STRUCTURE	REF. NO.
<b>Isoflavonoids</b>				
Daidzein	<i>D. volubilis</i>	Fl/ Eth		5
3-hydroxy daidzein	<i>D. odorifera</i> T.Chean	Ht Wd/ Eth		6
Koparin	<i>D. odorifera</i> T.Chean	Ht Wd/ Eth		6
Formononetin	<i>D. Odorifera</i> T.Chean	Ht Wd/ Eth		6

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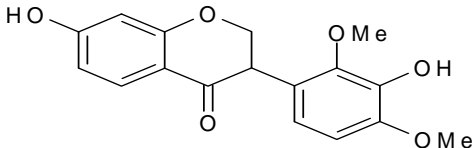
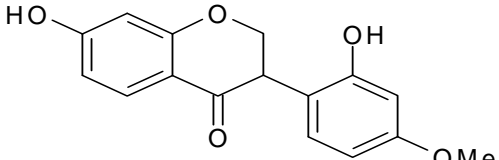
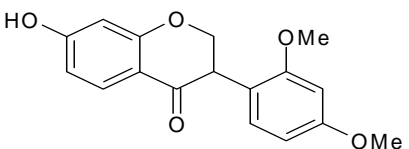
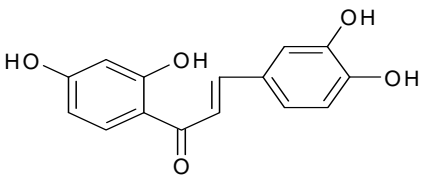
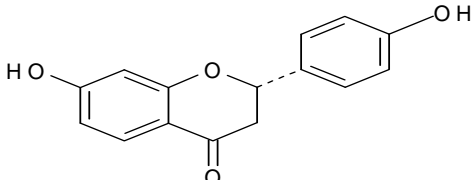
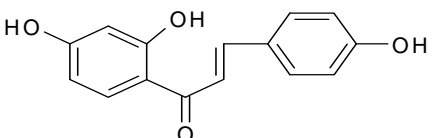
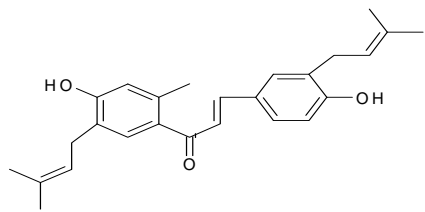
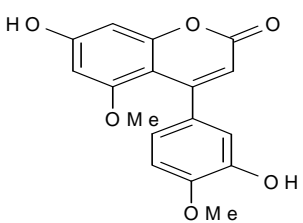
Prunetin	<i>D. odorifera</i> T.Chean	Ht Wd/ Eth		6
7,4'-dihydroxy-3'-methoxyisoflavone	<i>D. lowelii</i> R.Viguiet	Ht Wd/ Eth		7
Caviunin	<i>D. paniculata</i> Roxb.	Sd		8
Retusin	<i>D. retusa</i>	Ht Wd/ PE		9
Biochanin A	<i>D. volubilis</i>	Fl/ PE		5
Genistein	<i>D. volubilis</i>	Fl/ PE		5
Constanin	<i>D. volubilis</i>	Fl/ PE		5
Odoratin	<i>D. volubilis</i>	Fl/ PE		5
Glycitein	<i>D. volubilis</i>	Fl/ PE		5
Pseudobaptogenin	<i>D. volubilis</i>	Fl/ PE		5

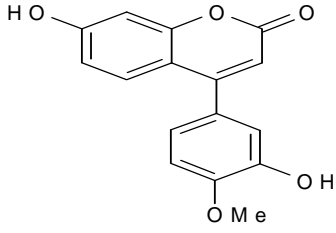
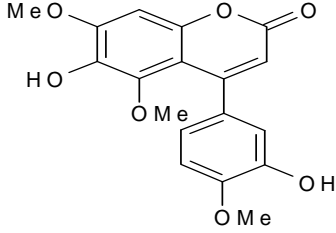
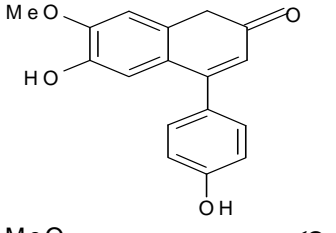
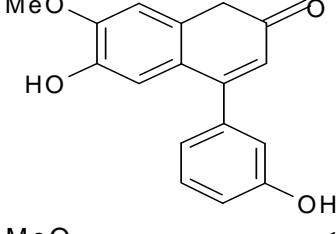
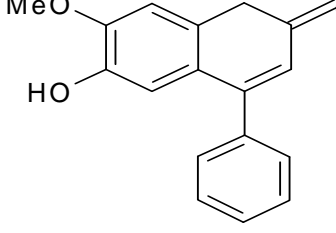
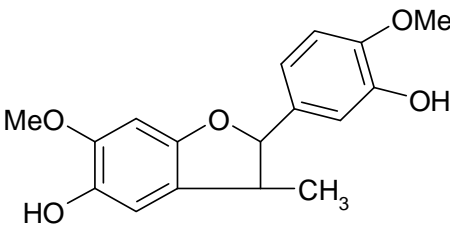
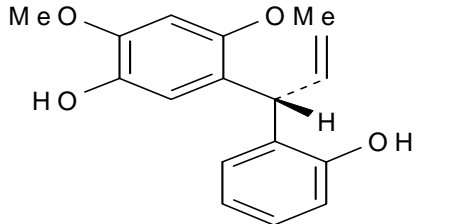
Fujikinetin	<i>D.volubilis</i>	Fl/ PE		5
Cuneatin	<i>D. volubilis</i>	Fl/ PE		5
Olibergin A	<i>D. olivera</i>	St B		10
Olibergin B	<i>D. olivera</i>	St B -		10
Dalpalatin	<i>D. paniculata</i> Roxb.	Sd/ PE		11
Dalpatein	<i>D.paniculata</i> Roxb.	Sd/ PE		11
Milldurone	<i>D. paniculata</i> Roxb.	Sd/ PE		11
Duartin	<i>D. ecastophyllum</i> (L.)Taub.	Wd/ Hex		12

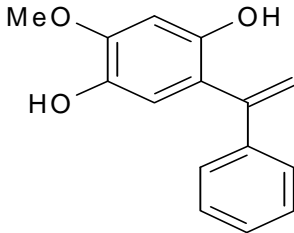
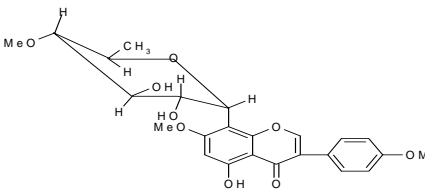
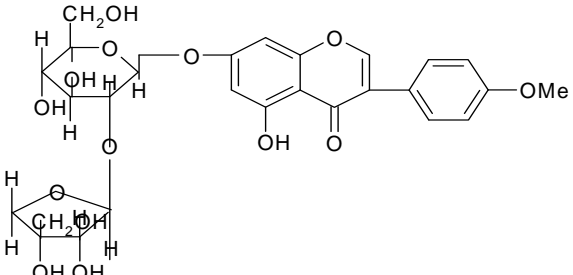
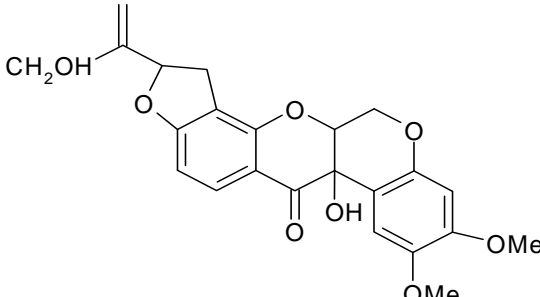
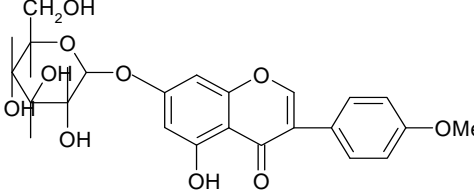
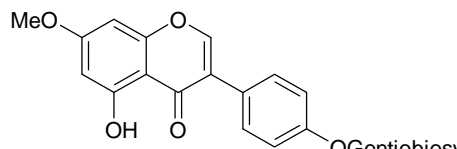
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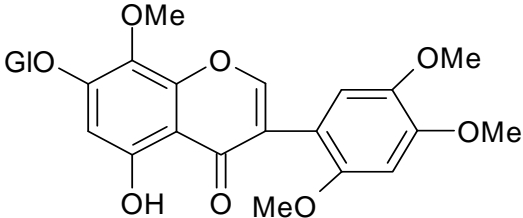
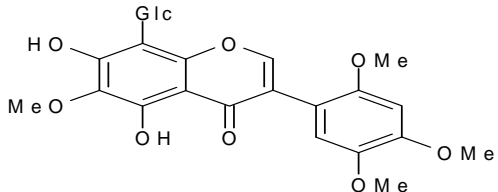
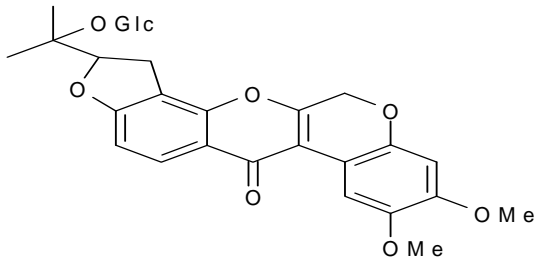
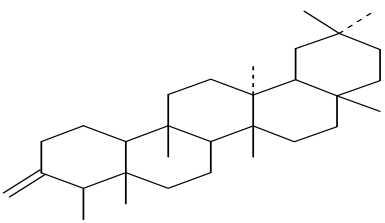
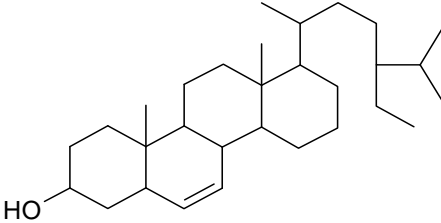
Mucronulatol	<i>D. ecastophyllum</i> (L.)Taub.	Wd/ Hex		12
Vesitol	<i>D. ecastophyllum</i> (L.)Taub.	Wd/ Hex		12
Equol	<i>D. ecastophyllum</i> (L.)Taub.	Wd/ Hex		12
Lonchocarpan	<i>D. ecastophyllum</i> (L.)Taub.	Wd/ Hex		12
Laxifloran	<i>D. ecastophyllum</i> (L.)Taub.	Wd/ Hex		12
Dalspinin	<i>D. spinosa</i> Roxb.	Rt/ PE		13
Dalspinisin	<i>D. spinosa</i> Roxb.	Rt/ PE		13
Tectorigenin	<i>D. sissoo</i>	Fl/ Eth		14
Dalpanol	<i>D. paniculata</i> Roxb.	Sd/ Eth		15

Isoflavanone

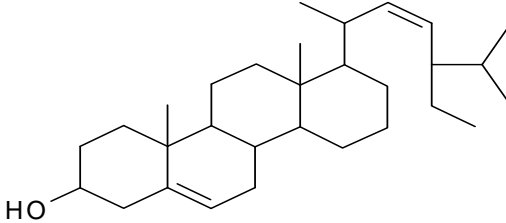
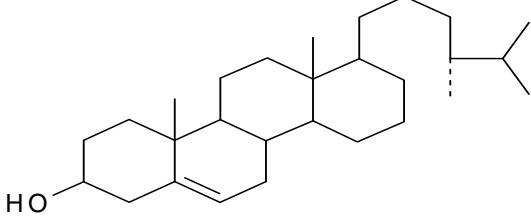
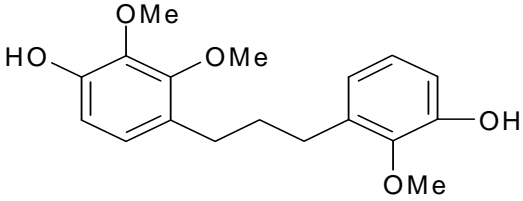
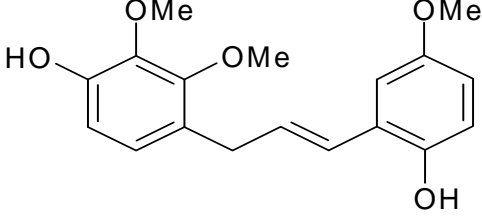
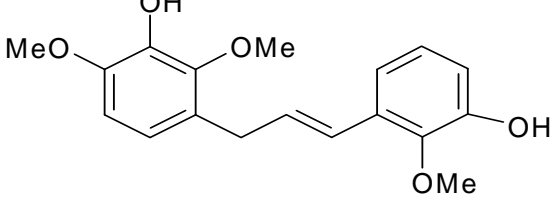
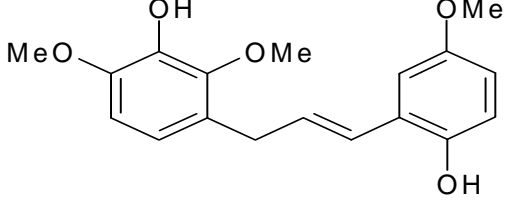
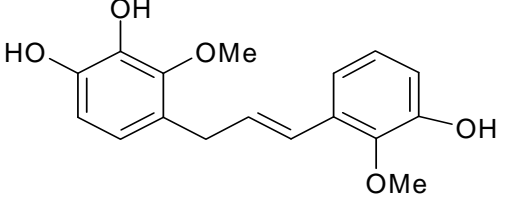
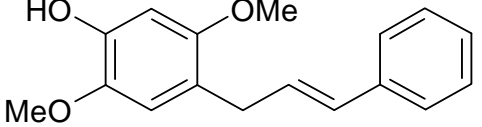
Violanone	<i>D. odorifera</i>	Ht Wd/ Eth		6
Vestitone	<i>D. odorifera</i>	Ht Wd/ Eth		6
Sativone	<i>D. odorifera</i>	Ht Wd/ Eth		6
<b>Flavanone</b>				
Butin	<i>D. odorifera</i>	Ht Wd/ Eth		6
Pinocembrin	<i>D. odorifera</i>	Ht Wd/ Eth	-	6
Liquiritigenin	<i>D. odorifera</i>	Ht Wd/ Eth		6
Isoliquiritigenin	<i>D. odorifera</i>	Ht Wd/ Eth		6
Stipulin	<i>D. stipulacea</i>	Rt/ PE		16
<b>Neoflavone &amp; Neoflavonoids</b>				
Seshadrin	<i>D. volubilis</i>	YBr/ PE		17

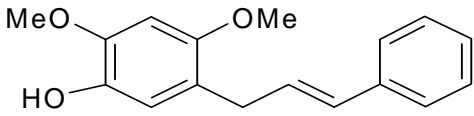
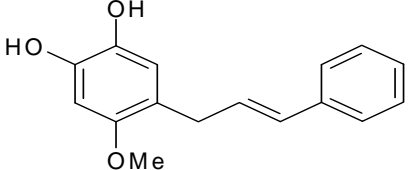
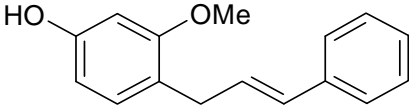
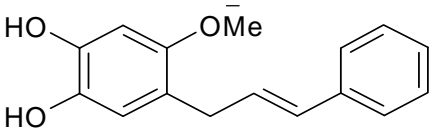
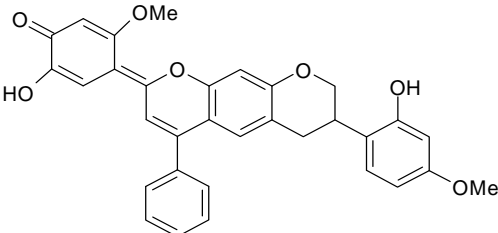
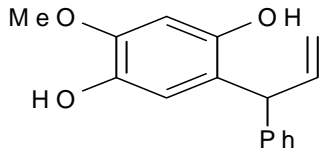
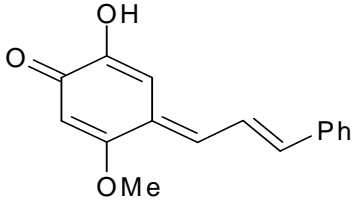
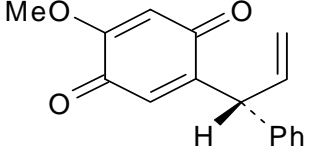
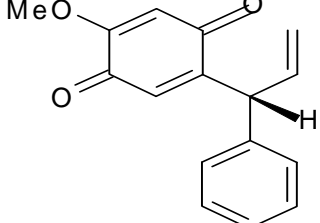
Volubolin	<i>D. volubilis</i>	Y Br/ Eth		18
Melannein	<i>D. baroni</i> , Baker	Ht Wd/ Eth		19
Melanettin	<i>D. odorifera</i>	Ht Wd/ Eth		6
Stevenin	<i>D. odorifera</i>	Ht Wd/ Eth		6
Dalbergin	<i>D. odorifera</i>	Ht Wd/ Eth		6
Melanoxin	<i>D. melanoxydon</i>	Ht Wd/ -		20
R (-)-Latifolin	<i>D. parviflora</i>	Ht Wd/ PE		21

Cearoin	<i>D. parviflora</i>	Ht.Wd./ P.E.		21
<b>Glycosides</b>				
Volubillin	<i>D. volubilis</i>	Fl/ PE		18
Isovolubilin	<i>D. volubilis</i>	Fl/ PE	-	22
Volubilin	<i>D. volubilis</i>	Fl/ PE	-	23
Lanceolarin	<i>D. lanceolaria</i>	RtB/ Ace		24
Dalbinol	<i>D. latifolia</i>	Sd/ Ben		25
Sissotrin	<i>D. sissoo</i>	LF/ PE		26
Dalsympathetin	<i>D. sympathetica</i>	LF/ Aq		27
Isocaviudin	<i>D. sissoo</i>	MatP/ PE	-	28
Tectoridin	<i>D. sissoo</i>	MatP/ PE	-	28

Caviunin-7-O-glucoside	<i>D. sissoo</i>	MatP/ PE		29
Dalcochinin-8'-O-β-D-glucoside	<i>D. cochinchinensis</i>	Sd/P E	-	30
Caviunin-7-O-rhamnoglucoside	<i>D. paniculata</i> Roxb	Rt/ PE	-	31
Paniculatin	<i>D. paniculata</i> Roxb	St B/ Eth	-	32
8-C-glucosylprunetin	<i>D. paniculata</i> Roxb	St B/ Eth	-	33
Dalspinosin 7-O-β-D-glucopyranoside	<i>D. spinosa</i>	Rt/ Eth	-	34
Dalpaniculin	<i>D. paniculata</i> Roxb	Sd		35
Dehydrodalpanol-O-glucoside	<i>D. paniculata</i> Roxb	Sd		35
<b>Terpenoids and sterols</b>				
Kaiksaponin-111	<i>D. hupeana</i>	St B/ Meth HtWd/ Eth	-	36
Oleanolic acid	<i>D. sissoides</i>	-	-	37
Friedelin	<i>D. monetaria</i>	St B/ Eth		37
Sitosterol	<i>D. volubilis</i> <i>D. volubilis</i> <i>D. sissoides</i> <i>D. paniculata</i> ROXB <i>D. monetaria</i>	St B/ Eth Br/ Eth Twig/ Eth SapWd/ Eth LF/ Eth		37



Stigmasterol	<i>D. monetaria</i>	St B/ Eth		37
Campesterol	<i>D. monetaria</i>	St B/ Eth		37
<b>Cinnamylphenols</b>				
Dalberatin A	<i>D. cultrate</i> Grah	St B/ Ether		38
Dalberatin B	<i>D. cultrate</i> Grah	St B/ Eth		38
Dalberatin C	<i>D. nigrescens</i>	St B/ Eth		38
Dalberatin D	<i>D. nigrescens</i>	St B/ Eth		38
Dalberatin E	<i>D. nigrescens</i>	St B/ Eth		38
Violastyrene	<i>D. miscolobium</i> Benth	Ht Wd/ Ben		39

Isoviolastylene	<i>D. miscolobium</i> Benth	Ht Wd/ Ben		39
4-cinnamyl-3-methoxycatechol	<i>D. retusa</i>	Ht Wd/ PE		9
Obtustylene	<i>D. retusa</i>	Ht Wd/ PE		9
Isomucrostylene	<i>D. odorifera</i>	Ht Wd/ Eth		40
Hydroxyobtustylene	<i>D. odorifera</i>	Rt, Ht Wd/ Eth		40
Neocandenatone	<i>D. congestiflora</i>	Ht Wd/ Eth		41
<b>Quinones</b>				
Obtustaquinol	<i>D. retusa</i>	Ht Wd/ Ben		9
Obtustaquinone	<i>D. retusa</i>	Ht Wd/ Ben		9
Dalbergione	<i>D. latifolia</i> <i>D. baroni</i> Baker	Ht Wd/ Ligroin		42
Dalbergenone(R)	<i>D. sissoo</i>	Ht Wd/ Eth		43

Dalbergenone(S)	<i>D. sisso</i>	Ht Wd/ Eth Ht Wd/ Eth Ht Wd/ Eth		43
Sissoidenone	<i>D. sissoides</i>	St B/ Ace		44
<b>Furans &amp; Other Miscellaneous Compounds</b>				
Parvifuran	<i>D. parviflora</i>	Ht Wd/ Eth		45
Isoparvifuran	<i>D. parviflora</i>	Ht Wd/ Eth		45
Voludal	<i>D. volubilis</i>	Non green branch/ Meth		46
(-) pinitol	<i>D. paniculata</i>	Sd/ Eth	-	47
Tricontanol	<i>D. paniculata</i>	LF/ Eth	-	47

Fl = Flower, Ht Wd=Heartwood, Sd = Seeds, St B = Stem bark, Rt = Root, Y Br = Young branch, LF = Leaf, MatP=Mature pods Eth = Ethanol, PE = Petroleum ether, Benz = Benzene, Hex = Hexane, Meth = Methanol, Ace = Acetone, Aq=Aqueous extract

### Biological activities

*Dalbergia* genus possesses immense traditional application. So far, a few species have been screened for their biological activity and experimental results have shown a wide spectrum of such effects, the important ones are as follows:

#### **Analgesic, antipyretic and anti-inflammatory activity**

Alcoholic extract of *D. sisso* leaves have shown peripheral analgesic activity and central analgesic activity in various models viz; acetic acid induced writhings, hot plate method, tail-clip test in mice and Randall-selitto assay. Similar activity has also been reported in ethanolic extract of *D. lanceolata* bark. The alcoholic extract of *D. sisso* leaves extract also showed antipyretic activity in Brewers yeast induced pyrexia in rats

(48). The ethanolic extract of *D. sisso* leaves significantly inhibited carragenin, kaolin, and nystatin induced paw edema as well as the weight of granuloma induced by the cotton pellet. It also inhibited dye leakage in acetic acid –induced vascular permeability test in mice (49). Biochanin- A (5,7-dihydroxy –4-methoxy isoflavone) isolated from flowers of *D. sisso* have shown to possess anti –inflammatory activity against PGE, bradykinin, 5-HT and histamine induced rat hind paw odema in dose dependent manner (50).

#### **Antiartitic activity**

The petroleum ether, alcohol and aqueous extracts of *D. lanceolaria* had been found effective against arthritis when tested against formaldehyde-induced arthritis in young growing albino rats. The effects of extracts were comparable with cortisone, a standard anti-inflammatory and anti-arthritic drug (51).

#### **Antimicrobial activity**

Citric acid extract of bark of *D. melanoxylon* have shown significant antibacterial activity against gram-negative bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhimurium* and *Yersinia pestis*) and gram-positive bacteria (*Bacillus subtilis*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*). The plant has potential antifungal activity against *Candida albicans* and *Aspergillus niger* (52).

#### **Antidiarrhoeal activity**

The decoction of dried leaves of *D. sisso* possesses antidiarrhoeal activity. The ethanolic extract of the bark of *D. lanceolaria* have shown activity against castor oil and magnesium sulphate induced diarrhoea in albino mice (53).

#### **Antiulcerogenic activity**

The lyophilized aqueous extract (LAE) of *D. monetaria* have shown a dose dependant inhibition of gastric lesions induced by indomethacin, ethanol, pylorus ligation and hypothermic–restraint stress on oral administration (54).

#### **Larvicidal and mosquito repellent activity**

The oil extracted from wood scrapings of *D. sisso* has shown dose dependent larvicidal activity, growth inhibitor and repellent action against *Anopheles stephensi*, *Aedes aegypti* and *Culex quinquefasciatus* (55).

#### **Antigiardial activity**

The extracts and formononetin an isoflavone from the bark of *D. frutescens* have shown significant activity against *Giardia intestinalis* with an IC<sub>50</sub> value of 30ng/ml (approx. 0.1 µm) as compared to the value for metronidazole, the current drug of choice of 100 ng/ml (approx. 0.6 µm) (56).

#### **Antiplasmodial activity**

The flavanoids isolated from air dried powdered heartwood of *D. lowellii* showed antiplasmodial activity with IC<sub>50</sub> values ranging from 5.8 to 8.7 µm (57).

#### **Antifertility activity**

Triterpenoid glycosides, DSS, isolated from the root of *D. saxatilis* have shown antifertility activity in female wistar rats at the dose rate of 200mg/kg body weight at the pre-mating period, inhibiting the conception in 71.4% of the treated animals. Fertility index was 107.82 compared to 373.5 for control rats (58).

#### **Antioxidant activity**

Butein isolated from *D. odorifera* have shown to inhibit the iron-induced lipid peroxidation in rat brain homogenate in concentration dependant manner with an IC<sub>50</sub> value 3.3±0.4µm. It was as potent as α-tocopherol in reducing the stable free radical diphenyl-2-picrylhydryl (DPPH) with an IC<sub>0.200</sub> value 9.2±1.8 µm. It also inhibited the activity of xanthine oxidase with IC<sub>50</sub> value 5.9±0.3µm. Butein scavenged the peroxy radical derived from 2,2-azobis (2-amidinopropane) dihydrochloride (AAPH) in aqueous phase. Butein have also shown to inhibited copper-catalyzed oxidation of human low-density lipoprotein (LDL) in a concentration dependent manner. Butein caused endothelium dependant relaxation of rat aorta, precontracted with phenylephrine (59).

#### **Cancer chemopreventive activity**

Ethanolic extracts of the stem bark of the *D. cultrate* Grati and *D. nigrescens* Kurz were found to exhibit a significant antitumor promoting activity on TPA (12-o-tetradecanoylphorbol-13-acetate, EBV-EA (Epstein Barr virus early antigen) and TPA-induced EBV-EA activation (38).

#### **CONCLUSION**

The genus *Dalbergia* though known for its timber value also possesses significant medicinal properties. Most of the work carried out on the various species is on the extracts of the different parts. This review will help the future researchers to further explore the medicinal potential of the phytoconstituents of this genus.

#### **REFERENCES**

1. Wealth of Indian Raw Materials. Publication and information directorate, Vol 2, CSIR, New Delhi, 214-230 (1972)
2. R.N. Chopra, S.L. Nyer, I.C. Chopra. *Supplement to the glossary of indian medicinal plants*, CSIR, New Delhi, **90** (1980)
3. K. R. Kirtikar, B. D. Basu. *Indian medicinal plants*, Vol 3: Lalit Mohan Basu Parkashan, Allahabad 275-279 (1991)
4. K.M. Nadkarni. *Indian material medica* third edition, Vol 1, Bombay, Popular book depot, 432 (1954)
5. H. Chawla, S.S. Chibber, T.R. Seshadri. Volubilin, a new isoflavone-glycoside from *Dalbergia volubilis* flowers *Phytochemistry*. **13**: 2301-2304 (1974)
6. S. Yahara, T. Ogata, R. Saijo, R. Konishi, J. Yamahara, K. Miyahara, T. Nohara. Isoflavan and related compounds from *Dalbergia odorifera*. *Ind Chem Pharm Bull*, **37 (4)**: 979-987 (1989)
7. N. Beldjoudi, L. Mambu, M. Labaied, P. Grellier, D. Ramanitrahambola, P. Rasoanaivo, M.T. Martin, F. Frappier. Flavanoids from *Dalbergia lowellii* and their antiplasmodial activity *J Nat Prod*. **66**:1447-1450 (2003)
8. J.R. Rao, M.A. Ahamed. Phytochemical Study of *Dalbergia paniculata* leaves *Fitoterapia*. **62(2)**: 187 (1992)
9. I. Jurd, K. Stevens, Manners. Phenolic and quinoidal constituents of *Dalbergia retusa*. *Tetrahedron Letters*, **21**:2149-2152 (1972)
10. C. Ito, M. Itoigawa, T. Kanematsu, N. Ruangrunsi, H. Higashihara, H. Tokuda, H. Nishino, H. Furukawa. New Cinnamylphenols from *Dalbergia* species with cancer chemopreventive activity. *J Nat Prod*. **66**:1574-1577 (2003)
11. D. Adinaraya, J. R. Rao. Isoflavanoid glycoside of *Dalbergia paniculata* the constituents of dalpanitin and dalpatin. *Tetrahedron*. **28**: 5377-5384 (1972)
12. K. Kurosawa, W.D.Ollis, I.O. Sutherland, O.R. Gottlieb. Absolute configuration of isoflavans. *Phytochemistry*. **17**: 1423-1426 (1978)
13. R. Gandhidasan, N.S. Nagarangan, S. Neelakantan, P.V. Raman. Dalspinin & dalspinosin, two new isoflavone from *Dalbergia spinosa* roots. *Ind J Chem* **21B**: 385-386 (1982)
14. A. Banerjee, V.V.S. Murti, T.R. Seshadri, R.S. Thakur. Chemical components of flowers of *Dalbergia sissoo*. Isolation of 7- methyl tectorigenin, a new isoflavone *Ind J Chem*. **1**: 25-27 (1963)

15. D. Adinaraya, J. R. Rao. Isoflavanoid glycoside of *Dalbergia paniculata*. *Ind J Chem.*, **13**: 425-426 (1975)
16. P. Bhatt, R. Dayal. Stipulin, A prenylated chalcone from *Dalbergia stipulacea*, *Phytochemistry*. **31** (2): 719-721 (1992)
17. H. M. Chwala, R.S. Mittal. 7, 3'-dihydroxy-5-4'-dimethoxy-4-phenylcoumarin (Seshadriin), a new neoflavanoid from *Dalbergia Volubilis*. *Ind J Chem.* **23B**: 375-376 (1984)
18. H. Chawla, S.S. Chibber, T.R. Seshadri. Volubilin, a new isoflavone-C-glycoside from *Dalbergia volubilis* flowers *Phytochemistry*. **13**: 2301-2304 (1974)
19. B.J. Donnelly, D.M.X. Donnelly, A.M. O'Sullivan. *Dalbergia* species-VI, The occurrence of melanoin in the genus *Dalbergia*. *Tetrahedron*. **24**: 2617-2622 (1967)
20. B.J. Donnelly, D.M.X. Donnelly, A.M. O'Sullivan, J.P. Prendergast. *Dalbergia* species-VIII, The isolation and structure of melanoxin, a new dihydrobenzofuran from *Dalbergia melanosylon* Guill And Perr (Leguminosae). *Tetrahedron*. **25**: 4409-4414 (1969)
21. N. Muangnoicharoen, A.W. Frahm. Neoflavanoids of *Dalbergia parviflora*, *Phytochemistry*. **21**(3): 767-772 (1982)
22. H. Chawla, S.S. Chibber, T.R. Seshadri. Isovolubilin, a new isoflavone-C-rhamnoside from *Dalbergia volubilis* flowers. *Ind J Chem.* **13**: 444-446 (1975)
23. H. Chawla, S.S. Chibber, T.R. Seshadri. Volubilinin, a new isoflavone-C-glycoside from *Dalbergia volubilis* flowers. *Phytochemistry*. **15**: 235-237 (1976)
24. A. Malhotra, V.V.S. Murti, T.R. Seshadri. Lanceolarin, a new isoflavone glycoside of *Dalbergia lanceolaria*. *Phytochemistry*. 405-409 (1966)
25. S.S. Chibber, U. Khera. Dalbinol- a new 12a-hydroxyrotenoid from *Dalbergia latifolia* seeds. *Phytochemistry*. **17**:142-143 (1978)
26. A. Banerjee, V.V.S. Murti, T.R. Seshadri. Isolation of Sissonin, a new isoflavone glycoside from leaves of *D. sisso*. *Ind J Chem.* **4**(2): 70-72 (1966)
27. N.S. Nagarajan, R.P. Rao, C.N. Manoj, M.G. Sethuraman. Spectral assignment and reference data, Piperodone derivatives from *Dalbergia sympathetica* *Magnetic resonance in chemistry*. **43**: 264-265 (2005)
28. A. Sharma, S.S. Chibber, H.M. Chawala. Isocaviudin, a new isoflavone glucoside isolated from *Dalbergia sisso*. *Ind J Chem.* **19B**: 237-238 (1980)
29. A. Sharma, S.S. Chibber, H.M. Chawala. Isocaviunin 7-gentioisobioside, a new isoflavone glycoside from *Dalbergia sisso*. *Phytochemistry*. **19**(4): 715 (1980)
30. J. Svasta, C. Srisomsap, S. Techasakul, R. Surarit. Dalcochinin-8'-O- $\beta$ -D-glucoside and its  $\beta$ -glucosidase enzyme from *Dalbergia cochiniensis* *Phytochemistry*. **59**: 459-463 (1999)
31. K.M. Rajulu, J.R. Rao. Caviunin-7-O-rhamnoglucoside from *Dalbergia paniculata* root. *Phytochemistry*. **19**: 1563(1980):
32. V Narayanan, TR Seshadri: Paniculatin, a new isoflavone-di-c-glucoside of *Dalbergia paniculata* bark *Ind J of Chem* **9**: 14-16 (1971)
33. M.R. Parthasarathy, T.R. Seshadri, R.S. Varma. New isoflavonoid glycosides from *Dalbergia paniculata*. *Phytochemistry*. **15**: 1025-1027 (1976)
34. R. Gandhidasan, K. Hariramakrishanan, S. Neelakantan, P.V. Raman. Dalspinosin 7- $\beta$ -D-glucopyranoside, a new isoflavone glycoside from *Dalbergia spinosa* Roxb. *Ind J Chem.* **27B**: 693 (1988)
35. J.R. Rao, S.R. Rao. Dalpanticulin, a C-glycosylisoflavone from *Dalbergia paniculata* seeds. *Phytochemistry*. **30**(2): 715-716 (1991)
36. S. Yahara, S. Emura, H. Feng, T. Nohara. Studies on constituents of the bark of *Dalbergia hupeana*. *Chem Pharm Bull.* **37**(8): 2136-2138
37. M.S.Y. Khan, K. Javed. Chemistry and pharmacology of *Dalbergia* species. *Indian Drugs*. **34** (7): 373-82 (1997)
38. C. Ito, M. Itoigawa, T. Kanematsu, N. Ruangrunsi, H. Higashihara, H. Tokuda, H. Nishino, H. Furukawa. New Cinnamylphenols from *Dalbergia* species with cancer chemopreventive activity. *J Nat Prod.* **66**:1574-1577 (2003)
39. M. Gregson, W.D. Ollis, I.O. Sutherland, O.R. Gottlieb, T. Magalhaes. Violstyrene and iso violstyrene, cinnamylphenols from *Dalbergia Micolobium*. *Phytochemistry*. **17**:1375-1377 (1978)
40. Y. Goda, M. Katayama, K. Ichikawa, M. Shibuya. Inhibitors of prostaglandin biosynthesis from *Dalbergia odorifera*. *Chem Phar Bull.* **33**(12): 5606-5609 (1985)
41. E. Blanca Barraganhuerta, Peralta-Cruz Javier. Neocandenatone, an isoflavan-cinnamylphenol quinine methide pigment from *Dalbergia congestiflora*. *Phytochemistry*. **65**: 925-928 (2004)
42. B.J. Donnelly, D.M.X. Donnelly, C.B. Sharkey. *Dalbergia* species-II Isolation of (S)-dalbergione from *Dalbergia baroni* Baker. *Phytochemistry*. **4**: 337-340 (1965)
43. V.K. Ahluwalia, T.R. Seshadri. Dalberginone from heartwood of *Dalbergia sisso* *Current Sci.* **32** (10): 455(1963)
44. P. Ravi, V. Narayanan, P.V. Raman. A novel quinone from *Dalbergia sissoides* Grah. *Ind J Chem.* **28B**:778-779 (1989)
45. N. Muangnoicharoen, A.G. Frahm. Arylbenzofurans from *Dalbergia parviflora*. *Phytochemistry*. **20**: 291-293 (1981)
46. H.M. Chawala, R.S. Mittal, D. Krastogi. Voludal, a new aldehydic compound from *Dalbergia volubilis*. *Ind J Chem.* **23(B)**: 175-176(1984)
47. J.R. Rao, M.A. Ahamed. Phytochemical Study of *Dalbergia paniculata* leaves *Fitoterapia*. **62**(2): 187 (1992)
48. A. V. Misar, M. Kale, M. Joshi, A.M. Mujbumder. Analgesic activity of *Dalbergia lanceolaria* bark extract in swiss albino mice. *Pharm Biol.* **43**: 723-725 (2005)
49. S.W. Hajare, S. Chandra, J. Sharma, S.K Tondon, J. Lal, A.J. Telanj. Anti-Inflammatory activity of *Dalbergia sisso* leaves. *Fitoterapia*. **72**:131-139 (2001)
50. S. Kaviswami, T. Vetrichelvan, N.S. Nagarajan. Possible mechanism of anti-inflammatory activity of biochanin-a isolated from *Dalbergia sissoides*. *Indian Drugs*. **39**(3): 161-162 (2002)
51. R.H. Singh, G.N. Chaturvedi. Further studies on the antiarthritic effect of an indigenous drug *Dalbergia lanceolaria*. *Ind J Med Res.* **54** (4): 363-367(1966)
52. M. Gundidga, N. Gaza. Antimicrobial activity Of *Dalbergia melanosylon* extracts. *J Ethnopharmacol.* **40**: 127-130 (1993)
53. A.M. Mujumdar, A.V. Misar, A.S. Upadhye. Antidiarrhoeal activity of ethanol extract of the bark of *Dalbergia lanceolaria*. *J Ethnopharmacol.* **102**:213-216 (2005)
54. A.R.M. Brito Souza, R.H.S. Cota, D.S. Nunes. Gastric antiulcerogenic effects of *Dalbergia monetaria* L in Rats *Phytotherapy Research*. **11**: 314-31(1997)
55. M.A. Ansari, R.K. Razdan, M. Tandon, P. Vasudeva. Larvicidal and repellent actions of *Dalbergia sisso* Roxb. (Family: Leguminosae) oil against mosquitoes. *Bioresource Tech.* **73**(3): 207-211
56. I.A. Khan, M.A. Avery, C.L. Burandt, J.R. Mikell, T.E. Nash, A. Azadegan, L.A. Walker. Antigiardial activity of isoflavones from *Dalbergia frutescens* bark. *J Nat Prod.* **63**:1414-1416 (2000)
57. N. Beldjoudi, L. Mambu, M. Labaied, P. Grellier, D. Ramanitrahambola, P. Rasoanaivo, M T. Martin, F. Frappier. Flavanoids from *Dalbergia lowelii* and their antiplasmodial activity. *J Nat Prod.* **66**:1447-1450 (2003)
58. C.N. Ucendu, B.F. Leek. Uterine Muscle Contractant from the root of *Dalbergia sisso* *Fitoterapia*. **70**: 50-53 (1999)
59. Z.J. Cheng, S.C. Kuo, S. Chan, F.N. Kou, C.M. Teng. Antioxidant properties of butein isolated from *Dalbergia odorifera*. *Biochimica et Biophysica Acta.* **1392**: 291-299 (1998)