

Review



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A Review on phytochemical and pharmacological studies of *Dysoxylum* species

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Abstract

A review of phytoconstituents and biological activities of *Dysoxylum* species has been presented, considering the fact that there are about 110 species of this genus distributed all around the world and many of these species occur in India. In Ayurveda, *Dysoxylum* species are used either alone or as an important ingredient of several formulations for the cure of inflammation, cardio-disorder, CNS disorder and tumor etc. Several of the chemical compounds (alkaloids, flavonoids, steroids and terpenoids etc) were isolated. This review focuses on the detail of its chemical constituents and medicinal uses with emphasis on the pharmacological action.

Keywords: *Dysoxylum* species, Photochemical and Pharmacological studies.

1. Introduction

Dysoxylum, a genus of large trees, belongs to family *meliceae* and is widely distributed throughout south east Asia to Australia. About a dozen species occurs in India namely *D. binectariferum*, *D. malabaricum*, *D. hamiltonii* and others [1,2]. Many of the *Dysoxylum* species possess a good amount of medicinal properties. The timber is used for building construction, boxes etc and is of great economic importance [2].

The bark of *D. binectariferum* contains about 15% tannins. Seeds of *D. binectariferum* contain 2.52% total ash and petroleum ether extract of

the seeds give 4.54% viscous oil [3]. Wood decoction of *D. malabaricum* is used in rheumatism and its oil in eye and ear diseases [1]. Some species of *meliceae* showed significant anti-feeding against green headed and brown headed leafroller larvae [4].

Extracts of 22 species of *meliceae* including *D. fraserianum* were examined for anti-malarial activity using *in vitro* test with two clones of *plasmodium falciparum*, sensitive of chloroquine (W2) and chloroquine resistant (D6) and the extracts showed better activity

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against W2 clone [5]. The extracts were also screened for antifeedant, toxicity bioassays and the toxicity tests, also performed with brine shrimp *A.salina* [9].

The leaf extract of *D.lenticellare* showed the molluscicidal and cardiac effects. Cumingianisides and triterpens were isolated from the leaves of *D.cumingianum*, which showed cytotoxic effects. Fruit and stem bark extracts of *D.binetariferum* were reported to have very promising anti-inflammatory, analgesic and immunomodulatory activities [6,7,8]. *D.spectabile* along with 17 more plants have been screened against green headed and brown headed leafroller larvae and showed significant antifeeding activity [4].

Methanolic extract of *D.cauliflorum* was tested *in vitro* for antiplasmodial, brine shimp toxicity and cytotoxicity assay. The samples showed an IC_{50} more than 10mg/ml against plasmodium falciparum [10]. Drugs from the wood extract of *D.malabaricum* is found to be effective towards rheumatism and diarrahioea [11].

Effect of some triterpenes and sesquiterpenes, isolated from the ethanolic extracts of stem bark

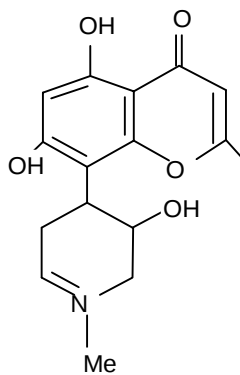
of *D.cauliflorum*, on a non-small cell bronchopummonary cinomas cell line (NSCLC-N6) [12]. Some more studied on pharmacological screenings of *Dysoxylum* genus in combination with other plants has also been carried out [13,14].

Encouraged by the interest in the phytochemical investigation of this genus and research work intermittently published on *Dysoxylum* species, an attempt is made to present a review on the phytochemical and pharmacological studies of *Dysoxylum* species which still remains a potential source of bioactive molecules.

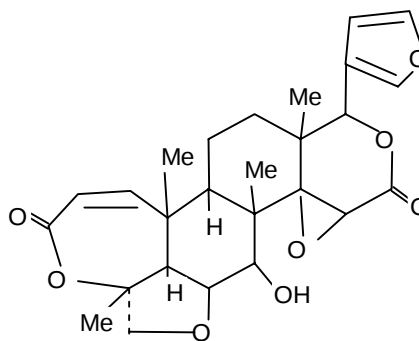
2. Pharmacological activity

The *Dysoxylum* species are considered to possess various pharmacological activities like anti-inflammatory, analgesic, anti-microbial, antitumor, CNS activities, molluscicidal and cardiac activities etc.

The literature survey reveals that a number of *Dysoxylum* species are used medicinally in India and other countries of the world. The chemical constituents and pharmacological actions of these constituents isolated from different species are summarized in Table 1



Pi-peridinybenzopyranone



Dysoxylene

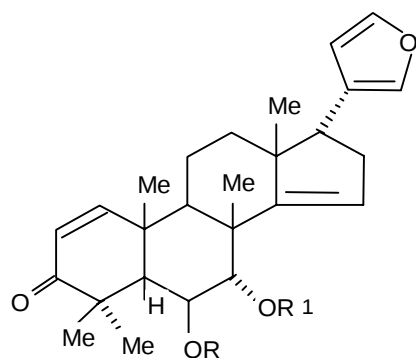
Table 1.

Chemical constituents and pharmacological activities of different parts of *Dysoxylum* species.

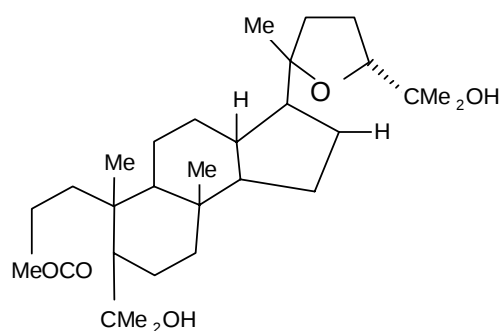
Name of Species	Plant Part	Chemical Constituents	Pharmacological activity	Ref.
<i>D. binectariferum</i>	Ground bark	Chromone alkaloid	Antiinflammatory, analgesic and immunomodulatory	7
<i>D. binectariferum</i>	Fruits	Dysobinin; Dysobinol	Central depressant and inflammation inhibitor.	6
<i>D. binectariferum</i>	Stem bark	Pi- peridinybenzopyranone	Antiinflammatory and immunomodulatory	8
<i>D. binectariferum</i>	Fruit	Dysobinin derivative	Antiinflammatory	15
<i>D. malabaricum</i>	Leaves	Ergosta-5,24(24')- diene-3 β , 4 β , 20S- triol; (24R)-cycloartane-3 β ,24,25-triol; Ergosta-5,24 (24')-diene-3 β , 7 α -diol	-	16
<i>D. malabaricum</i>	Leaves	Dymalol, ocotillane, shoreic acid	-	17
<i>D. malabaricum</i>	Leaves	Triterpenes, 21R,23R-epoxy-21 α -ethoxy-24S,25-dihydroxy aptirucall-7-en-3-one; 24R-acetoxy3 β ,25-dihydroxy cycloartane	-	18
<i>D. malabaricum</i>	Bark	Triterpenes, cabraleone, cabraleadiol, shoreic acid	-	19
<i>D. malabaricum</i>	Leaves	Acetylation and Deacetylation of triterpenes	-	20
<i>D. macranthum</i>	Bark	Tirucallan triterpenes, Dymacrins A-K, tetracyclic triterpenes, pregane steroids	Cytotoxicity activity	21
<i>D. richii</i>	Leaves	Dammarane triterpenoid, (20S,24S)-epoxy-4-hydroxy 3,4-secodammar-25(26)-en-3-oic acid.	-	22
<i>D. richii</i>	Fruits	Triterpenoids, Methylrichenoate; Richenone(I); Richenol (II); Richenoic acid (III); Ocotillone; Cabraleone; Shoreic acid; Eichlerianic acid.	-	23
<i>D. richii</i>	Leaves	Limonoids, Dysoxylin (I); Dysoxylene; Tigloyldysoxylin; 6 α -acetoxybacunol acetate	-	24, 25
<i>D. richii</i>	Leaves	Dysoxysulfone (sulphur metabolite)	-	26
<i>D. lenticellare</i>	Leaves	Dysomerithrine;3-epi-schelhammericine; 2,7-dihydrohomaerysotrien;3-epi-12-hydroxy schelhammericine; 21-phenyl ethylisoquinoline;dysoazecine;8 β -hydroxy-sandaracopimar-15-ene; phyllocladane; p-hydroxyacetophenone	Molluscicidal & Cardiodepressant activities	27,28,32
<i>D. lenticellare</i>	Leaves	Homolaudarocine; dysoxyline	Molluscicidal activity	28
<i>D. lenticellare</i>	Leaves	8-hydroxy sandaracopimarene;	-	29

Name of Species	Plant Part	Chemical Constituents	Pharmacological activity	Ref.
<i>D.lenticellare</i>	Leaves	Ferrubietolide	-	30
<i>D.lenticellare</i>	Leaves	Dyshomerythrine; 3-epi-12-hydroxy schelhammericine	-	35
<i>D. lenticellare</i>	Leaves	Biflavonoid, Robustaflavone 4', 7''-dimethyl ether, isoginlegetin, bilobetin	-	34
<i>D. lenticellare</i>	Leaves	Alkaloids	Cardioactive	33
<i>D.lenticellare</i>	Leaves & stem	Alkaloids, Lenticellarine; 3-epi-2,18-dimethoxyschelhammericine; 8 β -methoxysandaracopimarene; 3-epi-18-methoxyschelhammericine.	Molluscicidal activity	31,32
<i>D. lenticellare</i>	Stem	8b-methoxysandaracopimarene; Phyllocladene, 3-epi-2,18-dimethoxyschelhammericine	Molluscicidal activities	32,37
<i>D.lenticellare</i>	Stem	2 α -methoxy comosivine; 2 α -methoxy lenticellarsine; 2 α -hydroxylenticellarine	-	36
<i>D.spectabile</i>	Fruits	(2S, 3R)-2,3-dimethyl-1,3-(4-methyl-3-pentenyl)-2-norbormanol	-	38
<i>D.spectabile</i>	Fruits	(2S,3R)-2,3-dimethyl-3-(4-methyl-3-pentenyl)-2-norbornanal; sesquiterpenes	-	39
<i>D.spectabile</i>	Leaves	6 α -acetoxyobacunol acetate; Isopimara-8(14),15- diene	-	40
<i>D.cauliflorum</i>	Fruits	23(24-25)-abeo-20R,24-dihydroxydammaran-3-one	-	41
<i>D. hongkongense</i>	Leaves	20R,24R-epoxy-25-dammaren-3-one; 16 β -hydroxy-dammara-20(22),25-dien-3-one; 26-hydroxy-dammara-20,24-diene-3-one; 7 α , 21S, 25-trihydroxy-3b acetoxy-21S, 23R-epoxy-9(11)-en-dammarane; 5 α ,8 α -epidioxyergosta-6,22-dien-3 β -ol; Dammara -20,24-dien-3 β -ol; 20R-hydroxy-dammara-24-ene-3 β -one; Cycloart-23-ene-3 β , 25-diol	-	42
<i>D.roseum</i>	Leaves	5-Apotiurcallane derived triterpenes, Dysorones A-E; β -Sitosterol	Moderate Cytotoxic activity	43
<i>D.cumingianum</i>	Leaves	Cumingianosides, Cumindysoside	Antitumor activity	44,45,46, 47,48,63
<i>D.cumingianum</i>	Leaves	Triterpenes, Cumingianosides A-F, Cumindysoside A-B	Antileukemic, cytotoxicity activity	49
<i>D.alliceum</i>	Leaves	Bicalamenene	-	50
<i>D.acutangulum</i> and <i>D.alliacum</i>	Seed	(+)-8-hydroxycalamenene	Antibacterial activity	51
<i>D.kuskusense</i>	Stem	Diterpenes, Dysokusones A-C	Antitumor activity	52
<i>D.kuskusense</i>	Fruit	Prenyleudesmane diterpenes	Cytotoxic	53

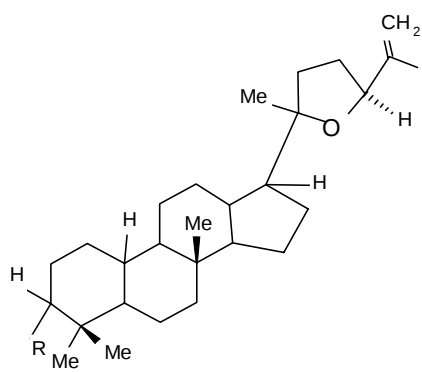
<i>D.schiffneri</i>	Wood	(+)-8-hydroxycalamenene; Schniffnerone- A (1,5-dihydroxy-1,3,5-bisabolatrien-10-one); Schifferone-B (2-hydroxy-11,12,13- trinor-7-calamenone)	-	54
<i>D.pettigrewianum</i>	Wood & bark	Masticadienonic acid (E-and Z form); 3 α -hydroxy-7, 24, Z-triucalladien-26-oic acid; Dysoxylic acid -A and B.	-	55
<i>D.variabile</i>	Stem bark	Tirucallane triterpenes, dyvariabilins A-H; niloticin; dihydroniloticin; tirucalla-7, 24-diene-3 β ,23-diol; sesquiterpenes, 1-(1-hydroxy -2-methoxy propyl)-3a	Cytotoxicity activity	56
<i>D.hainanense</i>	Bark	Ent-pimarane diterpenoids, ent-18-acetoxy-8(14)-pimaren-15S,16-diol; ent-18-acetoxy- 16-hydroxy-8(14)-pimaren-15-one; ent-19-nor-4,16,18-trihydroxy-8(14)-pimaren-15-one; 16,18-dihydroxy-8(14)-pimaren-15-one; richenoic acid; eichlerianic acid; shoreic acid	-	57
<i>D.hainanense</i>	Bark	Prieurianin-type tetranortriterpenoids	-	58
<i>D.beddomei</i>	Leaves	Triterpenes, dipterocarpol; 23-hydroxy tirucalla-7, 24Sdien-3-one; 3-oxo tirucall-7-ene	-	20,59, 60,61
<i>D.muelleri</i>	Wood	3a cinnamoyl glabretal, 3 α -benzoyl glabretal, 21, 24-epoxy-23 α , 25-dihydroxy-4 α , 4 α , 8b-trimethyl-14,18-cyclo-5 α , 13 α , 14 α , 17 α -cholestan-3-cinnamoyl-7-yl acetate; 21, 24- epoxy-23 α , 25-dihydroxy-4 α , 4 β , 8 β -trimethyl-14,18- cyclo-5 α , 13 α , 14 α ,17 α - cholestan, 3 β -benzoyl-7 α -yl acetate; 21-23-epoxy- 21,24,25-trihydroxy -4 α , 4 β , 8 β - trimethyl-14, 18-cyclo-5 α ,13 α , 14 α , 17 α - cholestan-3 α -cinnamoyl-7 α -yl acetate.	-	62



Dysobinin, R=Ac
Dysobindol, R=H

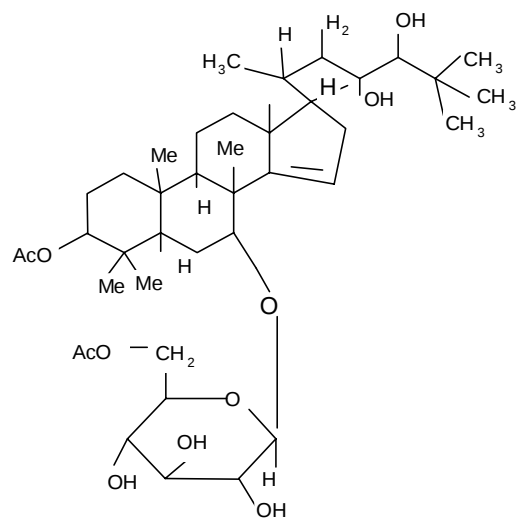


Dymalol

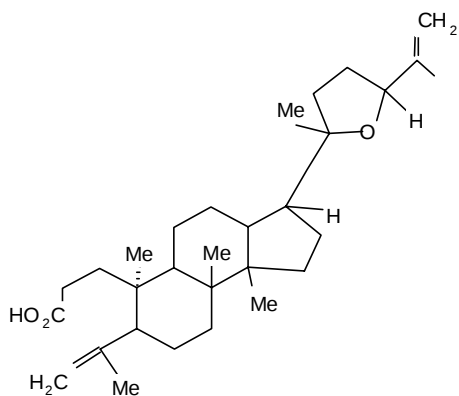


Rechenone, R=O

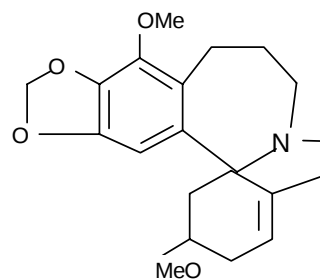
Rechenol, R=OH



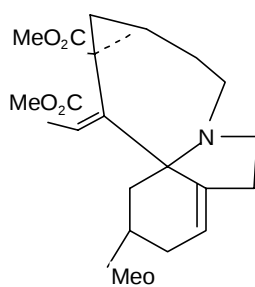
Cumingianoside



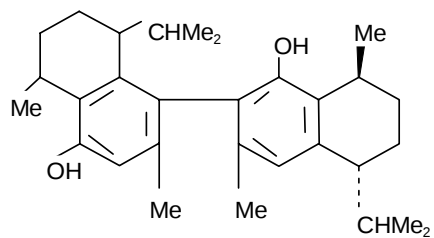
Richenoic acid



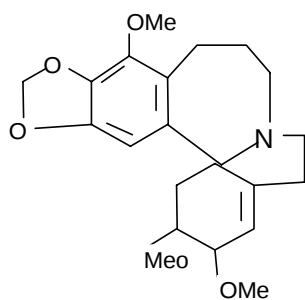
Dysomerithrine



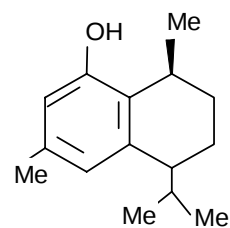
Lenticellarine



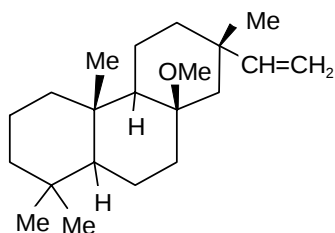
Bicalamenene



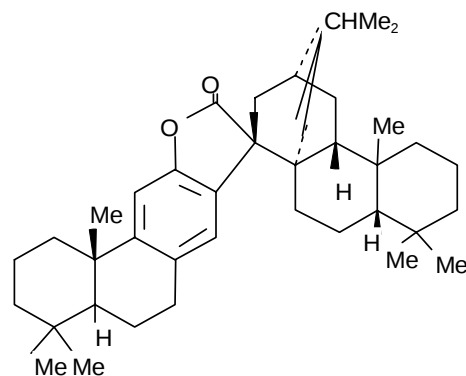
3-epi-2,18-dimethoxyschelhammericine



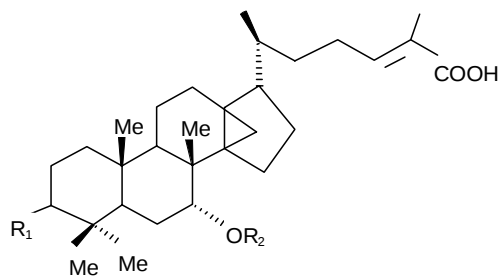
8-Hydroxycalamenene



8-methoxysandaracopimarene



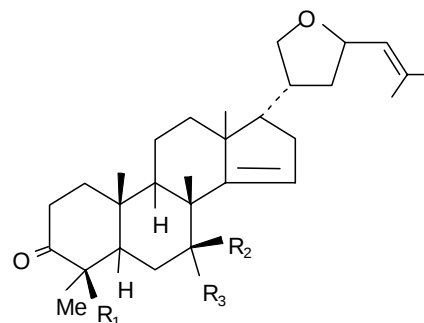
Ferrubietolide



Dysoxylic acid A-B

(A) $R_1 = \text{OAc}$, $R_2 = \text{H}$

(B) $R_1 = \text{O}$, $R_2 = \text{Ac}$

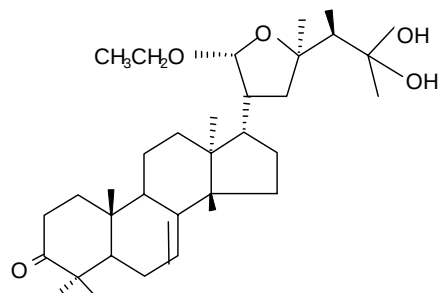


Dysorones(A-E)

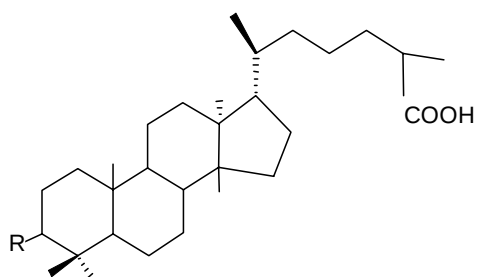
A, $R_1 = \text{CH}_2\text{OH}$, $R_2, R_3 = \text{O}$

B, $R_1 = \text{CH}_2\text{OH}$, $R_2 = \text{H}$, $R_3 = \text{OH}$

C, $R_1 = \text{Me}$, $R_2, R_3 = \text{O}$ Δ

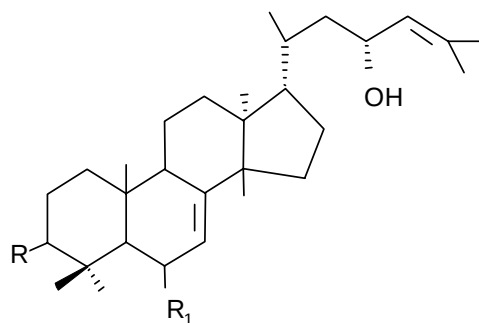


21R,23R-epoxy, 21-ethoxy, 24S,25-dihydroxyaportirucalla-7-ene-3one



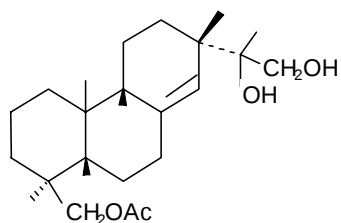
Masticadienoic acid (A-C)

A, R=O
C, R=OH

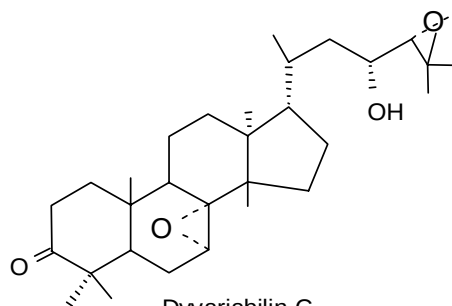


Dyvariabilin-A

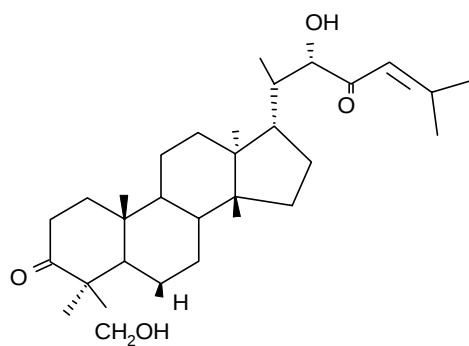
R=keto
R₁=keto



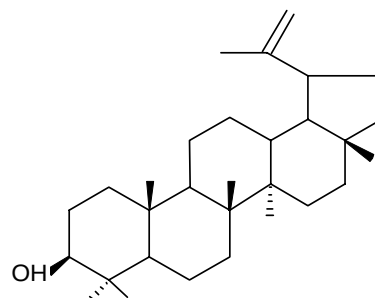
ent-18-Acetoxy-8(14)-pimarene-15S,16-diol



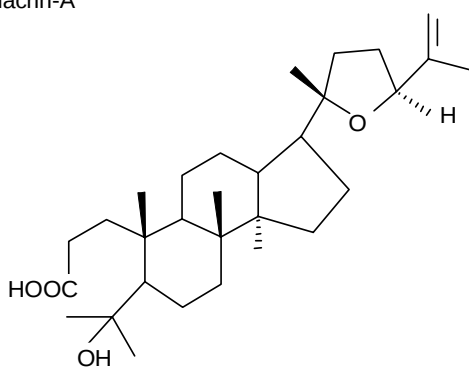
Dyvariabilin-C



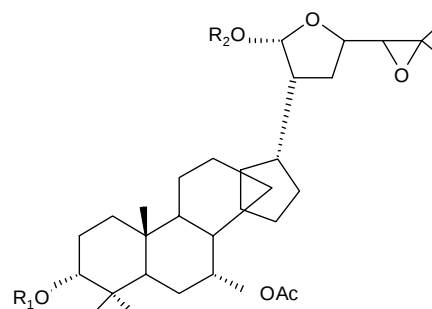
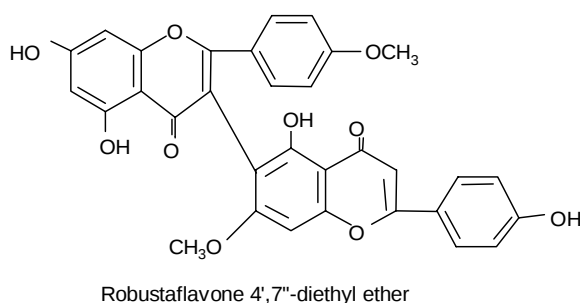
Dymacrin-A



Lupeol



(20S,24S)-epoxy 4-hydroxy 3,4 secodammar-25(26)-en3-oic acid



1a, $R_1 = \text{cinn}$, $R_2 = \text{H}$

1b, $R_1 = \text{benz}$, $R_2 = \text{H}$

1c, $R_1 = \text{H}$, $R_2 = \text{H}$

Conclusion

The *Dysoxylum* species have been studied for their phytoconstituents as well as for their biological activities. Terpene especially triterpene are major class of compounds isolated from genus. From this it can be concluded that out of 110 species of this genus distributed all around the world, some species have been phytochemically investigated. Phytochemical work on this genus seems to be by no means exhaustive and there still remains a vital scope

for study of bioactive molecules for human welfare.

Acknowledgements

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