Review Article

TRADITIONAL USE, PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIVITIES OF FOUR DALBERGIA SPECICES (DALBERGIA SISSOO, DALBERGIA ODORIFERA, DALBERGIA MELANOXYLON AND DALBRGIA LACTEA VATKE) (A REVIEW)

ABSTRACT

This review study concerned to survey traditional use and scientific reports for four Dalbergiaspecies, namely: Dalbergia sisso, Dalbergia melanoxylon, Dalbergia odorifera and Dalbergialactea vatke. Genus Dalbergia (Fabaceae or Leguminosae) *is an important plant in traditionaluse. For example, in different part of the world these plans have been used traditionally totreatment a wide range of ailments such as blood diseases, syphilis, stomach problems, dysentery,nausea, eye and nose disorders, ulcers, skin diseases, abdominal pains, anthelmintic and etc.*

Phytochemical studies on deferent parts of these plants have indicated the presences of varietiessecondary metabolites except Dalbergia lactea vatke. The widely reported are flavonoids,neoflavonoids, isoflavonoids, terpenoids, and benzofuran among other things. On the other handthe bioassay studies on crude extract and pure isolates have shown significant, anti-inflammatory,anti-cancer, anti-oxidant, anti-microbial, anti-diabetic and *anti-analgesic activities. Howeverthere is no literature survey performed on Dalbergia lactea vatke.*

Key word: *Dalbergia genus; phytochemical constituents; Biological activity*

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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, fragrances, colourant, biopesticides and food additives due to that, two thirds of the new chemicals identified yearly were extracted from higher plants (Snafi, 2017). 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 plant are being explored worldwide for their broad-spectrum medicinal potencies (Rashed et al., 2018).

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 (Sundar and Habibur, 2018). From large number of medicinal plants genus of Dalbrgia is the most common plants that are widely used throughout the world. Therefore on this seminar we are going to give detail explanation on these plants that belongs to this genus.

1.1 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 (Moritsuka et al., 2017).These 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 (Saha et al., 1901). 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 (McClure et al., 2015). From the genus of Dalbergia the following four species are selected and reviewed.

1.1.1 *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 **(Asif and Kumar, 2009).** Traditionally an aqueous extract of the leaves of *Dalbergia sissoo* has been used for the treatment of gonorrhea in arabic countries due to the presence of various biological activities such as effective against blood diseases, syphilis, stomach problems, dysentery, nausea, eye and nose disorders, ulcers, skin diseases and etc **(Asif and Kumar, 2011).**

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

Fig. 2: Flowers of *Dalbergia sissoo*

1.1.2 *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 **(Choi et al., 2009)**. Heartwood is used in Chinese traditional medicine in the treatment of ischemia, blood stagnation syndrome swelling, rheumatic pain, epigastria, traumatic injuries and necrosis **(Kang et al., 2005).**

Fig. 3 Leaves of *Dalbergia odorifera*

Fig.4 Seeda of *Dalbergia odorifera*

1.1.3 *Dalbergia melanoxylon*

Dalbergia melanoxylon is known as African Blackwood, and it is a flowering plant belongs to family of Fabaceae known to be an economically important tree with high-quality wood and being one of the most expensive timbers in the world (Amri and Juma, 2016). 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 (Kareru et al., 2008) and dried leaves smoked as cigarette to treat asthma and bronchitis (Chigora et al., 2007).

Fig.5 leaves of *Dalbergia melanoxylon*

Fig.6Areal parts of *Dalbergia melanoxylon*

1.1.4 *Dalbergia lactea vatke*

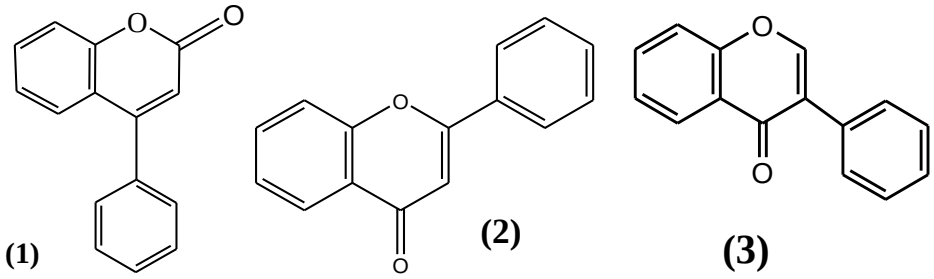
Dalbergia lactea vatke is one species belonging to the genus of Dalbergia, as reported by Fenetahun and Eshetu, 2017, the crushed leaves of this plant with water is used to treat Mastitis, Internal Parasite, local Swelling. There is no phytochemical constituents and pharmacological investigation performed 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 species

2.1 . Flavonoids

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



(1) **(2)** **(3)**

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

The stem bark of *Dalbergia sissoo* contains Isoflavone-O-glycoside (**Sabira et al., 2015).** According to **Liu, R et al., 2005,** the heartwood of *Dalbergia odorifera* and *Dalbergia sissoo* contains neo flavonoids (**4-6**), flavonoids **(7-10),** and **(15-19) (Zhao et al., 2011),** and **(23-25) (Zhao, X et al., 2019)** from the dried heartwood of *Dalbergia odorifera* and from the leave of *Dalbergia sissoo* compound **(20) (Behera et al., 2013)** are also obtained. From the heart wood of *Dalbergia melanoxylon* compound **(11-14)** is isolated **(lin et al., 2019).** From the heartwood of *Dalbergia odorifera* flavonoids (**26** and **27**) are isolated **(Wang, H et al., 2014**).

2.2 .Benzofurans

Basic skeletal structure of aryl benzofuran is depicted below

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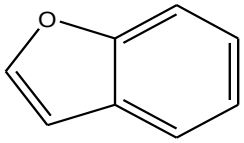

Fig.9: The basic structure of benzofuran

From the heartwood of *Dalbergia odorifera* two aryl benzofurans (**27** and **28**) were isolated **(An et al., 2008).** Obtusafuran (**29)** and melanoxin (**30) (Muangnoicharoen and Frahm, 1981),** and from the heart wood **(31) (Donnelly et al., 1969)** compounds are obtained from *Dalbergia melanoxylon.*

2.4. Terpenoids

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

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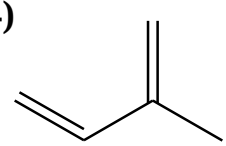

Fig. 10: Skeletal structures of isoprene

Phytochemical screening of the crude ethanol extract of the root of *Dalbergia sissoo* **(Hajare et al., 2001)** and methanolic extracts of *Dalbergia odorifera* showed presence of terpenoids in stem and root (**Tao and Wang, 2010).** The bark of *Dalbergia melanoxylon* also contains terpenoids **(Njeru and Obonyo, 2016).** The heartwood of *Dalbergia odorifera* afforded the sesquiterpenes **(35-38) (Wang, et al., 2014),** and **(39-44) (Zhao, X et al., 2019).** No phytochemical investigation is performed on *Dalbergia lactea vatke.*

2.6 Cinnamylflavan

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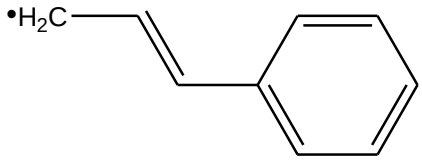

Fig.11 Basic structure of Cinnamyl

Cinnamylflavans **(45 and 46)** have been isolated in a number of phenol-cinnamyl alcohol condensations from the acetone extract of heartwood of *Dalbergia melanoxylon* **(Donnflly et al., 1975)**. From the heartwood and root heartwo od of *Dalbergia odorifera* cinnamylflavan n amely Obtustyrene **(47),**Hydroxyobtustyrene **(48)**,Isomucronustyrene **(49)** are isolated **(Goda et al., 1985).** The last compound (**50 and 51**) is isolated from the bark of *Dalbergia sissoo* **(Reddy, R et al., 2008).**

3. Pharmacological Activities

3.1 Anticancer activity

Crude ethanol bark extract of *Dalbergia sissoo* also shows antiulcer activity (**Al-Snafi, 2017).** 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 **(Saha et al., 1901).** Flavonoids and phenolic components isolated from the heartwood of *Delbergia odorifera* also shows cytotoxic activity against cancer cell (**Choi et al., 2009)** and also compounds (**33,24,25**) have significant anti-tumor effects on human cancer cell **(Zhao, X et al .,2019).** AS reported by **Bhattacharya, et al., (2014), c**ompounds 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 **(Cheng et al., 1998).** Stem bark extract of *Dalbergia sissoo* has higher antioxidant activity due to the presence of both the polyphenol and the flavonoid **(Roy et al., 2011).** Tannins and Neoflavanoids obtained from the roots bark, stem bark and leaves of *Dalbergia melanxylon* are the potent antioxidant and free radical scavenger activities **(Amri and Juma, 2016).**

3.3 Antimicrobial Activities

The investigation on *Dalbergia melanoxylon* extracts shows antimicrobial activity **(Gundidza and Gaza, 1993).** A crude extract and 3-Hydroxyisoflavanones from the stem bark of *Dalbergia melanoxylon* shows antibacterial activities **(Mutai et al., 2013).** Methanolic extracts of *Dalbergia sissoo* shows antibacterial activities against *S.aureus* and *Pseudomonas* (**Yadav et al., 2008: Prasad et al., 2014).** The isolated sesquiterpenes and flavonoids from the heart wood of *Dalbergia odorifera* also shows antibacterial activity against *C. albicans* and *S. aureus*, *R. solanacearum*. Isolated compound **15**, **16**, **17** and **18** showed strong antibacterial activity **(Zhao et al., 2011).**

3.4 Anti-inflammatory activities

The Neoflavonoid Latifolin, compound (**12)** isolated from MeOH extract of *Dalbergia odorifera* exhibit anti-inflammatory activity **(Lee et al., 2014).** Flavonoids have been reported to exhibit anti-inflammatory properties **(Hodeket al., 2002).** As reported by **Tao and Wang, (2010),** 4, 2′, 5′-Trihydroxy-

4′-methoxychalcone from *Dalbergia odorifera* exhibits anti-inflammatory properties**.** The ethanolic leaves extract of *Dalbergia sissoo* possesses anti-inflammatory activity **(Hajare et al., 2000).** Chalcone [(*E*)-3-(3,4dihydroxyphenyl)-1-(2,3,4-trihydroxyphenyl) prop-2-en-1-one] or compound **(20)** isolated from the leaves of *Dalberia sissoo* exhibit anti-inflammatory activity (**Behera et al., 2013).** The isolated compounds like isoflavanones, neoflavone benzofuran and N-cinnamoyl from the heartwood and bark of *Dalbergia melanoxylon* possesses anti-inflammatory activities **(Lin et al., 2019).**

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 **(Panda et al., 2016).** According to Al-Snafi, (2017), the ethanol leaf extracts of this plant, exhibited high ant diabetic activity which is comparable with the standard drug, Glibenclamide. Methanol extract **(Ninh, 2017)** and Isolated compounds like 6-dihydroxy-7-methoxyflavanone **(21)** and isoliquiritigenin **(22**) from the heart wood of *Dalbergia odorifera* show antidiabetic activity (**Zhao et al., 2013**). 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.

3.6 Analgesic activities

As reported by **Hajare et al., (2000),** flavonoids are known to inhibit prostaglandin synthetase. Ethanolic extract of *Dalbergia sissoo* leaves **(Vasudeva et al., 2009**) and seeds (**Sehra et al., 2018)** have shown analgesic activity Analgesic activities of *Dalbergia melanoxylon* and *Dalbergia odorifera* are not reported.

Summery in tabulated form

Table 1: Compounds isolated from the genus dalbrgia

No.	Class and compound name	Occurrence /part	References
1	Neoflavonoids (2'-*O*-methyl-isoliquiritigenin) Flavonoids Isoflavonoids	*Dalbergia odorifera* (HW) *Dalbergia melanoxylon* (HW) *Dalbergia sissoo* (HW)	(Zhao, X et al.,2011) (Zhao, X et al .,2019) (Liu, R et al., 2005)
2	Sisquiterpene	*Dalbergia melanoxylon* (bark) and *Dalbergia odorifera* (HW)	(Njeru, S. N. andObonyo, M. A. 2016) (Tao, Y and Wang, Y. 2010)
3	Obtusafuran and melanoxin	*Dalbergia odorifera* (HW) *Dalbergiamelanoxylon* (HW)	(An, R. et al., 2008). (Donnelly et al.,1969)
4	Phenolic compounds	*Dalbergia odorifera* (HW) *Dalbergia melanoxylon* (stem bark) *Dalbergia sissoo* (stem bark)	(Wang, H et al., 2014) (Swetha, U. 2017) (Roy, N et al., 2011).
6	Hydroxyobtustyrene and Isomucronustyrene	*Dalbergia odorifera* (HW) *Dalbergia melanoxylon* (HW) *Dalbergiasissoo* (bark)	(Goda et al., 1985) (Donnflly et al., 1975) (Reddy, R et al ., 2008).

Note: HW: heartwood

Fig.12:Structure of isolated compounds

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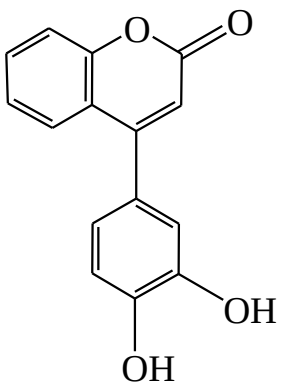

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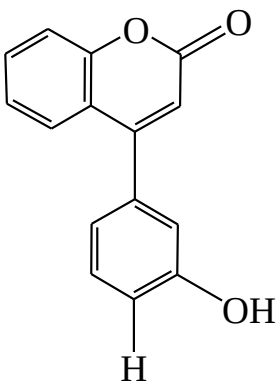

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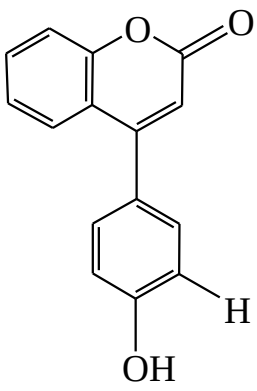

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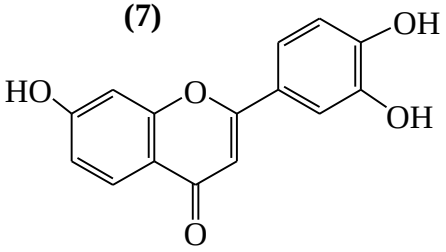

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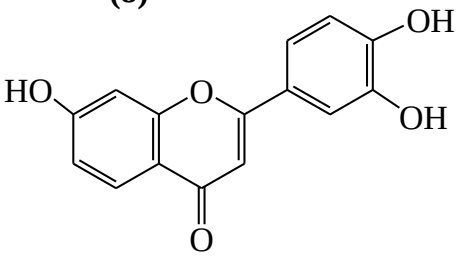

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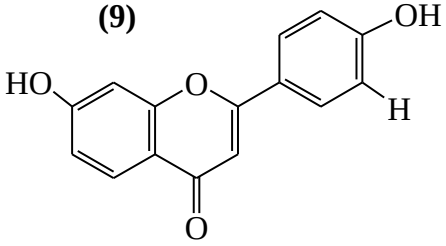

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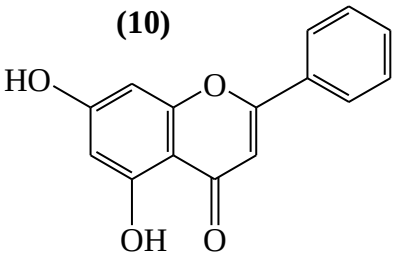

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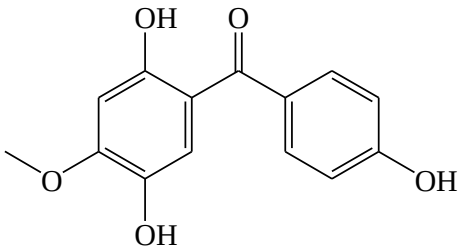

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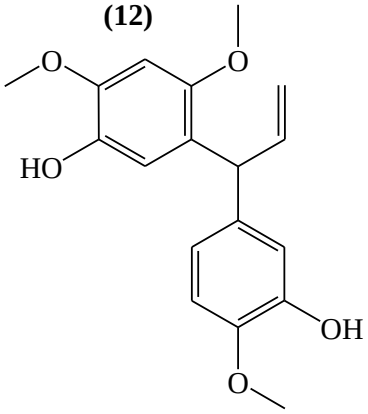

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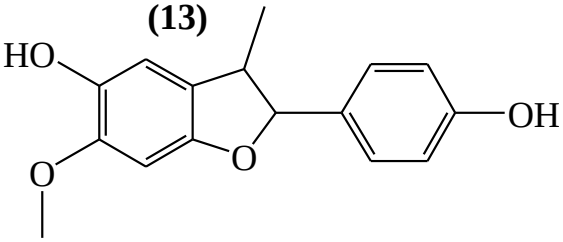

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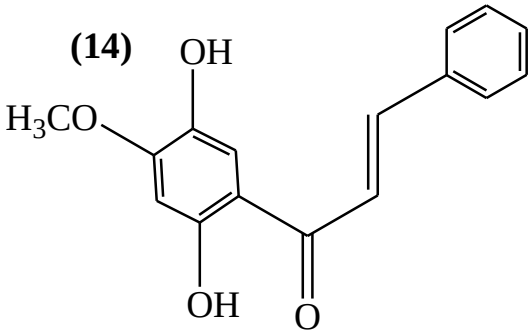

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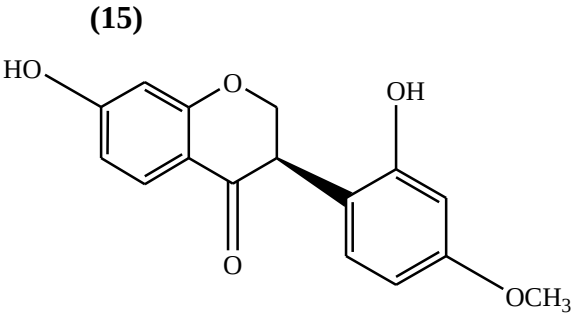

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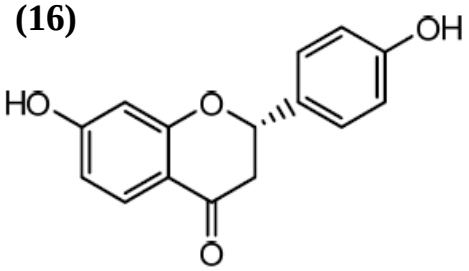

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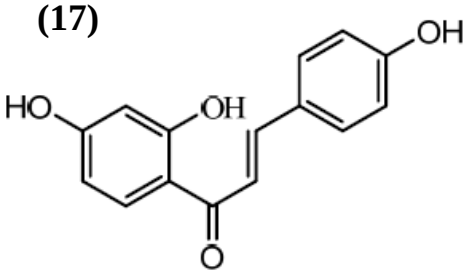

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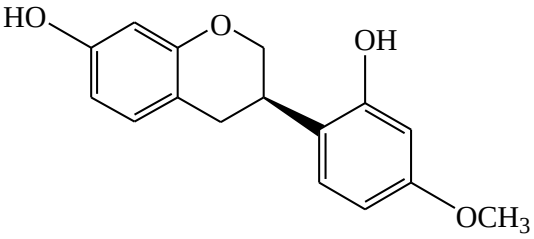

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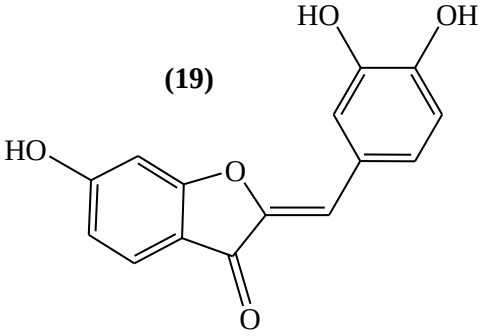

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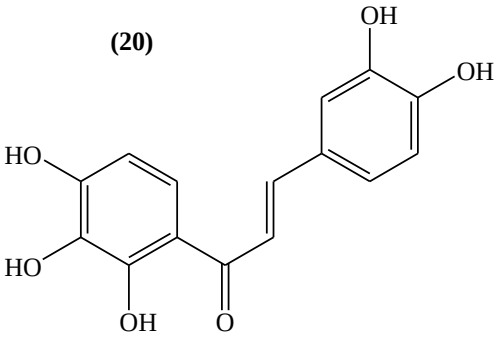

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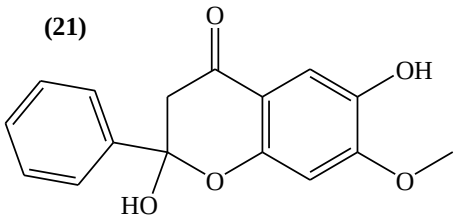

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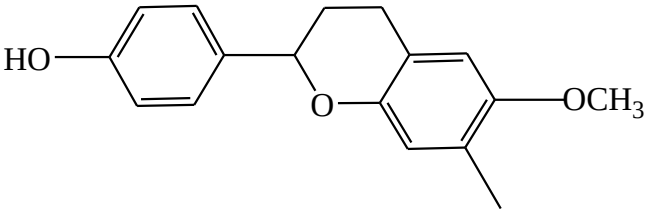

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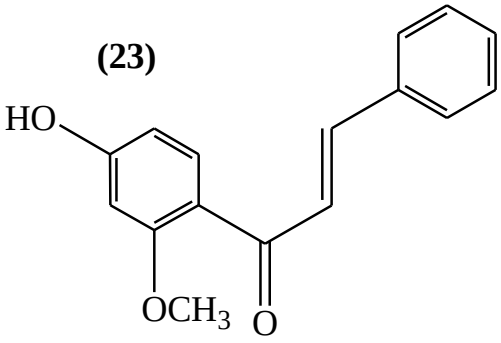

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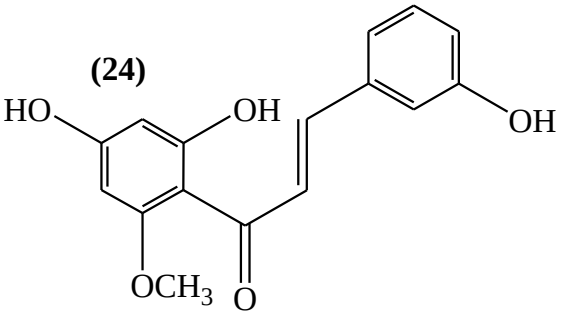

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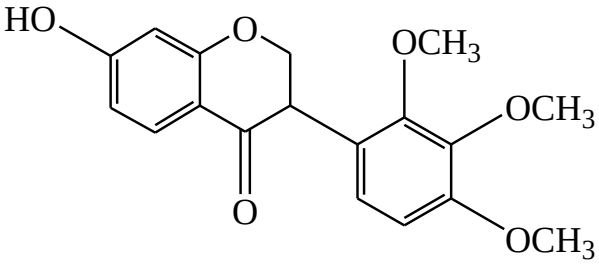

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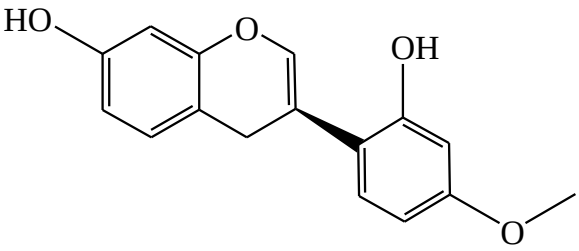

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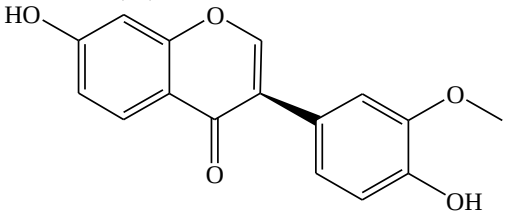

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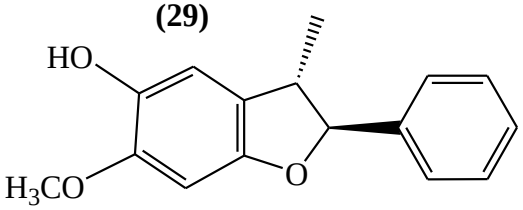

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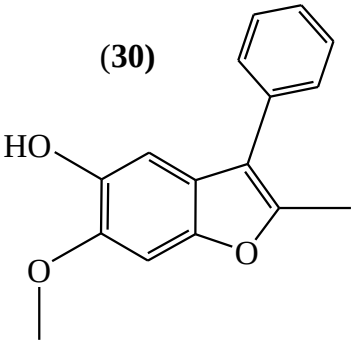

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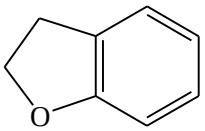

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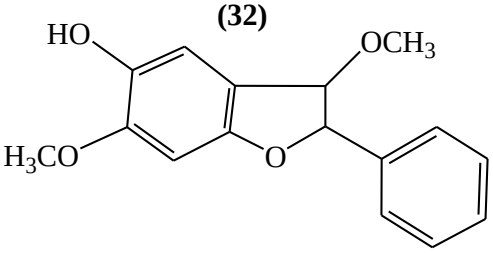

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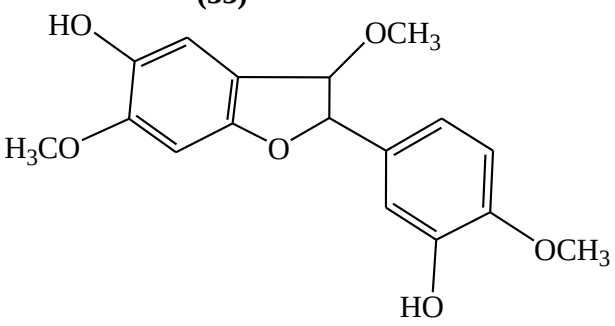

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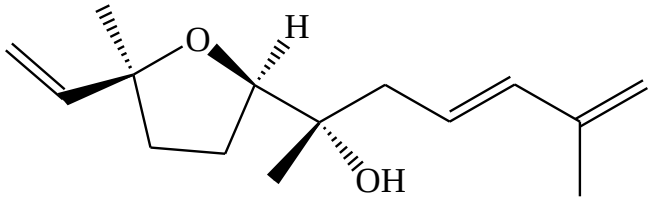

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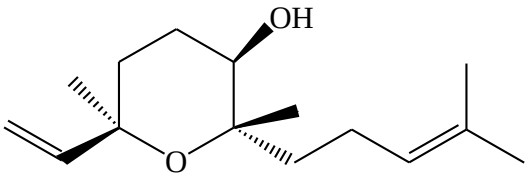

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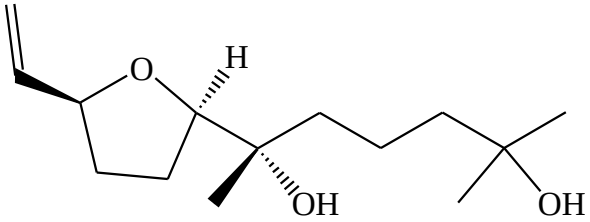

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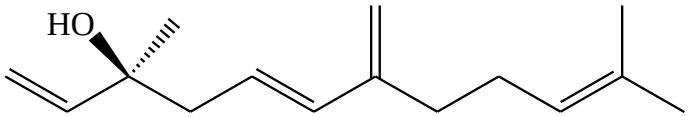

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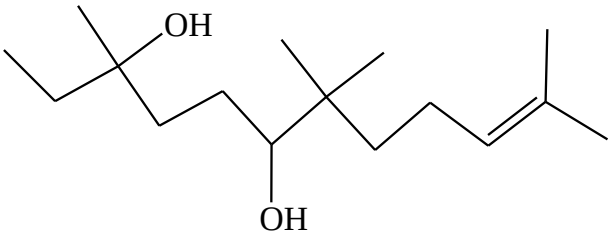

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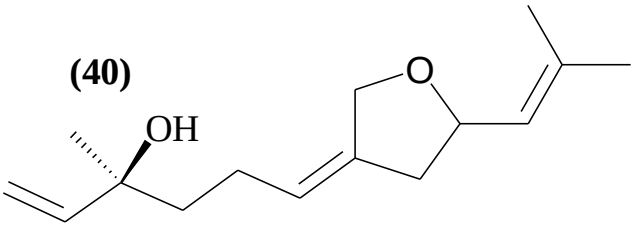

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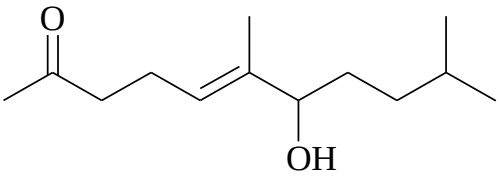

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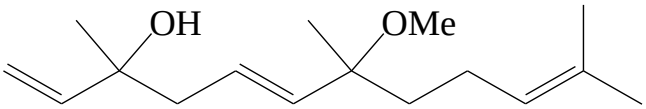

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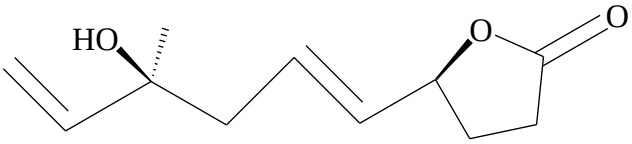

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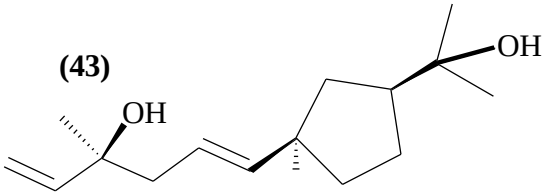

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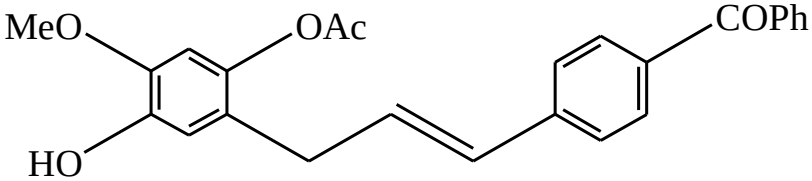

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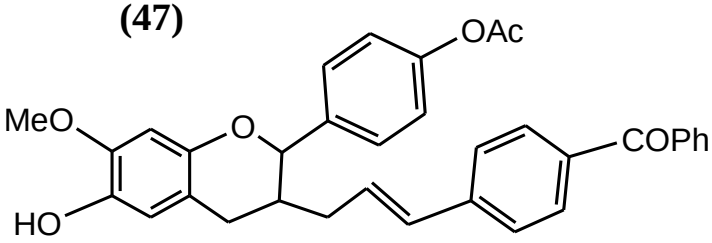

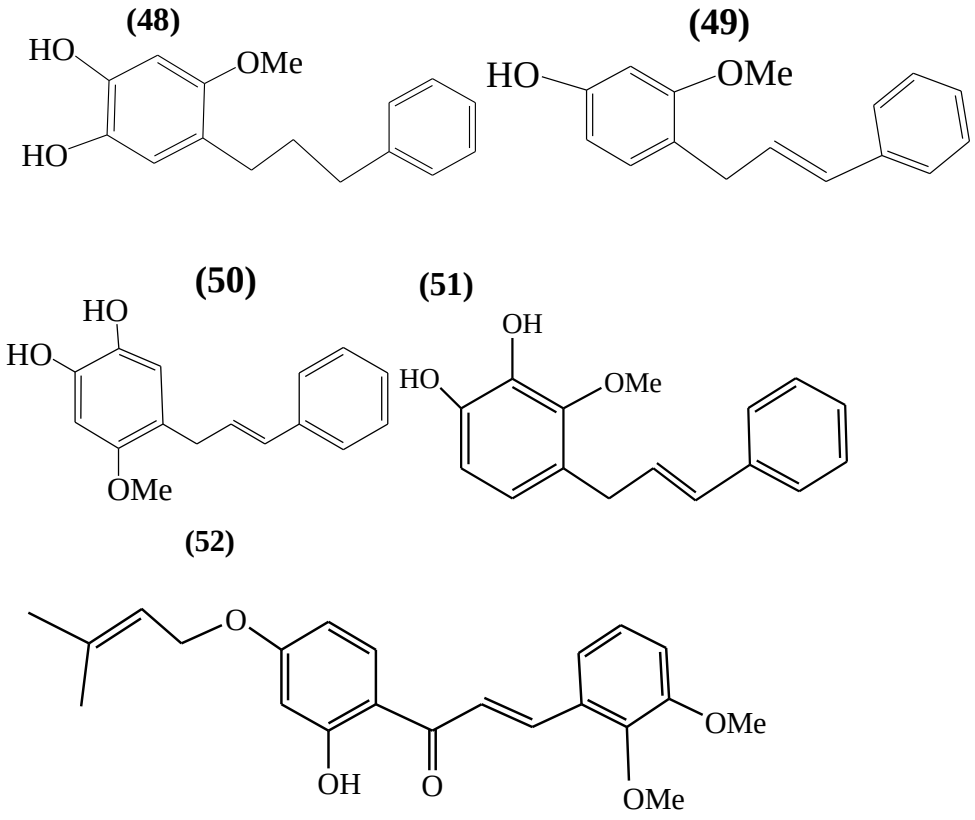

Pharmacological studies

Table 2: A summary of biological activities

Compound	Activity	References
2'-*O*-methyl-isoliquiritigenin	cytotoxic activity against cancer cell	(Saha, S et al .,1901)
Isoflavone and biochanin	cytotoxic activity against cancer cell	(Bhattacharya, M et al., 2014
Flavonoids	Antioxidant activities	(Swetha, U. 2017)
A 3-Hydroxyisoflavanones	Antimicrobial activity	(Mutai, P et al., 2013)
Sesquiterpenes	Antibacterial acyivity	(Zhao, X et al., 2019)
A 4,2′,5′-Trihydroxy-4′-methoxychalcone	Anti-inflammatory activities	(Tao, Y., and Wang, Y. 2010)
Chalcone or [(*E*)-3-(3,4-dihydroxyphenyl)-1-(2,3,4-trihydroxyphenyl) prop-2-en-1-one	Anti-inflammatory activities	(Bharath, M et al., 2013)
isoflavanones, neoflavone	Anti-inflammatory activities	(Lin .,et al 2019)

Compound	Activity	References
and benzofuran		
A 6-dihydroxy-7-methoxyflavanone and isoliquiritigenin	Antidiabetic activity	(Zhao, C et al., 2013).

3. 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. Except *Dalbergia lactea vatke*, 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. Three of these plants has medicinal values since it contains more secondary metabolites such as terpenoids, flavonoids (including neo and iso flavonoids), cinnamoylflavan and benzofuran and these phytochemicals shows biological activities such as, anti-inflammatory, anti-cancer, anti-oxidant, anti-microbial, ant diabetic and ant analgesic activities.

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Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.