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# A Review on the Phytochemistry and Pharmacology of Genus *Tephrosia*

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**Abstract**

The plants of genus *Tephrosia* of family *Leguminosae* are widely distributed in many tropical and subtropical countries of the world and have been used in folk medicine for the treatment of large number of diseases. The importance of this genus is similar to that of other therapeutically renowned genera. This review includes the chemical studies on different species mainly the isolation and identification of flavonoids, rotenoids and study of activity of some isolated compounds and also includes diffe-rent pharmacological activities like antioxidant, antimicrobial, anticancer, antiplas-modial, anti-inflammatory, larvicidal and toxicity studies of extracts and fractions.

**Keywords**: *Tephrosia*; Flavonoids; Rotenoids; Phytochemistry; Pharmacology; Acivity.

## Introduction

Plants have been used for the treatment of diseases from centuries. Natural product chemistry, especially phytochemistry, has become a topic of interest for most of the researchhers due to the advantages of the plant derived medicinal compounds over the traditional ways of using herbal plants. Ethnopharmacology plays an important role in the discovery of new biologically active compounds. The process usually starts with searching of useful plants from different records to the development of methods for the industrial production of drugs (Rout et al., 2009; Farnsworth et al., 1985; Koehn and Carter, 2005). According to World Health Organization (WHO) more than 80% of the world's population uses plants for the treatment of their diseases (Calixto et al., 1998; Duraipandiyan et al., 2006).

The genus *Tephrosia* belongs to the family *Leguminosae* and subfamily Papilionaceae. There are approximately 400 species included in this genus. The plants in this genus are widely distributed in tropical, sub-tropical and arid regions of the world (Willis, 1973; Al-

 

Zahrani, 2007). The plants are prostate or erect herbs or in the form of soft or woody shrubs (Hacker, 1990). The base chromosome number of this genus is X=11 and are placed in the tribe Galegeae of the family *Leguminosae* (Atchison, 1951; Agarwal and Gupta 1983). Many plants from this genus have been used traditionally for the treatment of diseases like rheumatic pains, syphilis, dropsy, stomach ache, diarrhea, asthma, abortifacient, respiratory disorderrs, laxative, diuretic, and inflammation etc (Qureshi et al., 2010; Dzenda et al., 2007). *Tephrosia purpurea*, an important plnt of the genus is used as tonic, laxative, antivenom, antiulcer, antidiarhheal, and in leprosy (Virupanagouda et al., 2011).

The main purpose of this review is to provide a comprehensive and up-to-date knowledge of the pharmacological and phytochemical research work performed on the genus *Tephrosia*. The plants of this genus have a large potential for study of its activities and chemical constituents for important leads.

## Chemical constituents from plants of genus *Tephrosia*

A great variety of plants belonging to genus *Tephrosia* have been studied for their chemical constituents and pharmacological activities. The number of species studied phytochemically are much more than those studied pharmacologically. Different classes of organic compounds have been isolated of which some have been tested for their biological activities and some still unknown for their effect. The main classes of compounds include flavonoids, rotenoids, terpenoids, and sterols. It should be noted that flavonoids are the most abundantly isolated and identified compounds in the genus. Similarly in case of essential oil and fixed oil, we can see that very little work has been done by the scientists. *Tephrosia purpurea, Tephrosia toxicaria, Tephrosia candida, Tephrosia elata*, and *Tephrosia villosa* have been the plants of interest for the scientists. The readers will also find some work on the stereochemistry of compounds. Praecansone A, flavonoid from *Tephrosia pumila* for example, exists in the form of two isomers (Dagne et al., 2012).

Table 1 briefly describes all the chemical work done on genus Tephrosia. Readers will see some novel compounds as well some compounds repeating in many species. Some chemicals in the table would be familiar to us as they have been isolated from other genera as well

Table 1. Chemical constituents from plants of genus *Tephrosia*.

| Species | Class | Compound | Reference |
|---|---|---|---|
| *Tephrosia abbottiae* | Flavonoid | abbotin | Gómez-Garibay et al., 1986 |
| | | tephrobotin | |
| *Tephrosia aequilata* | Flavonoid | obovatin methyl ether | Muiva, 2012 |
| | | (E)-praecansone A | |
| | | demethylpraecansone B | |
| | | 3,4:8,9-dimethylenedioxypterocarpan | Tarus et al., 2002 |
| *Tephrosia apollinea* | Flavonoid | (−)-semiglabrin | Waterman and Khalid, 1980 |
| | | (−)-pseudosemiglabrin | |
| | | (+)-glabratephrin | |
| | | (+)-glabratephrinol | |
| | | appollinine (7-methoxy-8-[3″-(2″,5″-dihydro-5″,5″-dimethyl-2″-oxofuryl)]-flavone | |

 

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|---|---|---|---|
| | | lanceolatin-A | |
| | | (+)-apollineanin | Hisham et al., 2006 |
| | | (−)-semiglabrin | |
| | | (−)-semiglabrinol | |
| *Tephrosia barbigera* | Flavonoid | isopongaflavone | Vilain, 1983 |
| | | barbigerone | Vilain, 1980 |
| *Tephrosia bidwilli* | Flavonoid | (-)-6aR; 11aR-maackiain | Ingham and Markham, 1980 |
| | | (-)-6aS; 11aS-pisatin | |
| | | (-)-6aR; 11aR-4-methoxy- maackiain | |
| | | tephrocarpin | |
| | | acanthocarpan | |
| *Tephrosia bracteolata* | Flavonoid | isopongaflavone | Khalid and Waterman, 1981 |
| | | trans-tephrostachin | |
| | | trans-anhydrotephrostachin | |
| | | obovatin | |
| *Tephrosia calophylla* | Coumestan | tephcalostan | Hari Kishore et al., 2003 |
| | Flavonoid | 7-O-methylglabranin | |
| | | kaempferol 3-O-β-D-glucopyranoside | |
| | | (2S)-5-hydroxy-7,4'-di-O-(gamma, gamma-dimethylallyl) flavanone | Reddy et al., 2009 |
| | | 6-hydroxy-E-3-(2,5-dimethoxy benzylidine)-2',5'-dimethoxyflavanone | |
| | | tephrowatsin C | |
| | | afrormosin | |
| | | kaempferol 3-O- β -D-glucopyranoside | |
| | Benzil | calophione A | Ganapaty et al., 2009b |
| | | 1-(6′-Hydroxy-1′,3′-benzodioxol-5′-yl)-2-(6″-hydroxy-2″-isopropenyl-2″,3″-dihydro-benzofuran-5″-yl)-ethane-1,2-dione | |
| | Coumestan | tephcalostan B | |
| | | tephcalostan C | |
| | | tephcalostan D | |
| *Tephrosia candida* | Flavonoid | candidol | Dutt and Chibber, 1983 |
| | | candidone | Roy et al., 1986 |
| | | ovalichalcone | |
| | | dehydrorotenone | |
| | | candidin | Parmar et al., 1988 |
| | | pongachin | |
| | | flemichapparin-B | Roy et al., 1987 |
| | Sterol | β -sitsterol | Parmar et al., 1988 |
| | Acid | caffeic acid | |
| | Rotenoid | 12a-hydroxyrotenone | Parmar et al., 1988 |
| | | tephrosin | |
| | | amorpholone | Kole et al., 1992 |
| | | 6a,12,-dehydodeguelin | Parmar et al., 1988 |
| | | 12a-hydroxy-β-toxicarol | Andrei et al., 1997 |
| | | deguelin | |
| | | α-toxicarol | |
| | | 6a,12a-dehydrodeguelin | |
| | | 12a-hydroxy-α-toxicarol, 6a | |
| | | 12a-dehydro-α-toxicarol | |
| | | 6a,12a-dehydro-β-toxicarol | |
| | | dehydrodihydrorotenone | Roy et al., 1987 |
| | | tephrospirolactone | Andrei et al., 2002 |
| | | tephrospiroketone 1 | |
| | | tephrospiroketone II | |
| *Tephrosia cinerea* | Flavonoids and Phenolics | demethylapollinin 7-O-β-D-glucopyranoside | Maldini et al., 2011 |
| | | apollinin | |
| | | glabatephrin | |
| | | semiglabrin | |

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|---|---|---|---|
| | | pseudosemiglabrin | |
| | | 3′-O-methyl- methylquercetin 3,7-di-O-rhamnopyranoside | |
| | | kaempferol 3,7-di-O-rhamnopyranoside | |
| | | quercetin 3,7-di-O-rhamnopyranoside | |
| | | 3-O-β-glucopyranosylquercetin 7-O-α-rhamnopyranoside | |
| | | 3-O-β-xylopyranosylquercetin 7-O-α-rhamnopyranoside | |
| | | 3-O-α-arabinopyranosylquercetin 7-O-α-rhamnopyranoside | |
| | | 5-O-methylgenistein 7-O-β-D-glucopyranoside | |
| | | quercetin 3-O-β-glucopyronoside | |
| | | quercetin 3-O-α-rhamnopyranoside | |
| | | kaempferol | |
| | | 7-O-methylquercetin | |
| | | cineroside A | |
| | Sesquiterpene | caryophyllene oxide | Arriaga et al., 2008 |
| | | teclenone B | |
| | | (1β,7R*)-opposit-4(15)-ene-1,7-diol | |
| | Lignan | pinoresinol | |
| *Tephrosia crassifolia* | Flavonoid | crassifolin | Gómez-Garibay et al., 1999 |
| | | crassichalcone | |
| *Tephrosia egreria* | Terpenoid | geijerene | Arriaga et al., 2005 |
| | | pregeijerene | |
| | Rotenoid | Dehydrorotenone. | Arriaga et al., 2009b |
| *Tephrosia elata* | Flavonoid | isopongaflavone | Bentley et al., 1987 |
| | | tephrosin | |
| | | 8-(3,3-dimethylallyl)-5,7- dimethoxy flavanone | Lwande et al., 1985a |
| | | obovatin methyl ether | |
| | | warangalone | |
| | | elatadihydrochalcone | Muiva, 2012 |
| | | obovatachalcone | |
| | | (*S*)-elatadihydrochalcone | Muiva et al., 2009 |
| | | obovatachalcone | |
| | | obovatin | Muiva et al., 2009; Muiva, 2012 |
| | | obovatin methyl ether | Muiva et al., 2009; Muiva, 2012 |
| | Pterocarpan | (+)-pisatin | Lwande et al., 1985a |
| | | (-)- maackiain | |
| | Rotenoid | deguelin | Muiva et al., 2009; Muiva, 2012 |
| | | rotenone | Muiva, 2012 |
| *Tephrosia elongata* | Flavonoid | elongatin | Smalberger et al., 1975 |
| *Tephrosia emoroides* | Flavonoid | emoroidenone | Machocho et al., 1995 |
| | | emoroidone | |
| | | emoroidocarpan | |
| | | 5-methoxyisolonchocarpin | |
| | Flavene | hildegardtene | |
| *Tephrosia falciformis* | Flavonoid | falciformin | Khan et al., 1986 |
| | | 7-hydroxy-8-(γ,γ-dimethylallyl)flavanone | |
| | Alcohol | triacontanol | Khan et al., 1984 |
| *Tephrosia fulvinervis* | Flavonoid | fulvinervin C | Venkataratnam et al., 1986 |
| | | fulvinervin A | Venkataratnam et al., 1986; Venkata et al., 1985b |
| | | fulvinervin B | Venkata et al., 1985b |
| | Rotenoid | α-toxicarol | Dagne et al., 1989 |

 

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|---|---|---|---|
| | | deguelin | |
| | | munduserone | |
| | | cis-12a-hydroxymunduserone | |
| | Pterocarpan | (-)-maackiain | |
| *Tephrosia hamiltonii* | Flavonoid | 5, 7-dimethoxy-8-(2, 3-epoxy-3-methylbutyl)-flavanone | Falak and Shoeb 1987 |
| | | pongamol | Rajani and Sarma, 1988 |
| | | flemichapparin-B | |
| | | flemichapparin-C | |
| | Coumestone | 2-methoxy-3,9-dihydroxy coumestone | |
| *Tephrosia hildebrandtii* | Pterocarpan | hildecarpidin | Lwande et al., 1987 |
| | | hildecarpin | Lwande et al., 1985b |
| | Flavonoid | trans-tephrostachin | Lwande et al., 1986 |
| | | trans-anhydrotephrostachin | |
| *Tephrosia hookeriana* | Flavonoid | hookerianin | Prabhakar et al., 1996; Vanangamudi et al., 1997b |
| | | (−)semiglabrin | |
| | | lanceolatin A. | |
| | | tephrorianin | Vanangamudi et al., 1997b |
| | | rutin | |
| *Tephrosia lanceolata* | Flavonoid | rutin | Rangaswami and Rao, 1955 |
| *Tephrosia leiocarpa* | Flavonoid | tephroleocarpin A | Quijano and Rios, 1991 |
| | | tephroleocarpin B | |
| *Tephrosia lupinifolia* | Flavonoid | lupinifolin | Smalberger et al., 1974 |
| | | lupinifolinol | |
| *Tephrosia madrensis* | Flavonoid | 5,7-dimethoxy-8-prenylflavan | Gómez et al., 1983 |
| *Tephrosia major* | Flavonoid | 2',6'-dihydroxy-3'-prenyl-4'-methoxy-β-hydroxychalcone | Gomez-Garibay et al., 2002 |
| | | quercetin | |
| | Sterol | β-sitosterol | |
| | | stigmasterol | |
| | Triterpene | lupeol | |
| *Tephrosia maxima* | Flavonoid | maxima flavanone A | Venkata et al., 1994 |
| | | maxima isoflavone A | Rao et al., 1984a |
| | | maxima isoflavone B | Venkata and Sree Rama, 1985a |
| | | maxima isoflavone C | Rao et al., 1984a |
| | | maxima isoflavone D | |
| | | maxima isoflavone E | |
| | | maxima isoflavone F | |
| | | maxima isoflavone G | |
| | | maxima isoflavone H | Venkata and Sree Rama, 1985a |
| | | maxima isoflavone J | Murthy and Rao, 1985; Venkata et al., 1994 |
| | | maxima isoflavone T | Venkata et al., 1994 |
| *Tephrosia multijuga* | Flavonoid | multijuginol | Vleggaar et al., 1975 |
| | | multijugin | |
| *Tephrosia nubica* | Flavonoidal glycoside | kaemferol 3,7-dirhamnoside | Sharaby and Ammar, 1997 |
| | | quercetin 3-galactoside 7-rhamnoside | |
| | | quercetin 3,7-dirhamnoside | |
| | Flavonoid | semiglabrin | |
| | | pseudosemiglabrin | |
| | | apollinine | |
| | | lanceolatin A | |
| | Rotenoid | rotenones | |
| | | deguelin | |
| *Tephrosia* | Rotenoid | dihydrostemonal | Dagne et al., 1989 |

 

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| *pentaphylla* | | | |
| | | 9-demethyldihydrostemonal | |
| | | 6-acetoxydihydrostemonal | |
| | | villosin | |
| | | sumatrol | |
| | | rotenone | |
| | | cis-12a-hydroxyrotenone | |
| | | 6-hydroxyrotenone | |
| | | α-toxicarol | |
| | Flavonoid | obovatin | |
| *Tephrosia polyphylla* | Flavonoid | 4′-demethyltoxicarol isoflavone | Dagne et al., 1992 |
| | | toxicarol isoflavone | |
| | | 7-methylglabranin | |
| *Tephrosia procumbens* | Rotenoid | rotenone | Venkataratnam et al., 1987 |
| | | sumatrol | |
| | β -diketone | praecansone A | |
| | | praecansone B | |
| | Flavonoid | obovatin | |
| | | 7-ethoxy-3,3′,4′-trihydroxyflavone; fisetin 7-ethyl ether | |
| | | 7,4′-dihydroxy-3′-methoxyisoflavone | |
| *Tephrosia pumila* | Flavonoid | pumilaisoflavones A | Yenesew et al., 1989 |
| | | pumilaisoflavones B | |
| | | pumilaisoflavones C | |
| | | pumilaisoflavones D | |
| | | pumilanol | Ganapaty et al., 2008b |
| | | tephrinone | |
| | | β-hydroxychalcone | Dagne et al., 1988 |
| | | Praecansone-A. | |
| | Rotenoid | rotenone | Ganapaty et al., 2008b |
| | Triterpene | lupeol | |
| | Sterol | stigmasterol | |
| *Tephrosia purpurea* | Flavonoid | tephrosin | Ahmad et al., 1999 |
| | | pongaglabol | |
| | | semiglabrin | |
| | | purpuritenin | Sinha et al., 1982 |
| | | purpureamethide | |
| | | pongamol | |
| | | karanjin | |
| | | lanceolatin B | Sinha et al., 1982; Chang et al., 1997 |
| | | (+)-tephrorins A | Chang et al., 2000 |
| | | (+)-tephrorins B | |
| | | (+)-tephrosone | |
| | | purpurenone | Rao and Raju, 1984b |
| | | (+)-purpurin | Rao and Raju, 1984b; Chang et al., 1997 |
| | | (−)purpurin | |
| | | dehydroisoderricin | |
| | | (−)-maackiain | |
| | | pseudosemiglabrin | |
| | | (−)-semiglabrin | |
| | | terpurinflavone | Juma et al., 2011 |
| | | pongamol | Parmar et al., 1989; Chang et al., 1997 |
| | | (-)-isolonchocarpin | Rao and Raju, 1979 |
| | | 7,4‘-dihydroxy-3‘,5‘-dimethoxyisoflavone | Chang et al., 1997 |
| | | (+)-tephropurpurin | |
| | | (−)-3-hydroxy-4-methoxy-8,9-methylenedioxypterocarpan | |
| | | (−)-medicarpin | |
| | | 3‘-methoxydaidzein | |

 

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| | | desmoxyphyllin B | |
| | | 3,9-dihydroxy-8-methoxycoumestan | |
| | | isoglabratephrin | Hegazy et al., 2009 |
| | | tephropurpulin A | |
| | | quercitin | Jain et al., 2009 |
| | | rutin | |
| | Ester | stigmast-5, 22-dien-34, 21diol-34, 21-dihexadecanoate | Sharma et al., 2008 |
| | Neoflavonoid glycoside | serratin 7-O-[β-D-glucopyranosyl-(1→4)-O-β-D-galoctopyranoside | Saxena and Choubey, 1997 |
| | Sterol | β-sitosterol | Chang et al., 1997; Parmar et al., 1989 |
| | | spinasterol-α | |
| | Acid | ursolic acid | |
| *Tephrosia quercetorum* | Flavonoid | quercetols A | Gómez-Garibay et al., 1988 |
| | | quercetols B | |
| | | quercetols C | |
| *Tephrosia semiglabra* | Flavonoid | glabratephrin | Vleggaar et al., 1978 |
| | | semiglabrinol | Smalberger et al., 1973 |
| | | semiglabrin | |
| *Tephrosia sinapou* | Flavonoid | toxicarine | Martinez et al., 2012 |
| | | 7-O-methylglabranine | |
| | | tephrowatsin A | |
| | | quercetol B | |
| | | flamichapparin B | |
| | Coumarin | 2,3-dihydro-p-coumaric acid | |
| | Rotenoid | tephrosin | |
| | | rotenolone | |
| | | deguelin | |
| | | 6-oxo-6a,12a-dehydrodeguelin | |
| | | 6-oxo-6a,12a-dehydro-α-toxicarol | |
| | | 6a,12a-dehydrorotenone | |
| | | rotenonone | |
| | | villosone | |
| *Tephrosia spinosa* | Flavonoid | spinochalcone C | Rao and Prasad, 1992 |
| | | spinoflavanones A | |
| | | spinoflavanones B | |
| | | fulvinervin A | |
| | | 3′,5′-diisopentenyl-2′,4′-dihydroxychalcone | Sharma and Rao, 1992 |
| | | tephrospinosin | |
| | | spinochalcones A | Rao and Prasad, 1992 |
| | | spinochalcones B | |
| | | flemistrictin A | |
| | Flavonol glycoside | eupalitin 3-O-b-D-galactopyranoside | Vanangamudi et al., 1997a; Chakradhar et al., 2005 |
| *Tephrosia tepicana* | Flavonoid | tepicanol A | Gómez-Garibay et al., 1997 |
| *Tephrosia tinctoria* | Flavonoid | 5,7-di-O-prenylbiochanin A | Khalivulla et al., 2008 |
| | | 7-O-methylglabranin | |
| | | tephrowatsin C | |
| | | flemichapparin B | |
| | | 2-hydroxy tephrosin | Ganapaty et al., 2009 |
| | | tephrinone | |
| | | lupinifolin | Ganapaty et al., 2010 |
| | | 7-O-methyl glabranin | |
| | Rotenoid | rotenone | |
| | | dehydrodeguelin | |
| | Sterol | stigmasterol | |
| | Acid | betulinic acid | |
| *Tephrosia toxicaria* | Flavonoid | iso-obovatin | Vasconcelos et al., 2009 |
| | | obovatin | Vasconcelos et al., 2009; |

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|---|---|---|---|
| | | | Jang et al., 2003 |
| | | 6a,12a-dehydro-β-toxicarol | |
| | | 6a,12a-dehydro-α-toxicarol | |
| | | α-toxicarol | |
| | | toxicarol | Clark, 1930 |
| | | (2S)-5-hydroxy-7-methoxy-8-[(E)-3-oxo-1-butenyl]flavanone | Jang et al., 2003 |
| | | isoliquiritigenin | |
| | | genistein | |
| | | chrysoeriol | |
| | | sumatrol | |
| | Rotenoid | 4‘,5‘-dihydro-11,5‘-dihydroxy-4‘-methoxytephrosin | |
| | | 11-hydroxytephrosin | |
| | Coumarin | marmesin | |
| | Triterpene | lupenone | |
| | Ester | benzyl benzoate | |
| | | benzyl trans-cinnamate | |
| *Tephrosia tunicata* | Flavonoid | tunicatachalcone | Andrei et al., 2000 |
| *Tephrosia uniflora* | Flavonoid | elongatin | Abreu and Luis, 1996 |
| | Rotenoid | 12a-hydroxyrotenone | |
| | Sterol | β-sitosterol | |
| | | stigmasterol | |
| *Tephrosia viciodes* | Flavonoid | enantiomultijugin | Gómez-Garibay et al., 1992 |
| *Tephrosia villosa* | Flavonoid | (2S)-5,4′-dihydroxy-7-O-[(E)-3,7-dimethyl-2,6-octadienyl]flavanone | Madhusudhana et al., 2010 |
| | | (2S)-5,4′-dihydroxy-7-O-[(E)-3,7-dimethyl-2,6-octa-dienyl]-8-C-[(E)-3,7-dimethyl-2,6-octadienyl]flavanone | |
| | | 7-O-methylglabranin | |
| | | tephcalostan | |
| | | 12a-dehydro-6-hydroxysumatrol | |
| | | 7-methylglabranin | Jayaraman et al., 1980 |
| | | villosin | David Krupadanam et al., 1997 |
| | | villosone | |
| | | villol | |
| | | villinol | |
| | | tephrinone | Rao and Srimanarayana, 1981 |
| | Triterpenoid | lupenone | Prashant and Krupadanam 1993 |
| | Triterpene | lupeol | Ganapaty et al., 2008a |
| | Sterol | stigmasterol | |
| | Rotenoid | 12a-dehydro-6-hydroxysumatrol | Prashant and Krupadanam 1993 |
| | | rotenone | Ganapaty et al., 2008a |
| | | dehydrorotenone | |
| | | 6a,12a-dehydro,2,3,6- trimethoxy-8-(3’,3’-dimethylallyl)-9,11dihydroxy rotenone | Prashant and Krupadanam, 1993 |
| | | 12a-hydroxy toxicarol | |
| *Tephrosia viridiflora* | Flavonoids | viridiflorin | Gómez et al., 1985 |
| *Tephrosia vogelii* | Sesquiterpene | (1β,6α,10α)-guai-4(15)-ene-6,7,10-triol | Wei et al., 2009 |
| | Lignan | (+)-lariciresinol 9′-stearate | |
| | Rotenoid | deguelin | Kalume et al., 2012; Delfel et al., 1970; Gills, 1992 |
| | | tephrosin | Gills, 1992 |
| | | toxiconol | |
| | | tephrosal | |
| | Flavonoid | quercitin | |
| *Tephrosia* | Flavonoid | tephrowatsin A | Gómez et al., 1985 |

 

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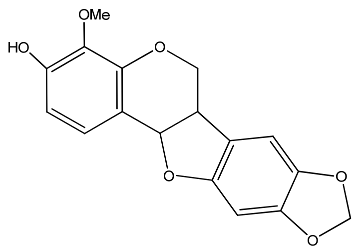
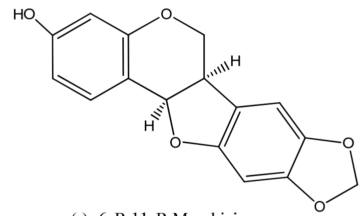
|---|---|---|---|---|
| *watsoniana* | | tephrowatsin B<br>tephrowatsin C<br>tephrowatsin D<br>tephrowatsin E | | |
| *Tephrosia woodii* | Flavonoid | oaxacacin<br>mixtecacin | | Dominguez et al., 1983 |



(-)- 6aR 11aR 4 Methoxy Maackiain



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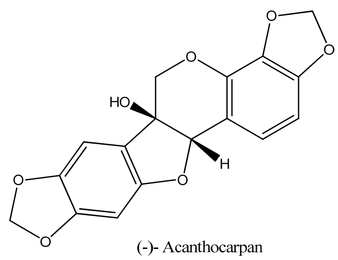

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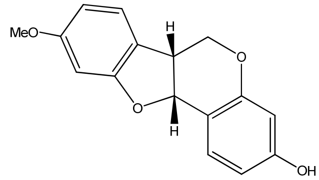

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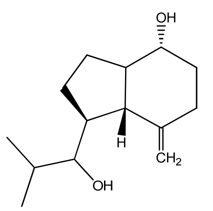
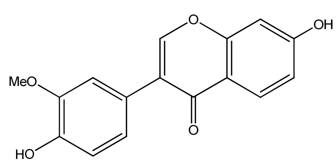
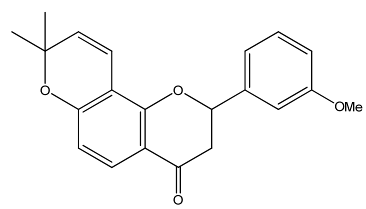


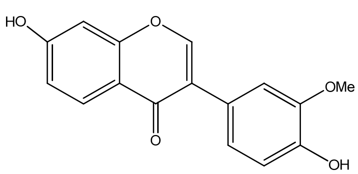
(1B,7R)-opposit-4(15)-ene-1,7-diol



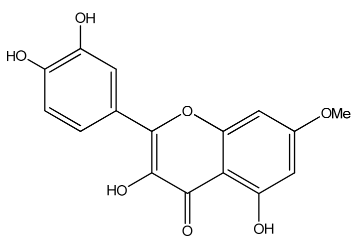
3 Methoxy Daidzein



5 Methoxy Isolonchocarpin



7,4 dihydroxy 3-methoxy isoflavone



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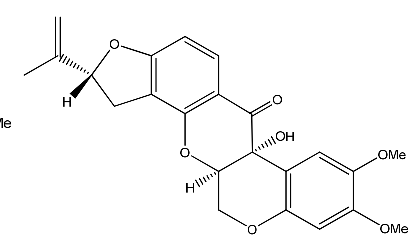
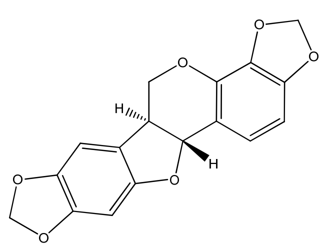
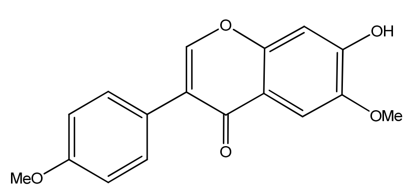


12 a hydroxyrotenone

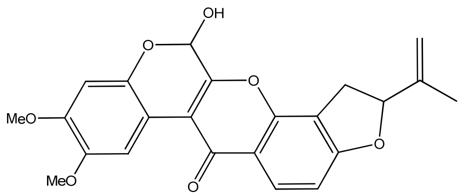


3,4,8,9 dimethylene dioxy pterocarpan



Afrormosin



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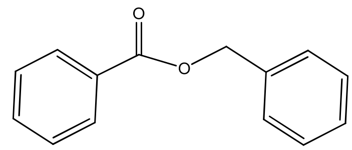
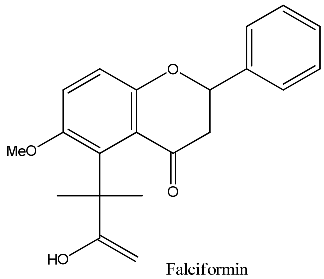
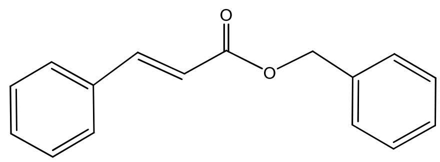


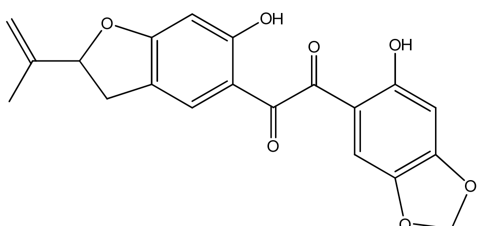
Benzyl Benzoate



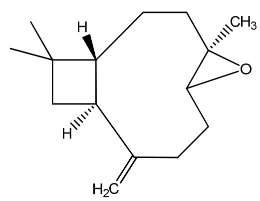
Falciformin



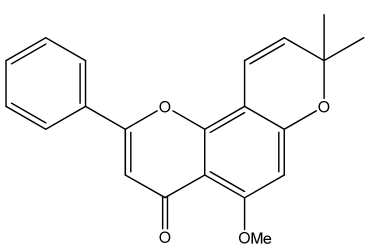
Benzyl Cinnamate



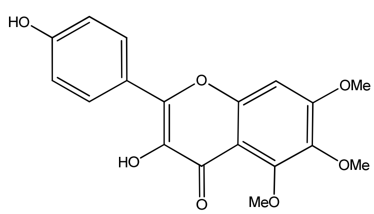
Calophione A



Calophyllene Oxide



Candidin



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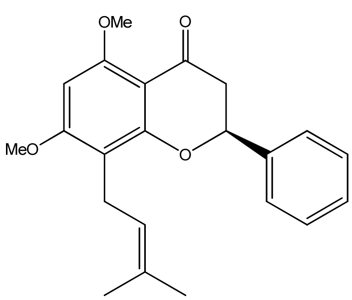

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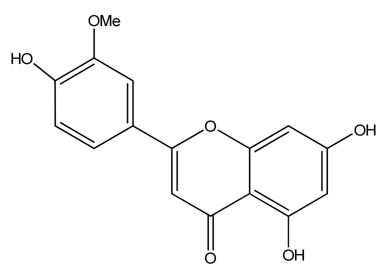
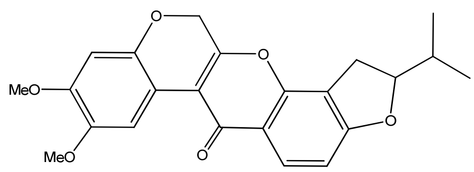
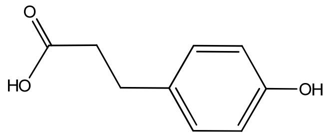


Chrysoeriol

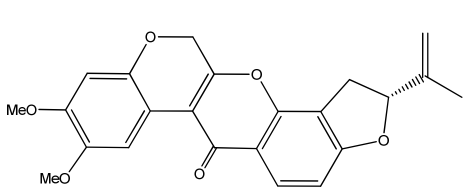
 



Dehydrodihydro Rotenone



Dihydro P-Coumaric Acid



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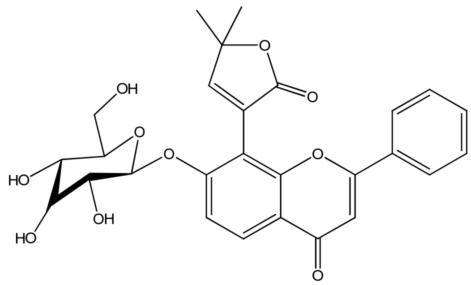
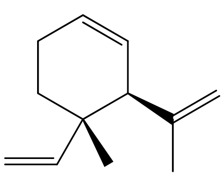
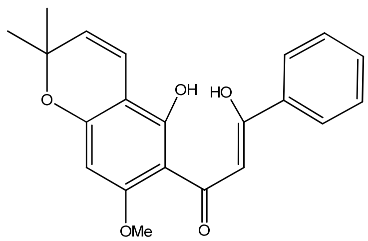


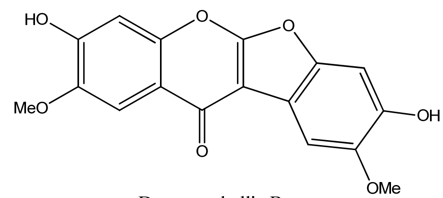
Demethyl Apollinin 7-O-Beta-D Glucopyranoside



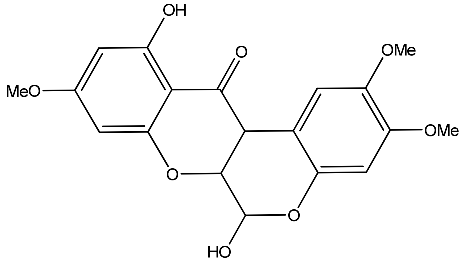
Geijerene



Demethyl Praecansone B



Desmoxyphyllin B



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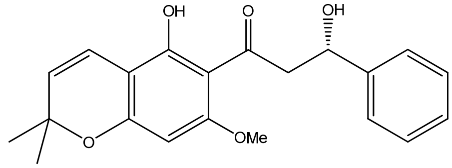
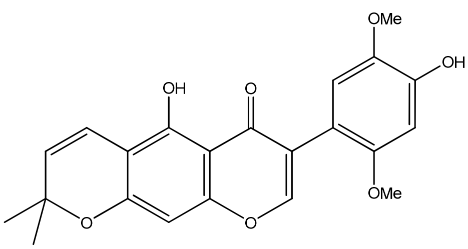


Elatadihydrochalcone



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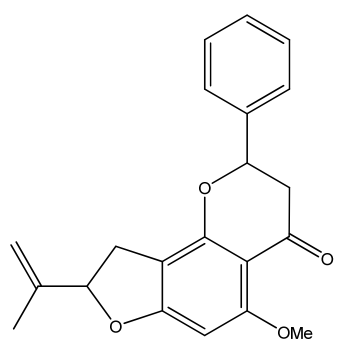
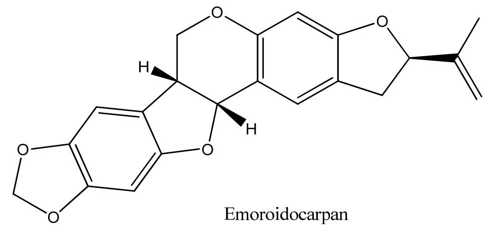
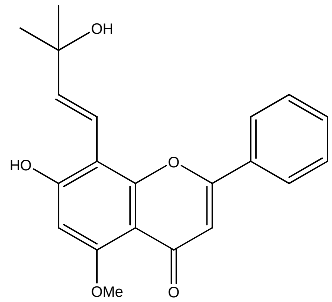


Emoroidenone



Emoroidocarpan



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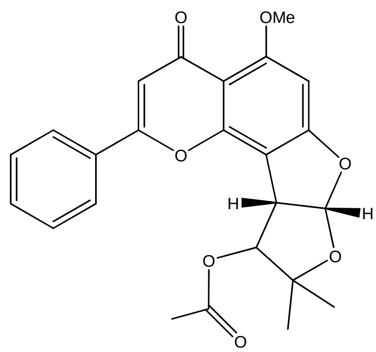
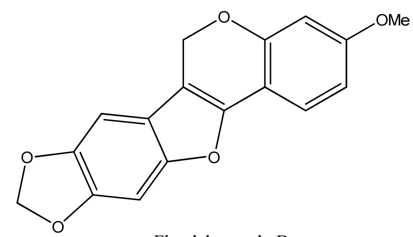
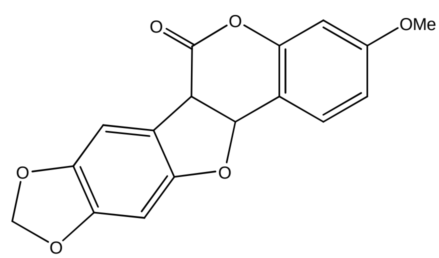


Enantiomultijugin



Flemichapparin B



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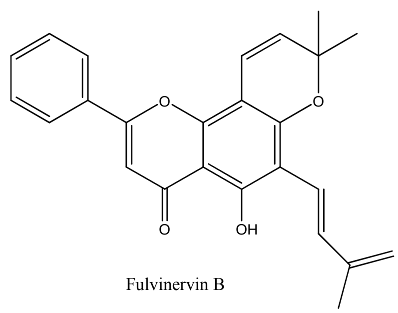

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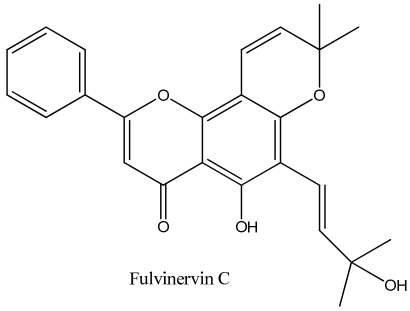

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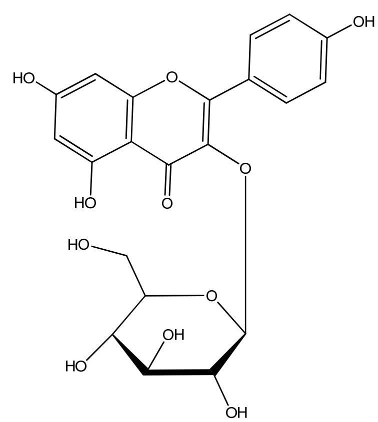
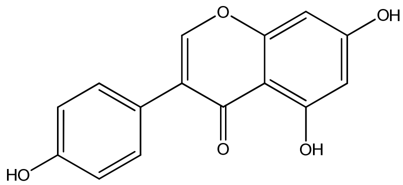


Kaempferol 3-O-Beta-D glucopyranoside



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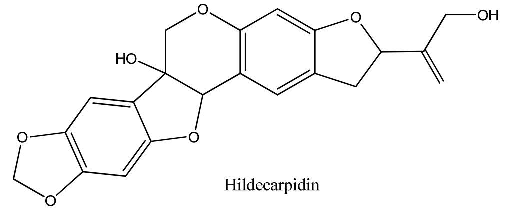
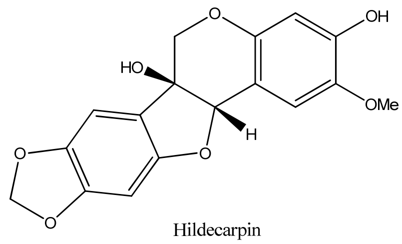


Hildecarpidin



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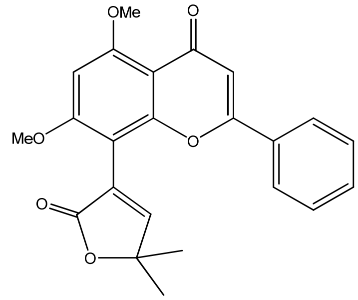
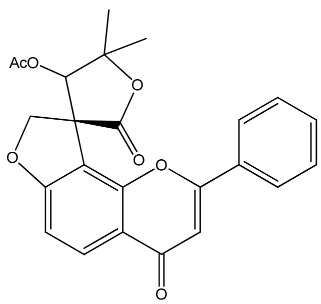


Hookerianin



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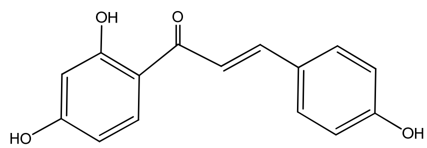
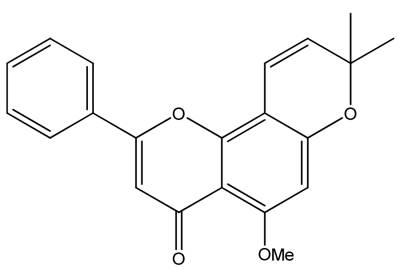


Isoliquiritigenin



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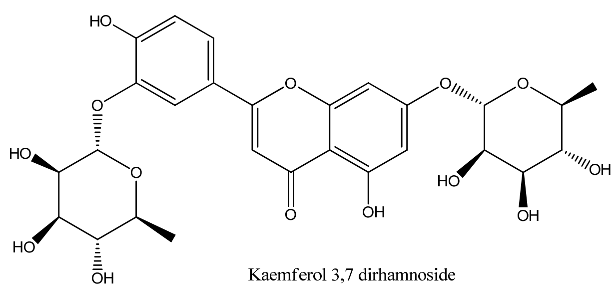
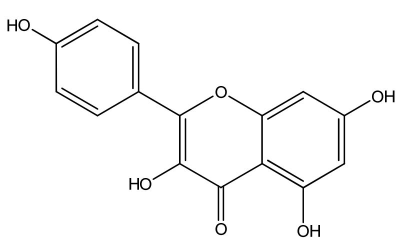


Kaemferol 3,7 dirhamnoside



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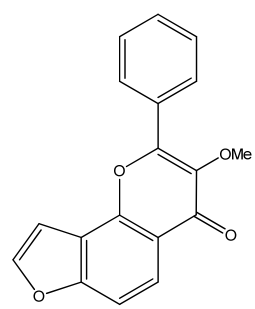
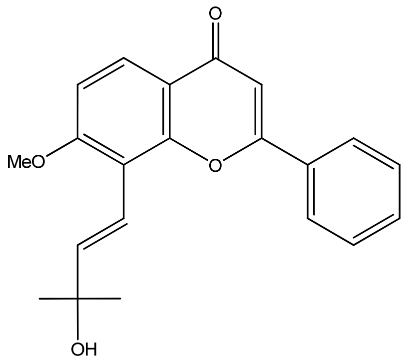


Karanjin



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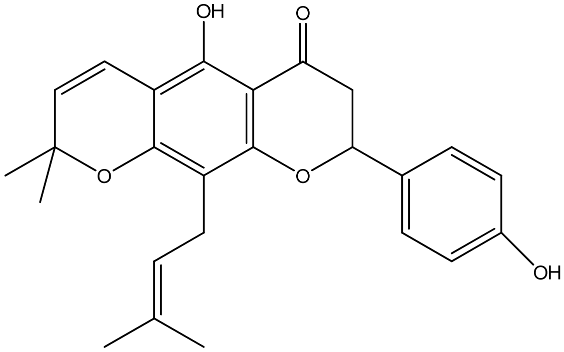
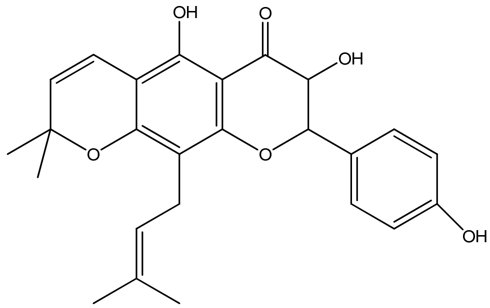


Lupinifolin



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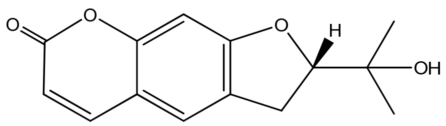

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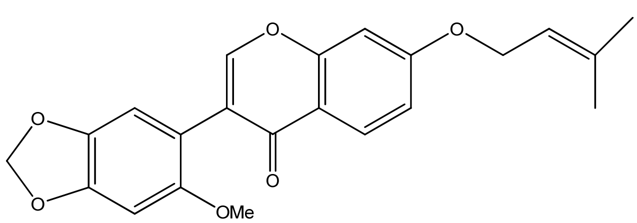
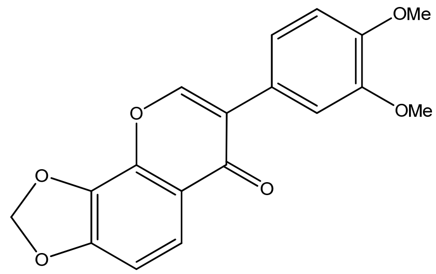


Maxima isoflavone C



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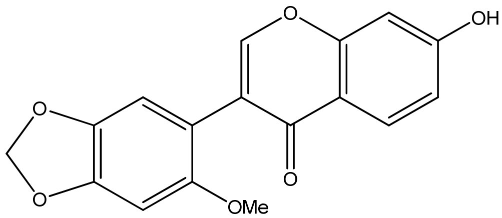

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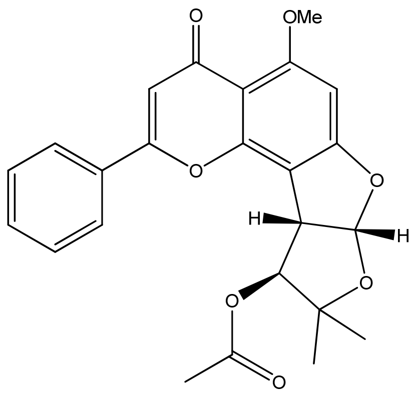
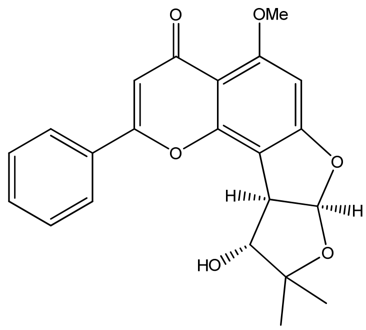


Multijugin



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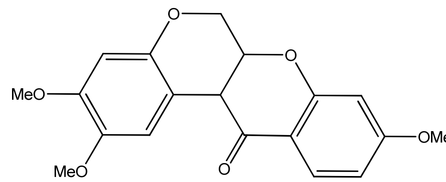
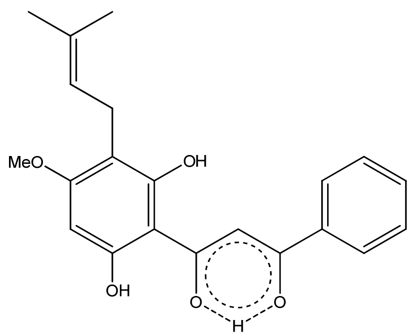
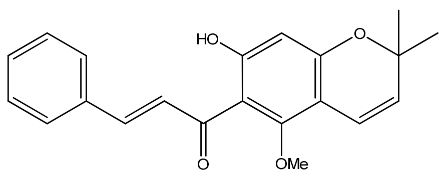


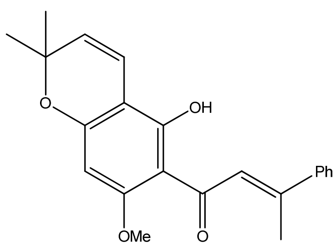
Munduserone



2',6'-dihydroxy-3'-prenyl-4'-methoxy-ß-hydroxychalcone



Oaxacacin



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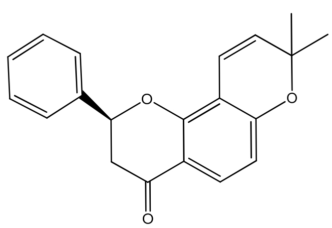
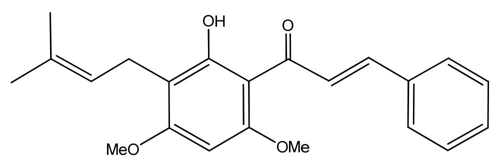
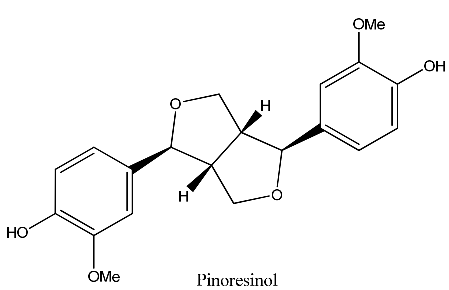


Obovatin methyl ether



Ovalichalcone



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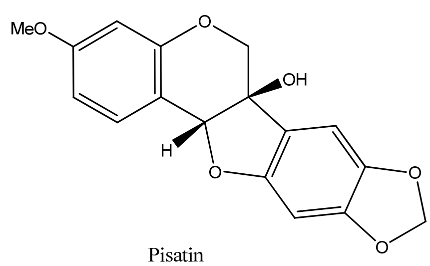

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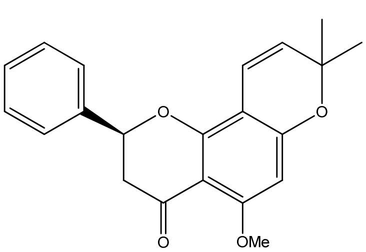
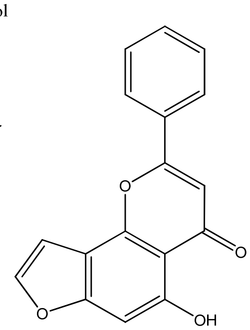


Pongachin



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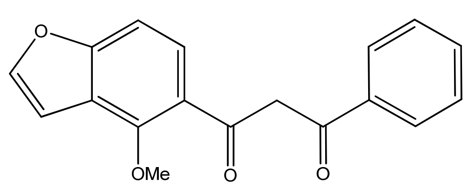

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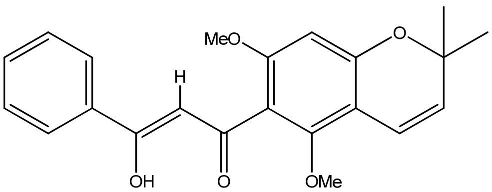
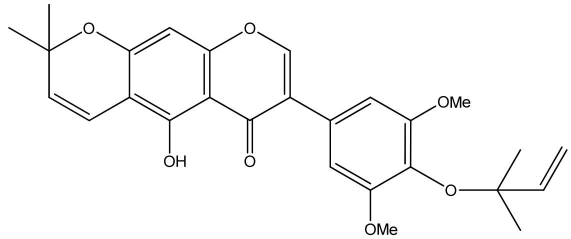


Praecansone B



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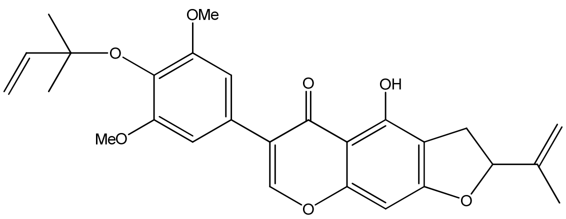

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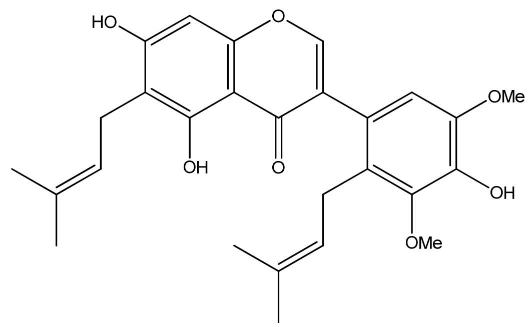

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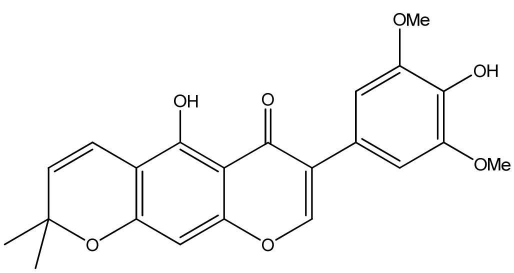

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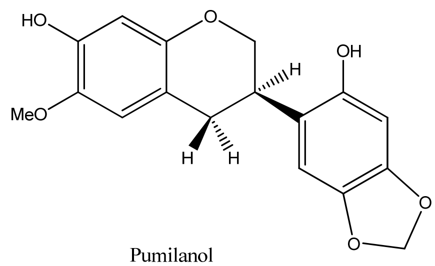

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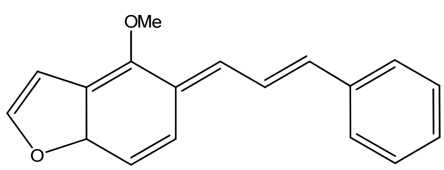

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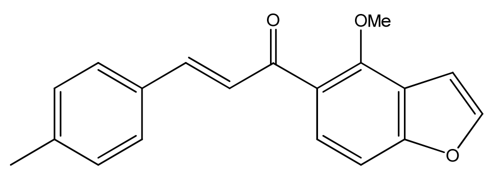

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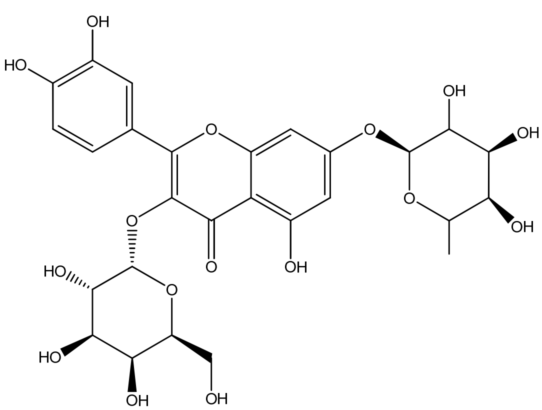

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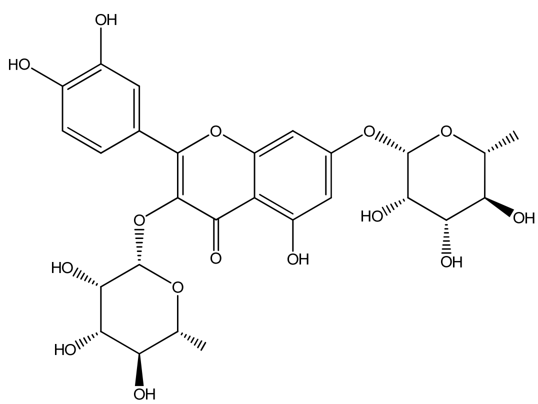

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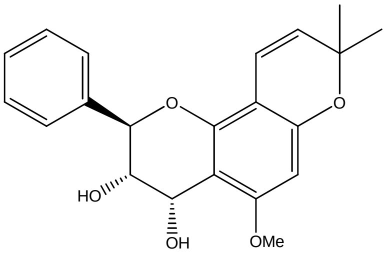

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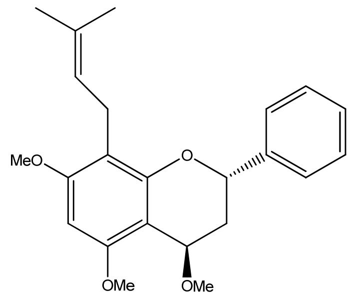

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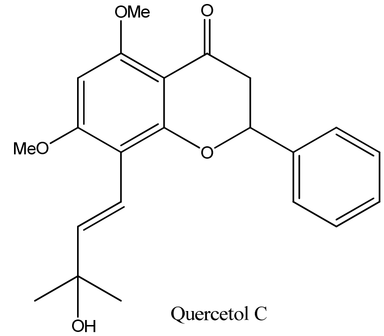

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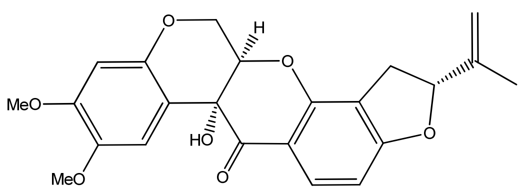

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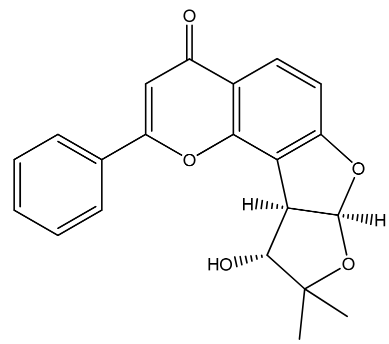

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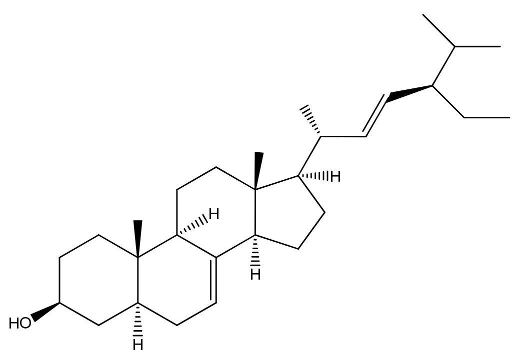

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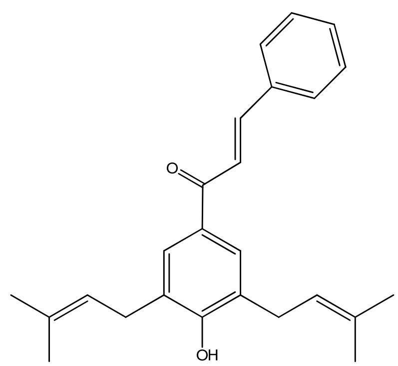

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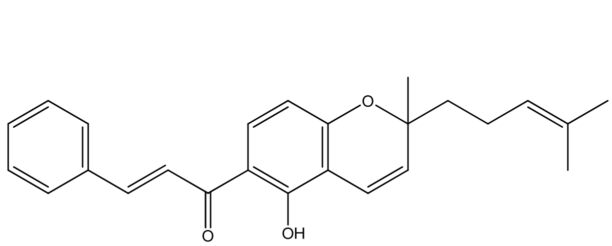

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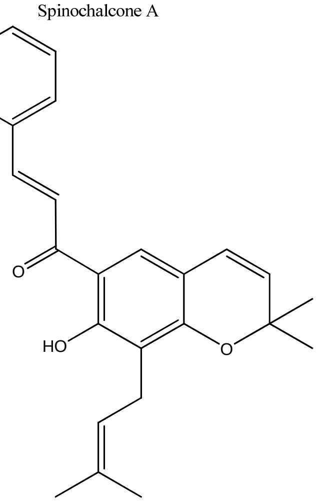

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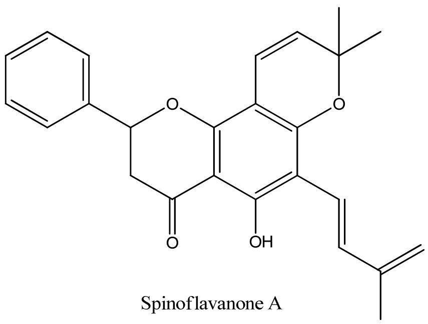

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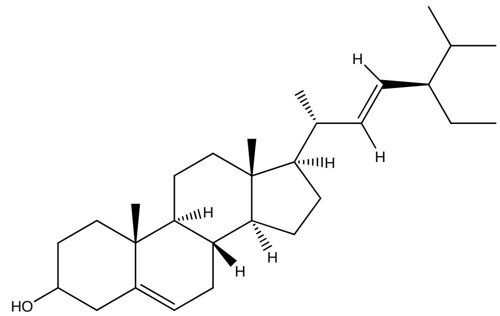

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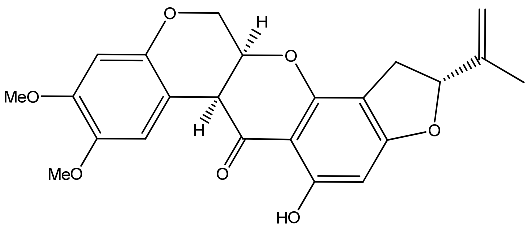

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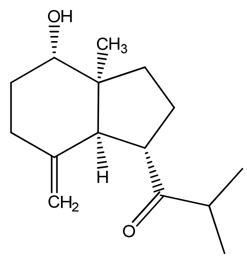

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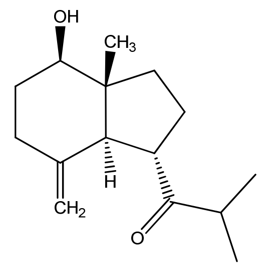

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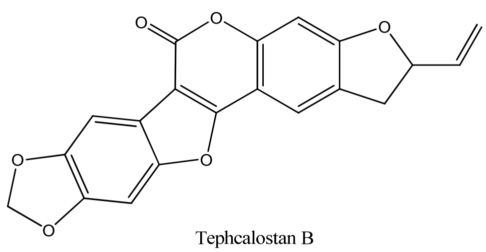

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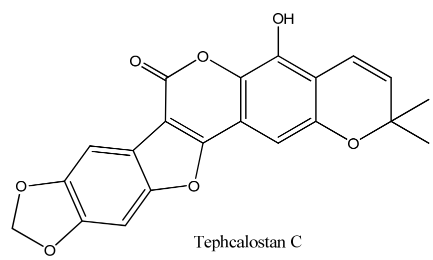

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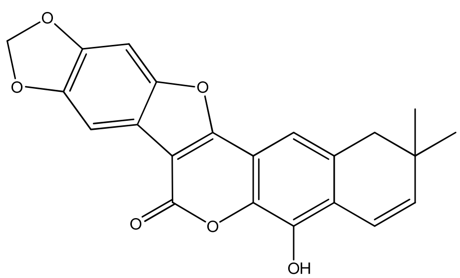

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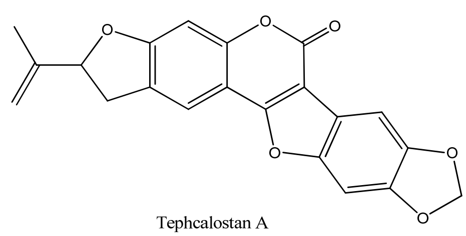

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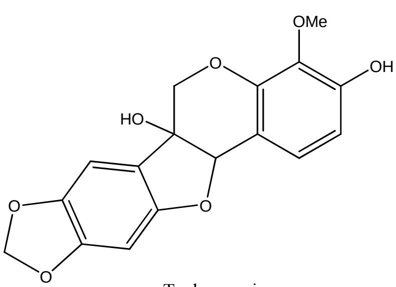

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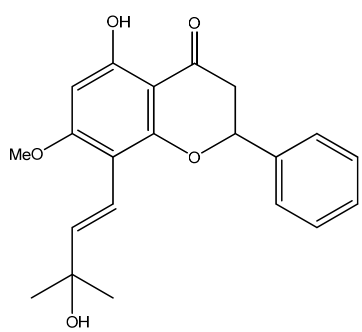

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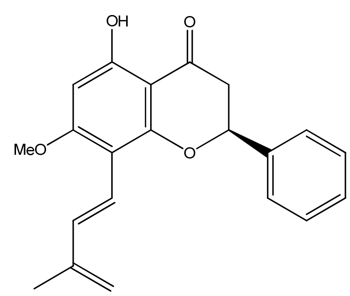

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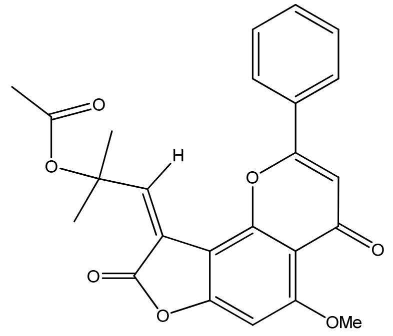


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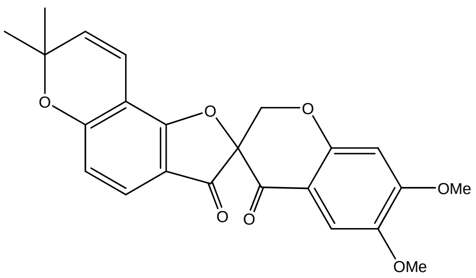


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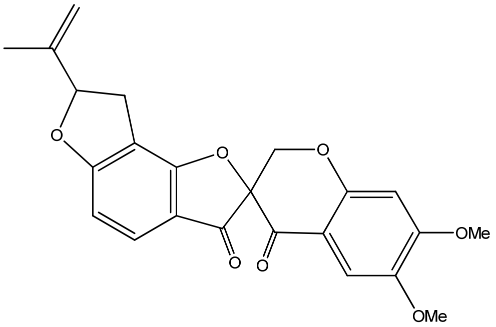


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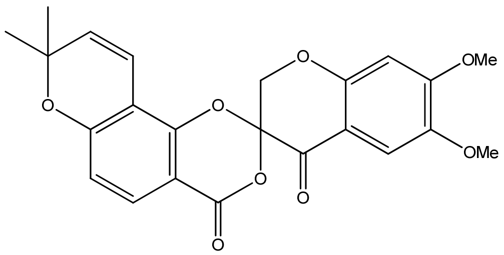


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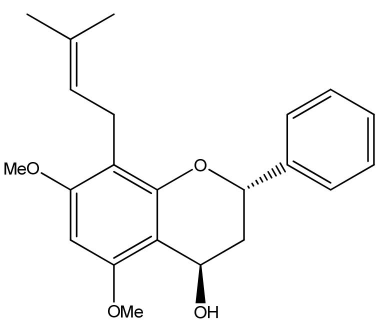


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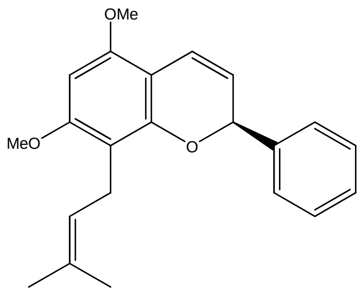


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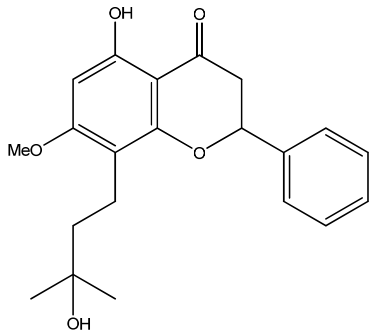


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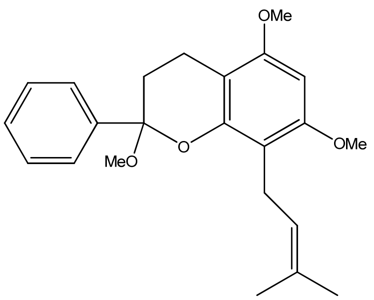


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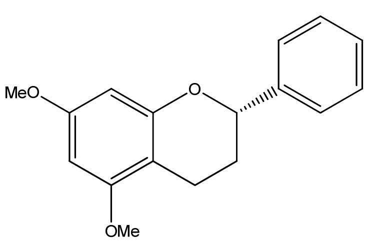


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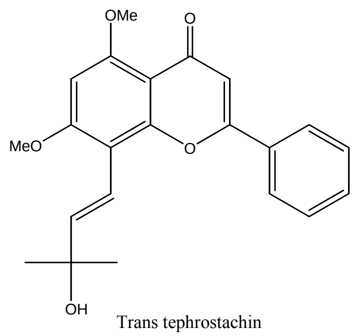
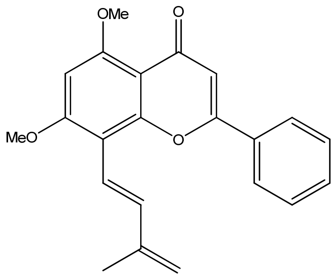



Trans tephrostachin



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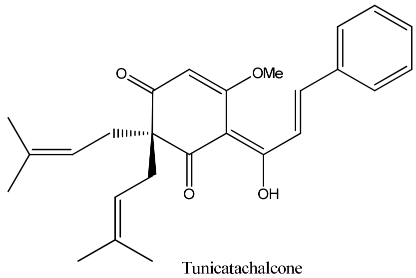

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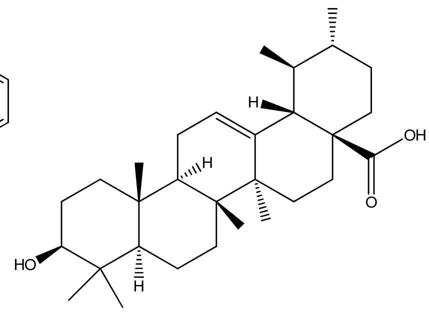

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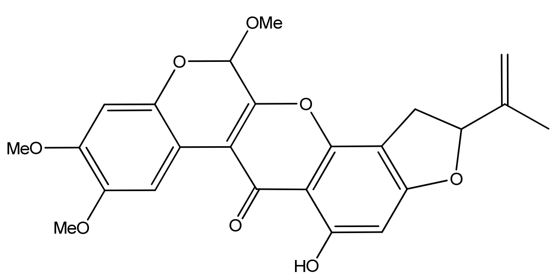

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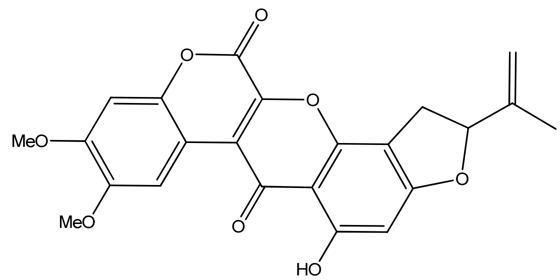

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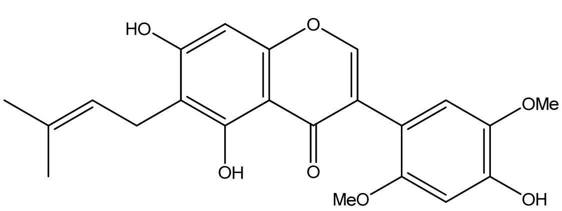

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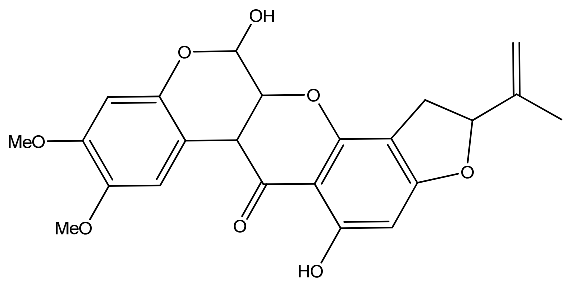

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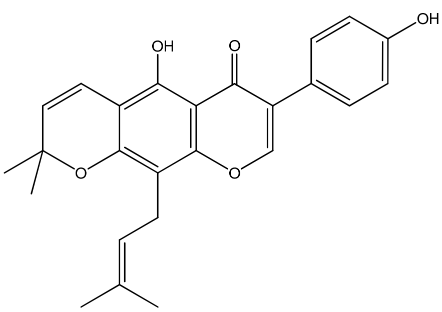

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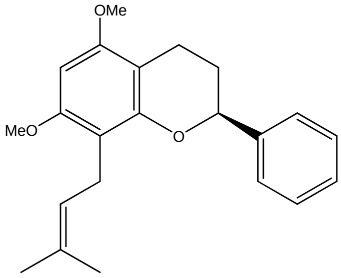
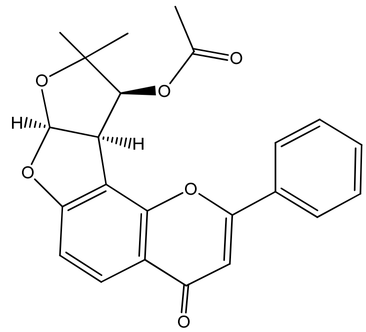
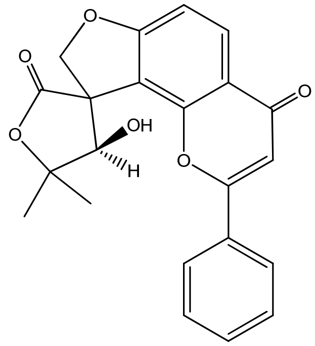


5 7 dimethoxy 8 prenylflavan

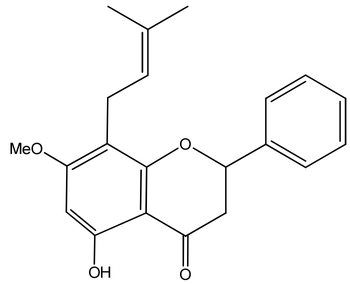


(-)- Pseudosemiglabrin

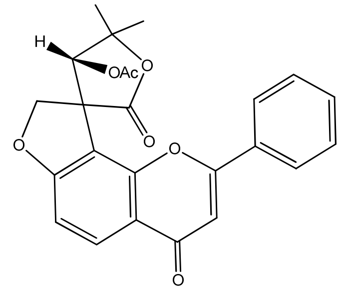
 



(+)- Glabratephrinol



7-O- Methyl Glabranin



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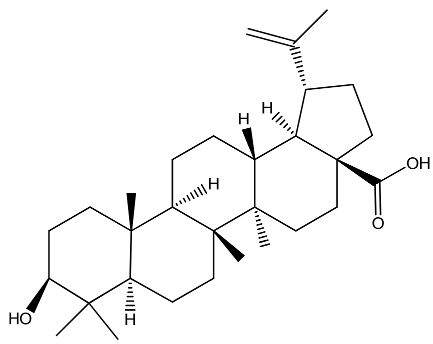

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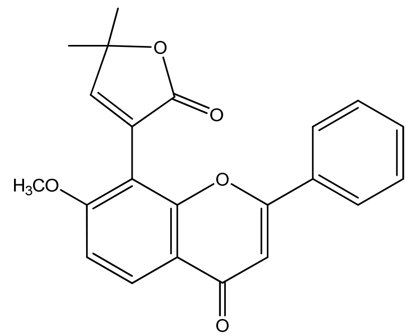

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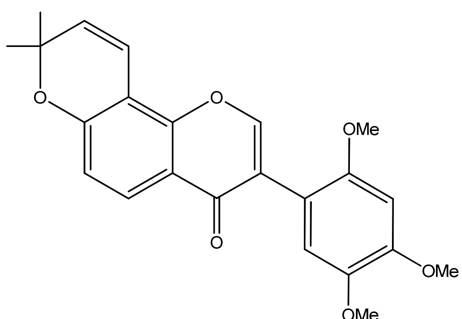

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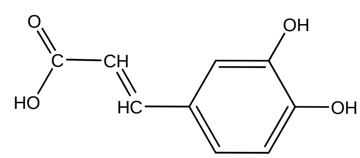

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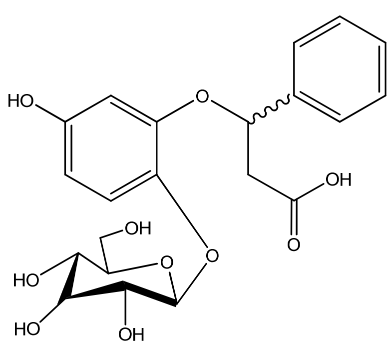

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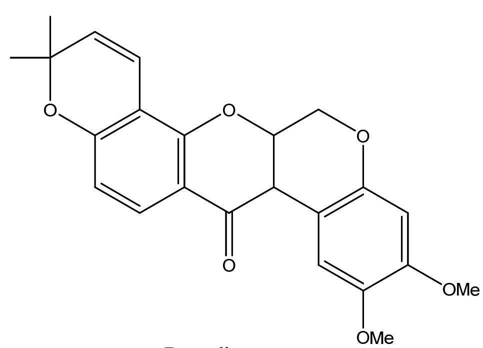

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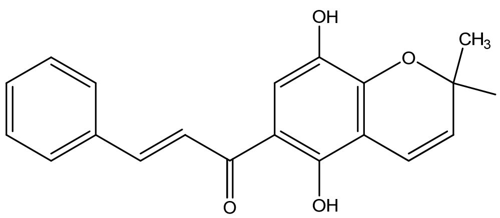

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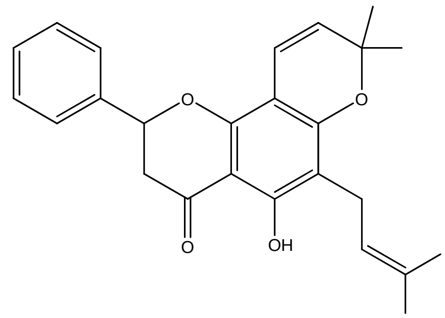

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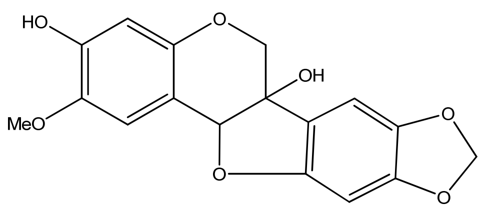

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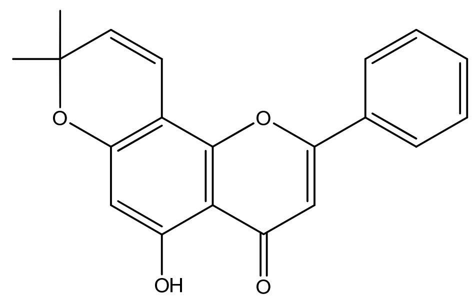
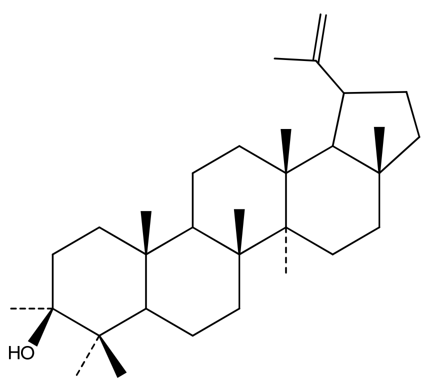


Isopongaflavone



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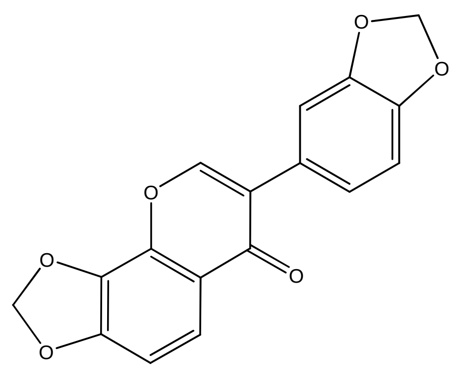
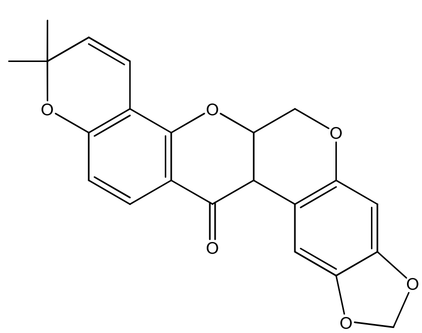


Maxima isoflavone A



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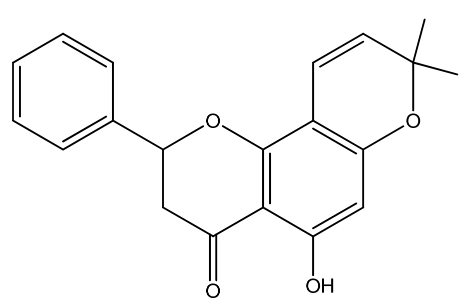
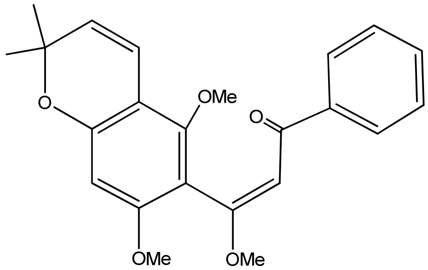
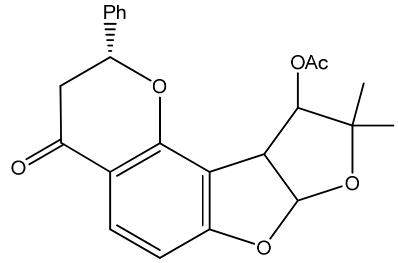


Obovatin




Praecansone A

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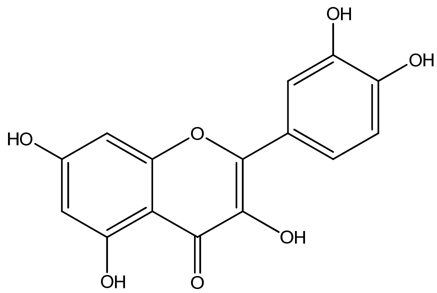
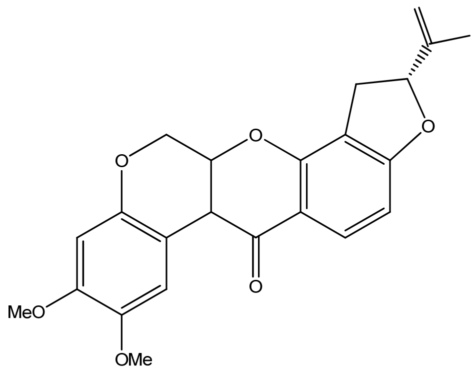



Quercitin

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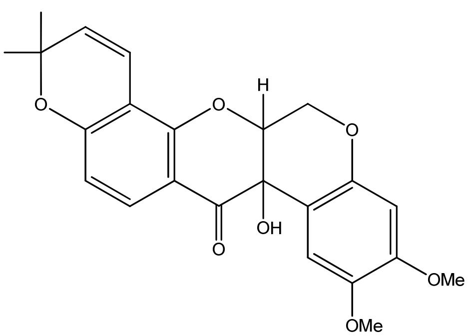
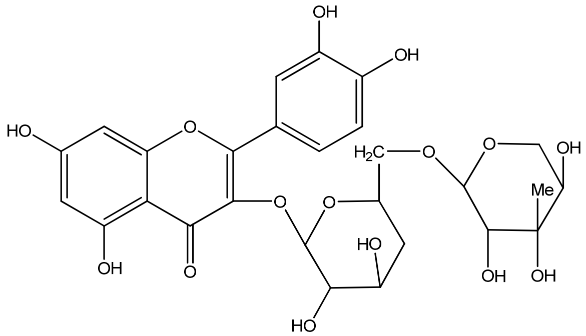
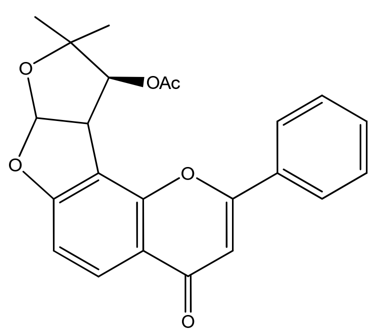


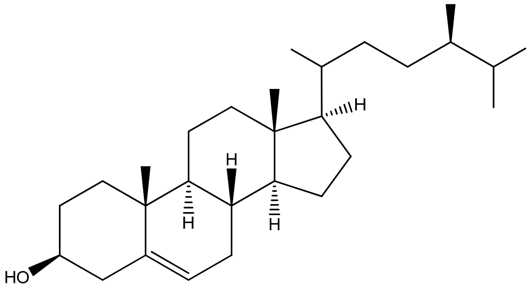

Tephrosin




Rutin

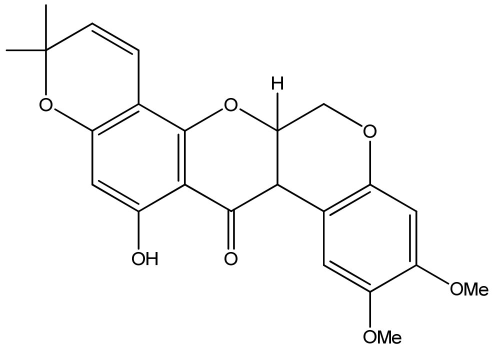



Semiglabrin

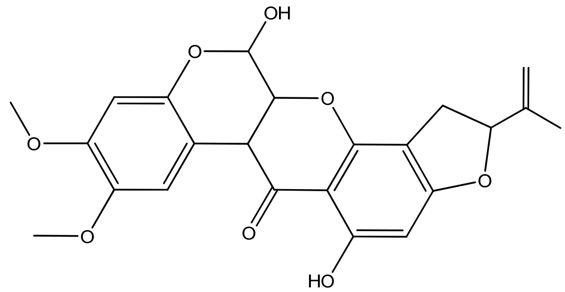



b-sitosterol

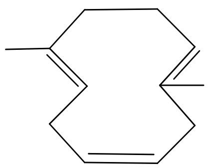
 




Toxicarol




Villosine



Pregeijerene


Triacontanol

Some of the compounds isolated have been studied for their pharmacological actions (see table 2). The activities reported include anticancer, antiplasmodial, larvicidal, and others. There are many compounds in Table 1 whose activities are not studied under the genus *Tephrosia* but if we look into the literature, we find their presence in other genera and their activities determined for example Pseudosemiglabrin, Flemichapparin, Caryophyllene oxide, deguelin, pongamol, lupeol, possess platelet aggregation antagonism, antifungal, antifungal, anticancer, anticonvusant, and antiinflammatory respectively (Pirrung and Lee, 1995; Gahlot et al., 2012; Yang et al., 2000; Udeani et al., 1997; Basu et al., 1994; Geetha and Varalakshmi, 2001). Caffeic acid and rutin, which are also found in *Phyllanthus sellowianus* have analgesic activity (Calixto et al., 1998).

Table 2. Pharmacological actions of isolated compounds from genus *Tephrosia*.

| Species | Compound | Activity | Reference |
|---|---|---|---|
| *Tephrosia calophylla* | calophione A | Cytotoxic | Ganapaty et al., 2009 |
| *Tephrosia candida* | candidone | Cytotoxic | Ganapaty et al., 2009; Roy et al., 1986 |
| | pongachin | | Ganapaty et al., 2009; Parmar et al., 1988 |
| | candidachalcone | Estrogenic activity | Hegazy et al., 2011 |
| *Tephrosia elata* | tephrosin | Antifeedant | Bentley et al., 1987 |
| | isopongaflavone | | |
| | rotenone | Larvicidal, antifeedant | Muiva, 2012; Bentley et al., 1987 |
| | (S)-elatadihydrochalcone | Antiplasmodial | Muiva, 2012 |
| | obovatin methyl ether | | Muiva, 2012 |
| | praecansone | | |
| *Tephrosia emoroides* | emoroidenone | Antifeedant | Machocho et al., 1995 |
| *Tephrosia ergeria* | dehydrorotenone | Antioxidant, larivcidal | Arriaga et al., 2009a |
| *Tephrosia hildebrandtii* | hildecarpin | Insect antifeedant Antifungal | Lwande et al., 1985 |
| *Tephrosia pulcherrima* | pulcherrimin | Cytotoxic | Ganapaty et al., 2009 |
| *Tephrosia pumila* | pumilanol | Antiprotozoal | Ganapaty et al., 2008 |
| *Tephrosia purpurea* | (+)-tephrorin A | Cancer chemopreventive activity | Chang et al., 2000 |

| | | | |
|---|---|---|---|
| | (+)-tephrorin B<br>(+)-tephrosone<br>7,4‘-dihydroxy-3‘,5‘-dimethoxyisoflavone<br>(+)-tephropurpurin<br>(+)-purpurin<br>pongamol<br>lanceolatin B<br>(−)-maackiain<br>(−)-3-hydroxy-4-methoxy -8, 9- methylenedioxy pterocarpan<br>(−)-medicarpin | | Chang et al., 2000 |
| | terpurinflavone | Antiplasmodial | Juma et al., 2011 |
| *Tephrosia spinosa* | eupalitin-3-O-β-D-glucoside | Anti-inflammatory | Chakradhar et al., 2005 |
| *Tephrosia tinctoria* | 2-hydroxy tephrosin<br>tephrinone | Antiplasmodial | Ganapaty et al., 2009 |
| *Tephrosia toxicaria* | (2S)-5-hydroxy-7-methoxy-8-[(E)-3-oxo-1-butenyl]flavanone<br>4‘,5‘-dihydro-11,5‘-dihydroxy-4‘-methoxytephrosin<br>isoliquiritigenin<br>genistein<br>chrysoeriol | Cancer chemopreventive activity | Jang et al., 2003 |
| | obovatin | Antioxidant | Vasconcelos et al., 2009 |
| | toxicarol | Fish poison | Clark, 1930 |
| | α-toxicarol | Larvicidal | Vasconcelos et al., 2009 |
| *Tephrosia vogelii* | deguelin | Larvicidal | Muiva, 2012; Kalume et al., 2012 |

It can be concluded from the above discussion that if, for example, any species of genus *Tephrosia* having rutin or caffeic acid as its major component, is not reported for analgesic activity, may possess it. So in this way this methodology can give us a hint or base, which study to be carried on plant.

## Pharmacological profile of plants from genus *Tephrosia*

Several plants of the genus have studied for their medicinal and therapeutic potential. A brief description of the work done so far is given below:

### *Antioxidant activity*

Only a few species of Genus *Tephrosia* have been studied for their antioxidant activity. In 2007, G.P. Choudhary studied the ethanolic extract of *Tephrosia purpurea* for its antioxidant activity (Choudhary, 2007). The aqueous extract of the whole plant of *Tephrosia purpurea* also showed free radical scavenging activity in DPPH test (Gunjegaonkar et al., 2010). From *Tephrosia egregia* the ethyl acetate and methanol extracts showed high antioxidant activities (Arriaga et al., 2009a). Obovatin, a flavonoid present in *Tephrosia toxicaria* showed significant antioxidant acivity of IC50 3.370 μg/mL. It was also seen that the methanol fraction of the ethanol extract from roots had the highest antioxidant activity (Vasconcelos et al., 2009). *Tephrosia villosa* also possess antioxidant activity due to the presence of 20(29)-lupen-3-one, a compound also identified in *Daedaleopsis tricolor* where it inhibited lipid peroxidation by 6.4% (Prashant and Krupadanam 1993; Kim et al., 2001). The ethanol ether extract of *Tephrosia vogelii* seeds also showed antioxidant and free radical scavenging activity (Li et al., 2010).

### *Antibacterial activity*

The species from Genus *Tephrosia* have also been studied for their antibacterial activity. *Tephrosia vogelii* was found to possess antimicrobial activity (Wanga et al., 2007). The dichloromethane extract from the roots and leaves was tested against *S. aureus*, *E. coli* and *F. phoseolida*. Hu et al., in 2011 also studied the antimicrobial and bactereostatic activity of ethanol and aqueous extract from *Tephrosia vogelii* seeds on *E. coli*, *S. aureus* and *S. paratyphi* B. and proved the antibacterial efficacy of the plant to be significant at high doses (Hu et al., 2011). The root extract of *Tephrosia villosa* showed moderate antibacterial and anti fungal activity (Ganapaty et al., 2008a). In another study on *Tephrosia villosa* the fruit, leaf, and root extract showed activity against *C.neoformans*, *E.coli* and *B.anthracis* respectively. The ethanolic twig extract was most active against *C.neoformans* and *S.typhi* (Nondo et al., 2011). In case of *Tephrosia purpurea*, studies have been made on the antimicrobial activity of methanolic extract of *Tephrosia purpurea* roots on *B. subtilis*, *S. aureus*, *M. luteus*, the gram positive bacteria and the gram negative including *E. coli*, *P. aeruginosa*, and *S. typhimurium* (Gupta et al., 2008). In another study on *Tephrosia purpurea*, the roots showed antimicrobial activity against *P. aeruginosa* and no activity against *S. aureus* and *E.coli* (BNLD Rangama et al., 2009). Chinniah et al., in 2009 and Annalakshmi et al., in 2009 proved *Tephrosia purpurea* to have marked activity against *H. pylori*, an agent responsible for GIT ulcers (Chinniah et al., 2009; Annalakshmi et al., 2009). The methanolic leaf extract from *Tephrosia tinctoria* showed activity against *B. subtilis*, *S. marceseans*, and low activity for *B. cereus* and *P. aeuriginosa* (Ganapaty et al., 2010). *Tephrosia deflexa* and its isolated compounds were studied for antibacterial activity (Kare et al., 2006). The antibacterial activity of *Tephrosia linearis* has also been reported (Ratsimamanga et al., 1994).

### *Antifungal activity*

In our literature survey, we found less work on antifungal activity of species from Genus *Tephrosia*. Only three species are known to possess antifungal potential. The methanolic extract of *Tephrosia purpurea* showed significant activity against *A. niger* and *C. albicans* (Gupta et al., 2008). *Tephrosia hildebrandtii* showed antifungal activity against *C.cucumerinum*. The activity was found to be related to a chemical compound isolated from its roots (see table 2) (Lwande et al., 1985b). *Tephrosia tinctoria* also showed activity against *A. niger*, *C. albicans*. The methanolic extract was found to be more active against the aforementioned organisms. However the methanolic extract showed no activity against *S. cerevisiae* (Ganapaty et al., 2010).

### *Antiprotozoal and anti plasmodial activity*

Extract from the seed pods of *Tephrosia elata* showed antiplasmodial activity (Muiva et al., 2009; Muiva, 2012). Flavonoid extracted from the roots of *Tephrosia pumila* also showed activity against *L. donovani*, *T. b. rhodesiense* and *T. cruzi* (Ganapaty et al., 2008b). Isolated flavonoids from the root of *Tephrosia tinctoria* were studied for antiprotozoal and antiplasmodial activities against *T. b. rhodesiense*, *T. cruzi*, *L. donovani*, and *P. falciparum* (Ganapaty et al., 2009a). Ganapaty, also studied the antiprotozoal activity of three *Tephrosia* species, namely, *T. pulcherrima*, *T. pumila*, and *T. calophylla* on *Leishmania*, *Trypanosoma* and *Plasmodium* parasites (Ganapaty et al., 2009c). Chloroquine sensitive and chloroquine resistant strains of *P. falciparum* were inhibited by the extracts from the stem of *Tephrosia purpurea* with $IC_{50}$ values of 10.47 ± 2.22 μg/ml and 12.06 ± 2.54 μg/ml, respectively (Juma et al., 2011). *Tephrosia purpurea* has also been studied for antileishmanial activity in hamsters and Indian langular monkeys infected by *L. donovani* (Sharma et al., 2003).

### *Anti pyretic and Anti inflammatory activity*

In 2010, Sandhya et al., studied the anti inflammatory activity of two species of *Tephrosia* namely *Tephrosia maxima* and *Tephrosia purpurea* by HRBC membrane stabilizing method. Both plants showed almost equal activity at doses of 500ug/ml. *Tephrosia maxima* giving 79.49% and *Tephrosia purpurea* giving 79.01% protection (Sandhya et al., 2010). Another study on *Tephrosia purpurea* root extracts showed its antipyretic and anti inflammatory activity (Valli et al., 2011). The methanolic extract of *Tephrosia vogelii* showed significant analgesic and anti-inflammatory activity in mice and rats using hot plate method and egg albumin induced oedema respectively (Adaudi et al., 2009). The root extract of *Tephrosia sinapou* showed to possess significant anti-inflammatory activity. The extract reduced inflammatory leukocyte recruitment, oxidative stress and other parameters involved directly or indirectly to the process of inflammation (Martinez et al., 2012). *Tephrosia spinosa* also showed anti inflammatory activity in an experimental model of carrageenin induced paw edema. The standard drug used was indomethacin (Chakradhar et al., 2005). The antipyretic activity of *Tephrosia bracteolata* has also been reported (Onaolapo et al., 2009).

### *Anticancer and cytotoxic activity*

Cytotoxicity of some chemical compounds found in *Tephrosia calophylla* and *Tephrosia candida* have been studied using different cell lines (Ganapaty et al., 2009a; Ganapaty et al., 2009b; Roy et al., 1986; Parmar et al., 1988). The cytotoxicity of *Tephrosia pulcherrima* and *Tephrosia pumila* has also been studied by Ganapaty et al., in 2009 using HT-29 and RAW cell lines (Ganapaty et al., 2009c). In 2011 Kishore et al., mentioned *Tephrosia purpurea* containing an important chemical, B-sitosteol having anticancer and cancer protective activities against prostatic, breast and colonic carcinomas. In addition to the aforementioned activities of B-sitosterol, it is also an antioxidant and has significant effect on hypercholesterolemia and BPH (Kishore and Roy, 2011). In another study the anticarcinogenic activity of *Tephrosia purpurea* extract was tested in an experimental model of hepatocarcinoma in rats. The extract showed significant cancer chemoprevention (Hussain et al., 2012). Shanmugapriya et al., also studied the anticarcinogenic potential of *Tephrosia purpurea* in HELA cervical cancerous cell line. Different extracts were tested out of which ethyl acetate produced the most potent effect (Shanmugapriya et al., 2011). In a study by Subhadra, three species namely, *Tephrosia calophylla*, *Tephrosia maxima* and *Tephrosia purpurea* showed significant cytotoxic activity out of which *Tephrosia calophylla* showed the maximum activity (Subhadra et al., 2011). The ethanolic fruit and root extract of *Tephrosia villosa* showed toxicity to brine shrimp whereas the extract from leaves and twigs was found to be non toxic (Nondo et al., 2011). The ethyl acetate extract from stems of *Tephrosia toxicaria* possess flavonoids having cancer chemopreventive activities (Jang et al., 2003). The flavonoids extracted from *Tephrosia tinctoria* possess cytotoxic activity tested in Cell line L-6 (Rat skeletal muscle myoblasts) (Ganapaty et al., 2009a). *Tephrosia calophylla* was also found to possess anticancer activity. The root extract inhibited growth and induced apoptosis in the human breast carcinoma (Adinarayana et al., 2009). *Tephrosia vogelii* root and leaf extract was found to be toxic to brine shrimps at doses of LC50: 0.960; 0.958 µg/ml, respectively (Wanga et al., 2007).

***Hepatoprotective activity***

In 2011, Shah et al., studied the hepatoprotective effect of *Tephrosia purpurea* in $CCl_4$ induced hepatotoxicity in rats. The ethyl acetate fraction at doses of 50mg/kg was found to be effective and comparable to silymarin (Rajal Shah et al., 2011). The hepatoprotective effect of *Tephrosia calophylla* has also been reported (Adinarayana et al., 2011).

***Animal feed***

In an effort to find new and cheap sources of food for animals, several species of genus Tephrosia have been studied. The nutritive value of three species of *Tephrosia*, namely, *Tephrosia candida*, *Tephrosia bracteolata*, and *Tephrosia linearis* have been studied (Babayemi et al., 2003). According to Babayemi and Bamikole, a mixture of *Tephrosia candida* leaves and guinea grass can serve as a good animal feed. The mixture has an additional benefit of low methane production upon fermentation (Babayemi and Bamikole. 2006b). *Tephrosia bracteolata* can serve as a good diet in laying hens both from nutritive and economic aspect (Akande et al., 2008). *Tephrosia vogelii, Tephrosia candida,* and *Tephrosia purpurea* can also be a good addition in the diet of ruminants (Mbomi et al., 2011). The use of *Tephrosia candida* and *Tephrosia bracteolata* in goats has also been established (Babayemi and Bamikole 2006a). A study on *Tephrosia candida* seeds has also been reported (Babayemi and Bamikole 2007).

***Larvicidal, insecticidal and antifeedant activity***

Different species from the genus have been studied for larvicidal, insecticidal, and antifeedant activities. There is an extensive work on the study of *Tephrosia* as an agent to control the population of insects harmful to animals and plants.

The hexane extract from *Tephrosia egregia* showed potent larvicidal activity against aedes aegypti (Arriaga et al., 2009a). The whole plant extract of *Tephrosia purpurea* was tested for its larvicidal activity against the larvae of *Culex quinquefasiciatus*. The extract showed 100% mortality in very small doses suggesting its beneficial use in controlling the mosquito reproduction (Deepak Kumar et al., 2012). The extracts of *Tephrosia vogelii* also possess larvicidal activity and therefore can be used to control mosquitoes (Matovu and Olila. 2007). The ethanolic extract of roots, leaves, fruit and twigs of *Tephrosia villosa* showed significant activity against *C. quinquefasciatus* larvae (Nondo et al., 2011). The ethanol extract from roots, stems, leaves, and pods and some fractions of *Tephrosia toxicaria* were tested for lavicidal activity with the larvae of *Aedes aegypti*. The ethanolic root extract, hexane and chloroform fractions had ($LC_{50}$ 47.86 ppm) ($LC_{50}$ 23.99 ppm) and ($LC_{50}$ 13.80 ppm) respectively (Vasconcelos et al., 2009). *Tephrosia nyikensis* have been reported to possess larvicidal activity on Anopheles mosquito's larvae (Wanjala et al., 2006). The oil obtained from *Tephrosia cinerea* showed larvicidal activity against *Aedes aegypti* larvae (Arriaga et al., 2008). The chloroform and methanol extracts of *Tephrosia nubica* were tested against *Spodoptera littoralis* and *Agrotis ipsilon*. The population of the pests was reduced due to the effect of the extract on all the stages of growth (Sharaby and Ammar, 1997). *Tephrosia vogelii* leaf extract was found to be effective in controlling ticks, an important insect and ectoparasite (Gadzirayi et al., 2010). *Tephrosia magropoda* is also reported to have insecticidal properties (Tatteksfield and Gimingham, 1932). In 2012, Kalume et al., reported the acaricidal activity of leaf extracts of *Tephrosia vogelii* on tick *Rhipicephalus appendiculatus* and mentioned its advantage of being economical than synthetic compounds (Kalume et al., 2012). The insecticidal property of *Tephrosia purpurea* whole plant was tested against *Callosobruchus maculates*, the pest on *Phaseolus mungo* (Diwan and Saxena, 2010). In 1992, Kole et al., isolated a rotenoid, amorpholone from *Tephrosia candida* having potent insecticidal properties (Kole et al., 1992). *Tephrosia elata* showed significant antifeedant activity against *M. testulalis*, *S. exempta* and *E. sacchariana*. The antifeedant activity is attributed to the presence of rotenoid compounds (Bentley et al., 1987). The larvicidal activity from seed pods of *Tephrosia elata* and *Tephrosia aequilata* has also been studied by Muiva, against the larvae of *Aedes aegypti* (Muiva, 2012). Antifeedant activity of flavonoids from *Tephrosia emoroides* was tested against *Chilo partellus*, a very destructive pest of maize. Emoroidenone, a flavonoid isolated showed strong feeding deterrence of 66.1% against the larvae at a dose of 100 µg (Machocho et al., 1995). The roots of *Tephrosia hidebrandtii* also possess antifeedant activity against the pest, *Maruca testulalis* (Lwande et al., 1985).

### *Antidiabetic activity*

The aqueous seed extract of *Tephrosia purpurea* showed significant antihyperglycemic activity in streptozotocin induced diabetic rats (Pavana et al., 2009). The ethanolic extract of from *Tephrosia villosa* leaves showed reduction in glucose level and pancreatic cell regeneration in alloxan induced diabetes in rats (Ahmad et al., 2009). Balakrishnan et al., also repoted antidiabetic activity of extract from root of *Tephrosia villosa* (Balakrishnan et al., 2007).

### *GIT activity*

*Tephrosia vogelii* leaf extract exerted a stimulant effect on the GIT smooth muscles. This was demonstrated by the contraction of the ileum isolated from guinea pig hence showing the purgative property of the plant (Dzenda et al., 2008b). Aqueous extract of *Tephrosia purpurea* root showed gastric ulcer healing and cytoprotective activities (Deshpande and Shah 2008). The extract of *Tephrosia calophylla* leaves showed significant antiulcer and cytoprotective activity at doses of 50mg/kg and 100mg/kg (Divya, et al., 2011).

### *Antihyperlipidemic effect*

The antihyperlipidemic effect of *Tephrosia calophylla* has been studied in wistar albino rats (Mohan, 2011). The leaf extract of *Tephrosia purpurea* showed antihyperlipi-demic activity in an experimental model of diabetic rats (Pavana et al., 2007). Akhtar et al., also studied *Tephrosia purpurea* for the same purpose and found a significant reduction in all the parameters (Akthar et al., 2011).

### *Toxicity*

*Tephrosia purpurea* extract was evaluated by Talib et al., in 2012 for its toxicity in rodents. A dose up to 2000mg/kg was well tolerated in the acute toxicity studies whereas in sub acute toxicity studies, a dose 200mr/kg and 400 mg/kg showed no significant change in any of the parameters thus concluding that the plant is safe for use in treatment of different diseases (Talib Hussain et al., 2012). *Tephrosia toxicaria* used as a fish poison was studied by Clark in 1930. A compound, Toxicarol was identified as the major component (Clark, 1930). The toxicity of *Tephrosia vogelii* was reported on mice. The signs were similar to those associated with the toxicity from rotenone. The $LD_{50}$ of leaf extract calculated was 134.16 mg/kg (Dzenda et al., 2008a). The chloroform extract of *Tephrosia tinctoria* leaves exhibited significant piscicidal activity compared to methanolic extract in gold fish (Ganapaty et al., 2010). Toxic hepatopathy was reported in sheep grazing on *Tephrosia cinerea*. The disease was also experimentally induced in the sheep in order to confirm the results (Santos et al., 2007). *Tephrosia apollinea* was also found to be toxic in a study on goats (Suliman et al., 1982). The toxicity of *Tephrosia bracteolata* has also been studied (Onaolapo et al., 2009). In a study on mice Cai et al., found *Tephrosia candida* to be safe and no significant signs of toxicity were observed (Cai et al., 2010).

### *Miscellaneous activities*

The root extract of *Tephrosia purpurea* showed xanthine oxidase inhibitory activity compare with standard, Allopurinol (Nile and Khobragade, 2011). Patel et al., studied the effect of *Tephrosia purpuria* on polycystic ovary syndrome (PCOS) in rats. (PCOS) was induced by the administration of Letrozole. The dried seed powder given orally showed normalization in the estrous cycle and reduction in the weight of the reproductive system as well as of the ovary (Patel and Thakor, 2012). Kumar et al., found *Tephrosia purpuria* to be effective anxiolytic agent and comparable to the standard drug, Diazepam. The hydroalcoholic extract at a dose of 200mg/kg and 400mg/kg orally was administered to mice in different maze models in the study (Kumar, et al., 2011). The acetylcholinesterase inhibitory activity of *Tephrosia purpurea* and neurobehavioral studies were made on zebra fish, a model for the study of neurodegenerative activities (Kannan and Vincent, 2012). *Tephrosia purpurea* has also been proved for its antiepileptic effect (Asuntha et al., 2010). Lodhi et al., studied the flavonoidal extract of *Tephrosia purpurea* and proved its potential for healing burn wounds. This activity is supposed to be due to its free radical scavenging property (Lodhi et al., 2010). The anti allergic effect of *Tephrosia purpurea* has been reported (Gokhale and Saraf 2000). The extract of *Tephrosia purpurea* stabilized mast cells significantly showing its usefulness in the treatment and management of asthma (Gajera Paresh Lallubhai and Dalal Mittal, 2011). In another study *Tephrosia purpurea* showed spasmolytic activity in the trachea of guinea pigs thus strengthening the view of its use in asthma (Soni et al., 2004). *Tephrosia purpurea* has also been studied for its immunomodulatory effect (Damre et al., 2003). Ashokkumar et al., studied the diuretic activity of methanol extract of *Tephrosia purpurea* (Ashokkumar et al., 2012). The aqueous extract from roots of *Tephrosia purpurea* also posses antilithiatic activity

(Swathi et al., 2008). Still another study was made on the *Tephrosia purpurea* leaves for its protective and curative ability for renal injury in rats (Jain and Singhai, 2009). Study on chemical constituents of *Tephrosia candida* revealed a sesquiterpene having significant estrogenic activtity (Hegazy et al., 2011). The chloroform and methanolic extract of *Tephrosia spinosa* showed significant ant helmintic activity against earth worms (*Pheretima posthuma*) (Ilango et al., 2011). The leaf extract of *Tephrosia vogelii* was found to possess significant anthelmintic activity against *Ascaridia galli*, a parasite in chicken (Siamba et al., 2007). The methanol extract of *Tephrosia vogelii* produced significant reduction in the blood pressure of cats (Adaudi et al., 2009).

**Conclusion and discussion**

The plants of genus *Tephrosia* are of high therapeutic importance. We can see that a large number of species are studied for their chemical constituents but the number of isolated compounds from individual specie is very few with some exceptions. Mostly studied compounds include flavonoids and rotenoids. Studies on oil composition are very less. The genus has significant anticancer and larvicidal potential.

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