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Traditional Use, Phytochemistry and Pharmacological Activities of Four Dalbergia Species (*Dalbergia Sissoo, Dalbergia Odorifera, Dalbergia Melanoxylon* and *Dalbergia Lactea Vatke*): A Review

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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Review Article

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ABSTRACT

This review study concerned to survey traditional use and scientific reports for four Dalbergia species namely: *Dalbergia sisso, Dalbergia melanoxylon, Dalbergia odorifera and Dalbergia lactea vatke. Genus Dalbergia (Fabaceae or Leguminosae)* is an important plant in traditional use. For example, in different part of the world these plants have been used traditionally for the treatment of blood diseases, syphilis, stomach problems, dysentery, nose disorders, ulcers, skin diseases, abdominal pains and anthelmintic.

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Phytochemical studies on different parts of these plants have indicated the presences of varieties secondary metabolites except *Dalbergia lactea vatke.* The widely reported are flavonoids, Cinnamyl flavan, terpenoids, and benzofuran among other things. On the other hand the bioassay studies on crude extracts and pure isolates have shown significant anti-inflammatory, anti-cancer, anti-oxidant, anti-microbial, anti-diabetic and anti-analgesic activities. However there is no literature survey performed on *Dalbergia lactea vatke.*

Keywords: Dalbergia; genus; phytochemical constituents; biological activity.

1. INTRODUCTION

1.1 Background of the Study

Plants are a valuable source of wide range of secondary metabolites that are used in pharmaceuticals, agrochemicals, flavour, colorant, bio pesticides and food additives due to that, two thirds of the new chemicals identified yearly were extracted from higher plants [1]. Plants are natures gift remedies in treating limitless range of diseases from acute to chronic from human and live stocks, as a matter of facts currently medicinal plants are getting attention than ever more, especially in the line of multidrug resistant bacteria and chronic disease like cancer, so that the bioactive phytochemical constituents of plants are being explored worldwide for their broad-spectrum medicinal potencies [2].

Medicinal plants used traditionally, are now moving from fringe to mainstream as people are becoming more aware of therapeutic properties of these medicinal plant resources and their products in maintaining health and preventing diseases. A medicinal plant" is any plant, which in one or more of its organ contains substance that can be used for the therapeutic purpose or which, are precursors for the synthesis of use full drugs [3]. From large number of medicinal plants genus of Dalbergia is the most common plants that are widely used throughout the world. Therefore on this review we are going to give detail explanation on *Dalbergia sissoo, Dalbergia odorifera, Dalbergia melanoxylon* and *Dalbergia lactea vatke* that belongs to this genus.

1.2 The genus of Dalbergia

The genus Dalbergia is placed under the subfamily Faboideae containing 274 species distributed all over the world, especially in the tropical and subtropical regions [4].This genus widely used in traditional medicinal system in Pakistan, India, Afghanistan, Bangladesh, Persia, Iraq, Palestine, India, Malaysia, Thailand, Indonesia, Cameroon, Sudan, Zimbabwe, Kenya, Tanzania and China [5]. The wood of these species has a characteristic color and texture that makes it highly desirable, and they are referred to by the common name of rosewood [6]. From the genus of Dalbergia the following four species are selected and reviewed.

1.2.1 *Dalbergia sissoo*

Dalbergia sissoo is called Indian Rose wood and belongs to the legume family (Fabaceae). It is a large deciduous perennial tree found in the lowland region throughout India, Pakistan, Afghanistan, China and Nepal [7].

Traditionally an aqueous extract of the leaves of *Dalbergia sissoo* has been used for the treatment of gonorrhea, blood diseases, syphilis, stomach problems, dysentery, nose disorders, ulcers and skin diseases due to the presence of various biological activities [8].

Fig. 1. Leaves and pods of *Dalbergia sissoo*

Fig. 2. Flowers of *Dalbergia sissoo*

1.2.2 *Dalbergia Odorifera*

Dalbergia odorifera is also known as fragrant rosewood, which belongs to genus of Dalbergia, is a semi-deciduous perennial tree. It grows in East Asian countries especially across Hainan and Guangdong province in China [9]. Heartwood is used in Chinese traditional medicine in the treatment of ischemia, blood stagnation syndrome swelling, rheumatic pain, epigastria, traumatic injuries and necrosis [10].

Fig. 3. Leaves of *Dalbergia odorifera*

Fig. 4. Seeds of *Dalbergia odorifera*

1.2.3 *Dalbergia melanoxylon*

Dalbergia melanoxylon is known as African Blackwood, and it is flowering plants belong to family of Fabaceae [11].

Traditionally, stem bark has a diverse local medicinal uses in Africa. For example, the leaves are boiled in soup and drunk to relieve pain in joints [12] and dried leaves smoked as cigarette to treat asthma and bronchitis [13].

Fig. 5. Leaves of *Dalbergia melanoxylon*

Fig. 6. Areal parts of *Dalbergia melanoxylon*

1.2.4 *Dalbergia lactea vatke*

Dalbergia lactea vatke is one species belonging to the genus of Dalbergia, as reported by Fenetahun and Eshetu, [14] the crushed leaves of this plant with water is used to treat mastitis, internal parasite and local swelling.

Phytochemical constituents and pharmacological activity are not performed on this plant. The areal parts of this plant have been depicted below.

Fig. 7. Leaves and flower of *Dalbergia lactea vatke*

2. PHYTOCHEMISTRY OF DALBERGIA

Phytochemicals are chemical that found in the different parts of plants. The following phytochemical has been reviewed for the selected four species of Dalbergia.

2.1 Flavonoids

Basic structure of neoflavonoid (1), flavonoid (2) and isoflavonoid are depicted below:

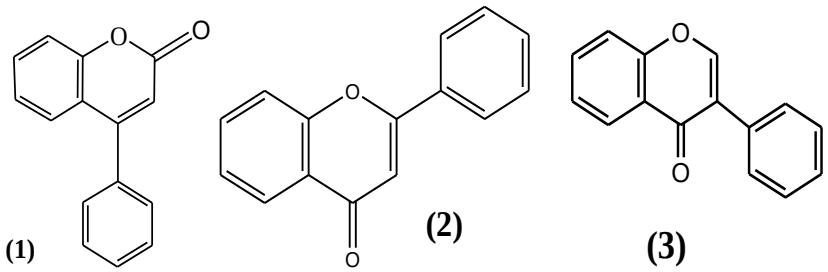

Fig. 8. Basic structure of neoflavonoids (1), flavonoids (2) and isoflavonoids (3)

The stem bark of *Dalbergia sissoo* contains Isoflavone-O-glycoside [15]. According to Liu, R et al., [16], the heartwood of *Dalbergia odorifera* and *Dalbergia sissoo* contains neo flavonoids (4-6), flavonoids (7-10), and (15-19) [17], and (23-25) [18] from the dried heartwood of *Dalbergia odorifera* and from the leave of *Dalbergia sissoo* compound (20) [19] are also obtained. From the heart wood of *Dalbergia melanoxylon* compound (11-14) is isolated [20]. From the heartwood of *Dalbergia odorifera* flavonoids (26 and 27) are isolated [21].

2.2 Benzofurans

Basic skeletal structure of aryl benzofuran is depicted below

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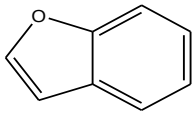

Fig. 9. The basic structure of benzofuran

From the heartwood of *Dalbergia odorifera* two aryl benzofurans (27 and 28) were isolated [22]. Obtusafuran (29) and melanoxin (30) [23], and from the heart wood (31) [24] compounds are obtained from *Dalbergia melanoxylon.*

2.3 Terpenoids

Terpenoids have unsaturated molecules composed of linked isoprene units and its skeletal structure of isoprene unit is depicted below.

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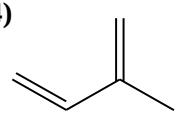

Fig. 10. Skeletal structures of isoprene

Phytochemical screening of the crude ethanol extract of the root of *Dalbergia sissoo* [25] and methanolic extracts of *Dalbergia odorifera* showed presence of terpenoids in stem and root [26]. The bark of *Dalbergia melanoxylon* also contains terpenoids [27]. The heartwood of *Dalbergia odorifera* afforded the sesquiterpe-nes (35-38) [21], and (39-44)[18]. No phytochemical investigation is performed on *Dalbergia lactea vatke.*

2.4 Cinnamylflavan

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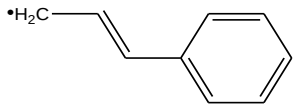


Fig. 11. Basic structure of Cinnamyl

Cinnamylflavans (45 and 46) have been isolated from acetone extract of heartwood of *Dalbergia melanoxylon* [28]. From the heartwood and root of *Dalbergia odorifera* Obtustyrene (47), Hydroxyobtustyrene (48), Isomucronustyrene (49) are isolated [29]. The last compounds (50 and 51) are isolated from the bark of *Dalbergia sissoo* [30].

3. PHARMACOLOGICAL ACTIVITIES

3.1 Anticancer Activity

Crude ethanol bark extract of *Dalbergia sissoo* also shows antiulcer activity [1]. The methanol extract and of the heartwood of *Delbergia odorifera* possessed potent inhibition of human tumor cell. Compound, 2'-*O*-methyl-isoliquiritigenin, isolated from the heartwood of *Dalbergia odorifera*, showed cytotoxic activity against cancer cell [5]. Flavonoids and phenolic components isolated from the heartwood of *Delbergia odorifera* also shows cytotoxic activity against cancer cell [9] and also compounds (33,

24,25) have significant anti-tumor effects on human cancer cell [18]. As reported by Bhattacharya, et al., [31], compounds like an isoflavone, biochanin is a potent chemotherapeutic cancer preventive agent.

3.2 Antioxidant Activities

Flavonoids compound isolated from the root of *Dalbergia odorifera* showed very strong anti-oxidant activities **[**32]. Stem bark extract of *Dalbergia sissoo* has higher antioxidant activity due to the presence of both the polyphenol and the flavonoid [33]. Tannins and Neoflavanoids obtained from the roots bark, stem bark and leaves of *Dalbergia melanxylon* are the potent antioxidant and free radical scavenger activities [11].

3.3 Antimicrobial Activities

A crude extract and 3-Hydroxyisoflavanones shows antibacterial activities [34]. Methanolic extracts of *Dalbergia sissoo* shows antibacterial activities against *Staphylococcus aureus* and *Pseudomonas aeruginosa* [35,36]. The isolated sesquiterpenes and flavonoids from the heart wood of *Dalbergia odorifera* also show antibacterial activity against *Candida albicans* and *Staphylococcus aureus* Isolated compound (15, 16, 17 and 18) showed strong antibacterial activity [17].

3.4 Anti-Inflammatory Activities

The Neoflavonoid Latifolin, compound (12) isolated from MeOH extract of *Dalbergia odorifera* exhibit anti-inflammatory activity [37]. Flavonoids have been reported to exhibit anti-inflammatory activity [38].

As reported by Tao and Wang, [26], 4, 2′, 5′-Trihydroxy-4′-methoxychalcone from *Dalbergia odorifera* exhibits anti-inflammatory properties**.** The ethanolic leaves extract of *Dalbergia sissoo* possesses anti-inflammatory activity [39]. Chalcone [(*E*)-3-(3,4-dihydroxyphenyl)-1-(2,3,4-trihydroxyphenyl) prop-2-en-1-one] or compound (20) isolated from the leaves of *Dalberia sissoo* exhibit anti-inflammatory activity [19]. The isolated compounds like isoflavanones, neoflavone benzofuran and N-cinnamoyl from the heartwood and bark of *Dalbergia melanoxylon* possesses anti-inflammatory activities [20].

3.5 Ant-Diabetic Activity

The ethanol, ethyl acetate, n-butanol and petroleum ether extracts of leave of *Dalbergia sissoo* showed most potent ant diabetic activities [40]. According to Al-Snafi, [1], the ethanol leaf extracts of this plant, exhibited high ant-diabetic activity which is comparable with the standard drug, Glibenclamide. Methanol extract [41] and isolated compounds like 6-dihydroxy-7-methoxyflavanone (21) and isoliquiritigenin from the heart wood of *Dalbergia odorifera* show anti-diabetic activity [42]. Anti-diabetic activities of *Dalbegia melanoxylon* are not reported. But since different flavonoids are isolated from the different parts of *Dalbergia melanoxylon* it will show anti-diabetic activities [43-46].

3.6 Analgesic Activities

As reported by Hajare et al. [39], flavonoids are known to inhibit prostaglandin synthetase. Ethanolic extract of *Dalbergia sissoo* leaves [47] and seeds [48] have shown analgesic activity. Analgesic activities of *Dalbergia melanoxylon* and Dalbergia *odorifera* are not reported.

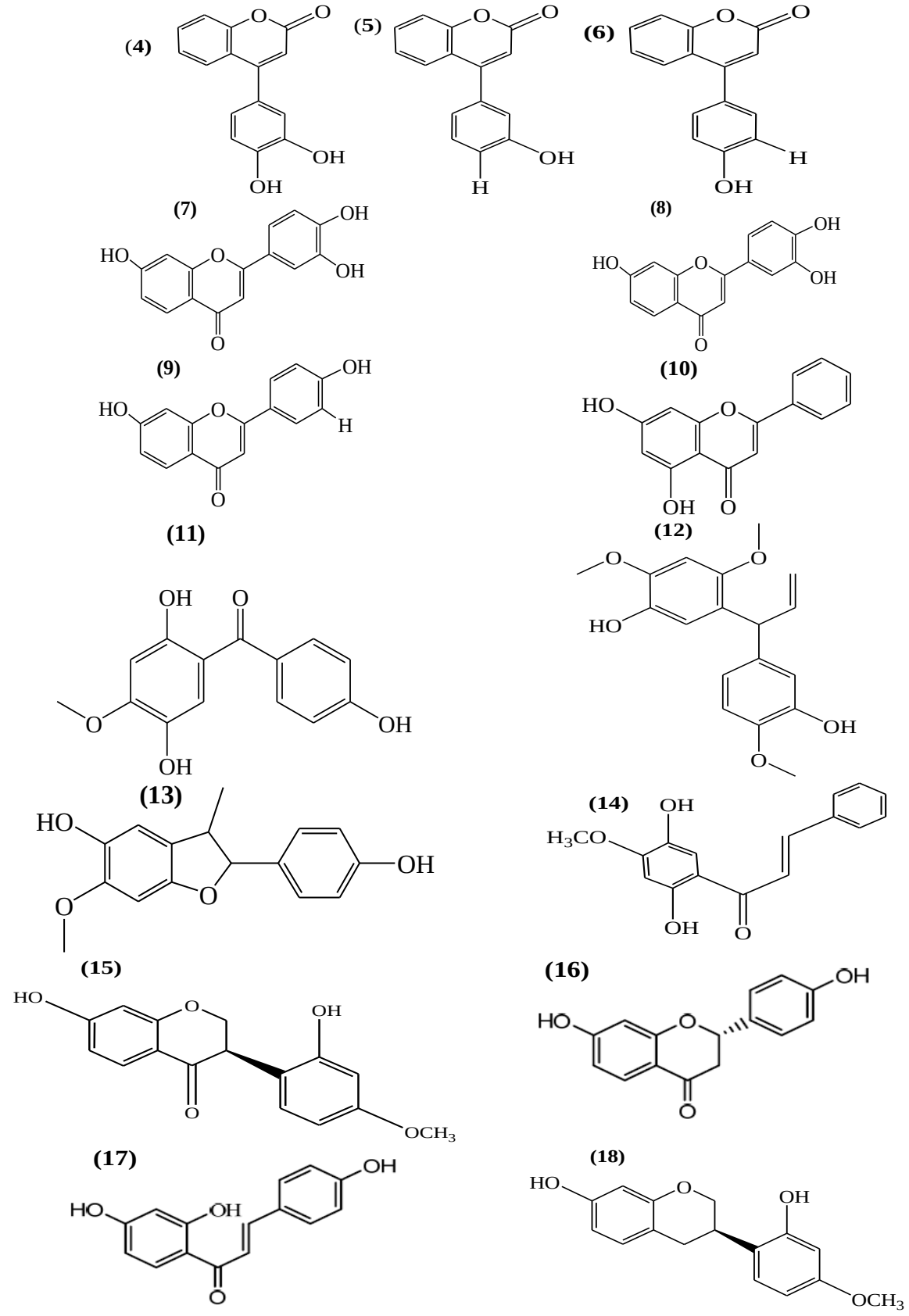
3.6.1 Summery in tabulated form

Table 1. Compounds isolated from the genus Dalbergia

No.	Class and compound name	Occurrence /part	References
1	Neoflavonoids (2'-*O*-methyl-isoliquiritigenin) Flavonoids	*Dalbergia odorifera* (HW)	[17]
		Dalbergia melanoxylon (HW*)*	[18]
	Isoflavonoids	*Dalbergia sissoo* (HW)	[16]
2	Sisquiterpene	*Dalbergia melanoxylon* (bark*)* and *Dalbergia odorifera* (HW)	[27] [26]
3	Obtusafuran and melanoxin	*Dalbergia odorifera* (HW) *Dalbergiamelanoxylon* (HW)	[22]. [24]
4	Phenolic compounds	*Dalbergia odorifera* (HW)	[21]
		Dalbergia melanoxylon (stem bark)	[45]
		Dalbergia sissoo (stem bark)	[33].
6	Hydroxyobtustyrene and Isomucronustyrene	*Dalbergia odorifera* (HW)	[29]
		Dalbergia melanoxylon (HW)	[28] [30].
		Dalbergiasissoo (bark)	

Note: HW: heartwood

3.6.2 Structure of isolated compounds



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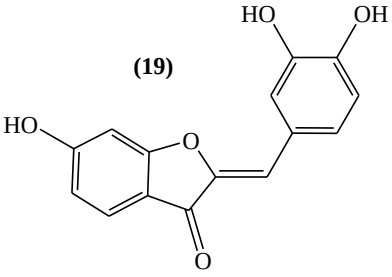

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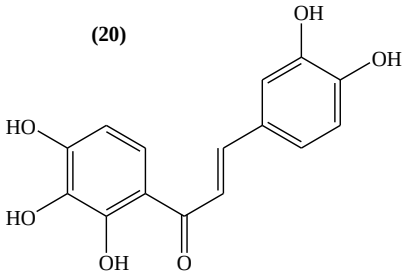

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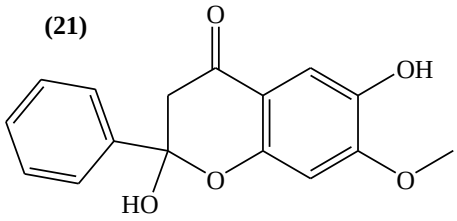

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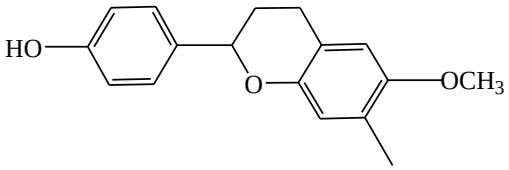

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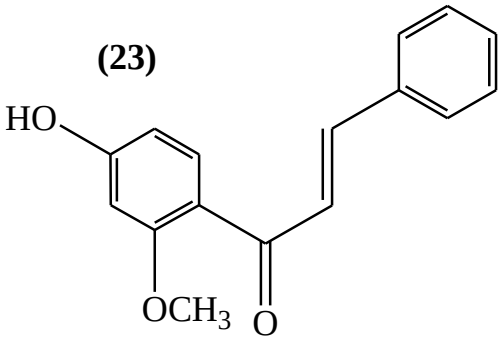

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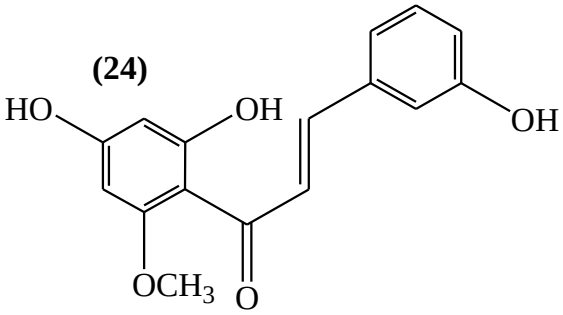

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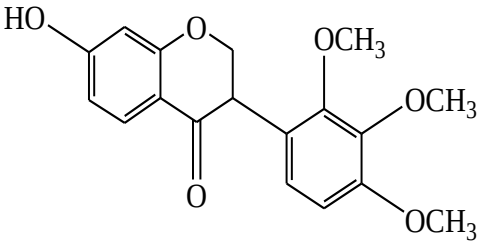

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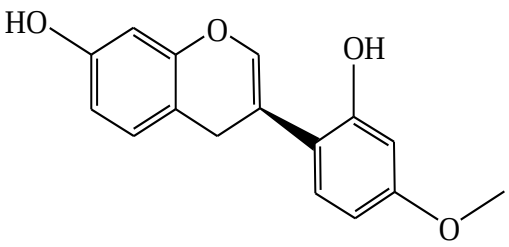

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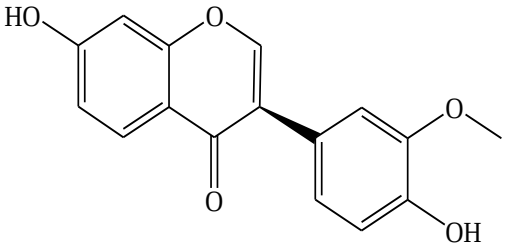

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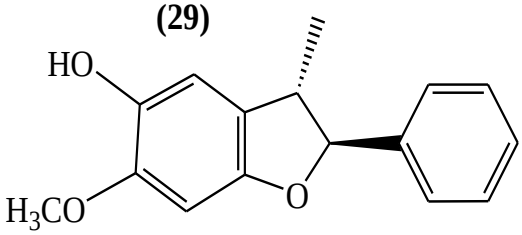

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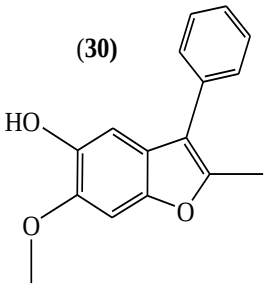

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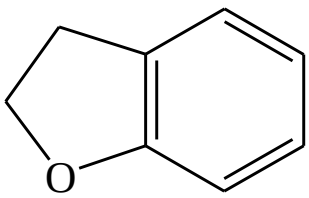

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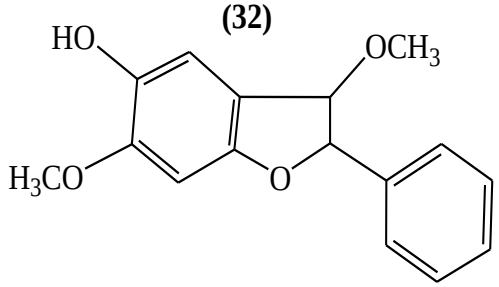

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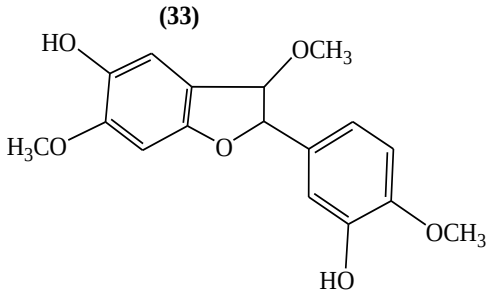

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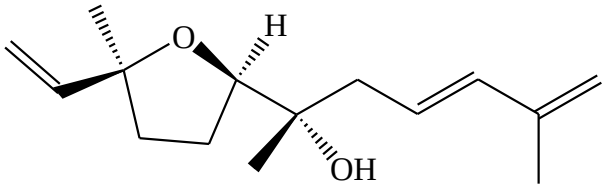

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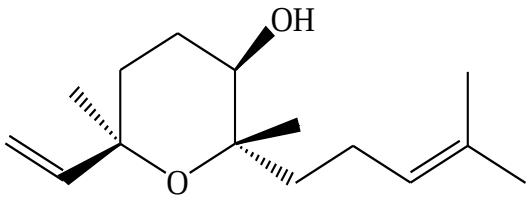

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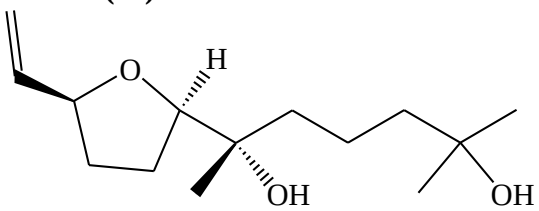

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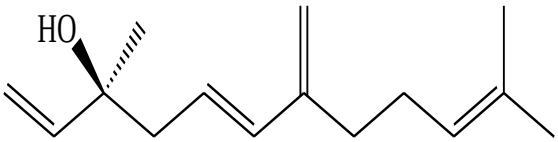

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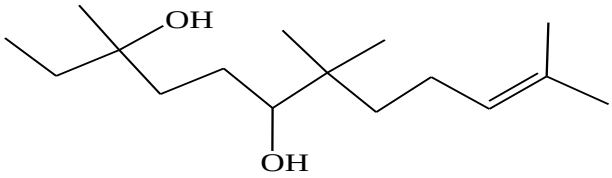

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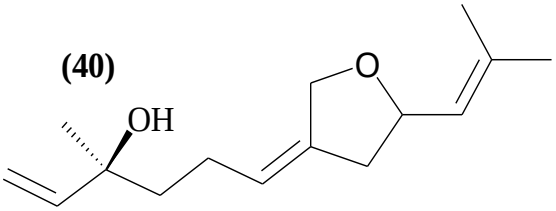

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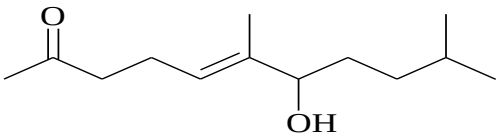

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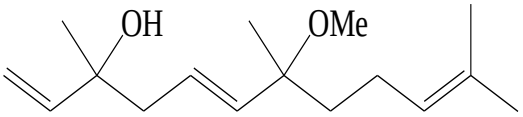

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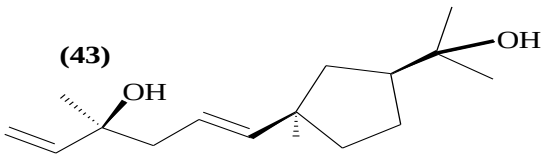

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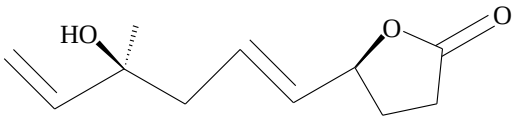

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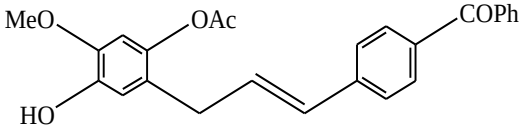

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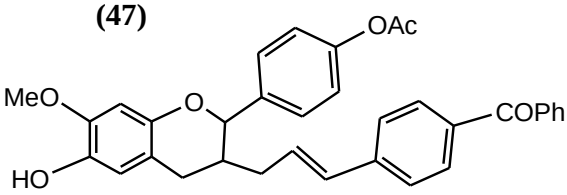

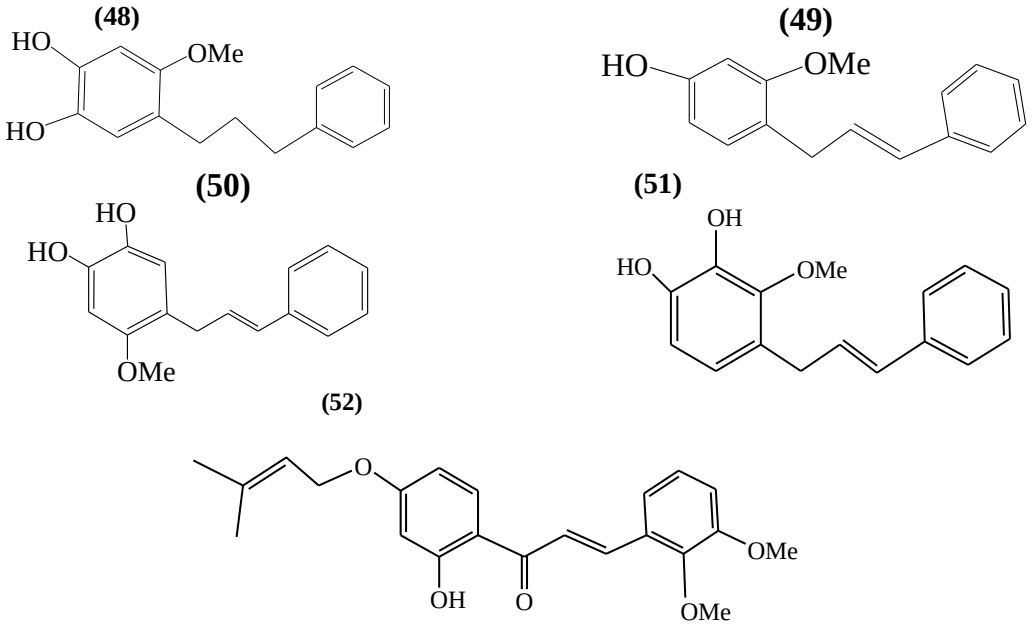

3.7 Pharmacological Studies

Table 2. A summary of biological activities

Compound	Pharmacological Activity	References
2'-*O*-methyl-isoliquiritigenin	cytotoxic activity against cancer cell	[5]
Isoflavone and biochanin	cytotoxic activity against cancer cell	[31]
Flavonoids	Anti-oxidant activities	[49]
A 3-Hydroxyisoflavanones	Anti-microbial activity	[34]
Sesquiterpenes	Anti-bacterial acyivity	[18]
A 4,2′,5′-Trihydroxy-4′-methoxychalcone	Anti-inflammatory activities	[26]
Chalcone or [(*E*)-3-(3,4-dihydroxyphenyl)-1-(2,3,4-trihydroxyphenyl) prop-2-en-1-one	Anti-inflammatory activities	[50]
isoflavanones, neoflavone and benzofuran	Anti-inflammatory activities	[20]
A 6-dihydroxy-7-methoxyflavanone and isoliquiritigenin	Antidiabetic activity	[42].

4. CONCLUSION

Medicinal plants are the bio resources given by nature and are used to heal a group of human diseases and to evaluate the probable sources for new drugs. Among medicinal plants *Dalbergia odorifera*, *Dalbergia sissoo, Dalbergia melanoxylon* and *Dalbergia lactea vatke* are the known plants have been used medicinally for thousands of years all over the world. Phytochemical investigation and pharmacological activity of the bark, leave, heart wood, root and fruits of these plants reveal a number of secondary metabolites that showed good to moderate biological activities [51-55]. These plants has medicinal values since it contains more secondary metabolites such as terpenoids, flavonoids (including neo and iso flavonoids), cinnamoylflavan, benzofuran, and these phytochemicals shows moderate biological activities such as, anti-inflammatory, anti-cancer, anti-oxidant, anti-microbial, ant- diabetic and analgesic activities. No phytochemical investigation and pharmacological activity was performed on *Dalbergia lactea vatke,*

COMPETING INTERESTS

Author has declared that no competing interests exist.

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