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Review Article

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Aegiceras corniculatum Linn (Myrsinaceae)

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ABSTRACT

In this review, the literature data on photochemical and biological investigations of the Aegiceras are complied. The Aegiceras species are mangroves plants widely distributed along the sea coasts of Africa, South eastAsia to South china, New Guniea and Australia. To date 16 Terpenoids, 17 Terpenes, 9 Alkaloids, 1 Flavonoid, 3 Saponnins, 7 Tannins, 23 Acids, 9 polyketides, 7 Macrolides. From the Fruits, stems and Twigs, Bark, Leaves of Aegiceras. The isolated compounds shown an enorms structural diversity and bacterial and In Vitro blocking activity Cytotoxicity.

Key words: *Aegiceras*, Isolated Compounds, Biological Activity studies.

Contents

INTRODUCATION

The *Aegiceras* Commonaly known as Black Mangrove, river Mangrove or Khalsi, is a species of shrub or tree Mangrove in the Myrsine family with a distribution in costal and esturine areas rangings from India through southeastasia to southeren china, New Genea and Australia.

2. Chemical Constituents

To date Terpenoids **1-16** including Monoterpenoids **1-12** and Triterpenoids **13-16** and Terpenes **17-33** including Triterpenes and Alkaloids **34-43** and Flavonoids **43-44** and Saponins **45-48** and Tannins **49-55** and Acids **56-78** and Polyketides **79-87** and Macrolides **88-94** have been reported from Fruits, Bark, Stems and Twigs, Leaves and Aerial parts of *Aegiceras Corniculatum*.Names of compounds and their corresponding plant sources are compiled in the Table.

2.1 *Terpenoids*

2.1.1 Mono Terpenoids

Science 2011, **16** Terpenoids, **1-16** have been identified from bark of *Aegiceras Corniculatum* including Monoterpenoids **1-12** and Triterpenoids **12-16**.In [1] [5] [11].The relative configuration of Emerimidine A-B**[1-2],** Emeriphenolicin A-F**[3-8]** and Aspernidine A-B **[9-10]** , Austin**[11]** , Dehydro Austin **[12]** was established in 2011 [1] and Arjunolic acid **[13]** in 2012 [5] and then Protoprimulagenin **[14],**Aegicerin **[15],** Embelinone **[16]** was established in 2013[11].

2.2 *Terpenes*

2.2.1 Triterpenes

Science 2012 **17-33** Terpenes including Triterpenes its new indol triterpenes named Sharinines D-K **[18-25]** along with Shearinine A**[26]**, Paspalitrem A**[27]**, Paspaline E**[28]** was established in 2007 [9].A new Oleanane Triterpene from the stem of the *Aegiceras Corniculatum* 16α-hydroxy-13,28-epoxy oleanane 3-one**[29]** and it have been identified from the stem of the plant in 2013[11].From the stems and twigs of the *Aegiceras Corniculatum* four new compounds 2,7-dihydroxy-8-methoxy-3,6-diundecyl dibenzofuran-1,4-dione **[30]**, 2,8-dihydroxy-7-methoxy-3,9-di undecyl di benzofuran-1,4-dione [31],10-hydroxy-4,0-methyl-2,11-di undecyl gomphilactone**[32]**, 5-o-methyl embelin **[33].** In 2004[12].

2.3 *Alkaloids*

Several unusual alkaloids N-2-methylpropyl-2-methlbutenamide**[34]**,2-acetyl-1,2,3,4-tetrahydro-β-carbolin**[35]**, Fusarine**[36]**,3-(1-amino ethylidine)-6-methyl-2H-pyran-2,4(3H)-dione**[37]**,Fusamine **[38]** were isolated from the Fruits of *Aegiceras Corniculatum* in 2012 [4].And then new pyrrole alkaloids N-[4-(2-formyl-5-hydroxy methyl pyrrole-1-yl) butyl]-acetamide **[39]**, N-[5-(2-formyl-5-hydroxy methyl pyrrole-1-yl)-pentyl]-acetamide**[40]** and a new indole derivative (3aR,8aR)-3a-acetoxyl-1,2,3,3a,8,8a-hexahydro pyrrolo-(2,3-b) indol**[41]** and derivatives of indol (3aR,8aS)-1-acetyl-1,3,3a,8,8a-hexahydro pyrrolo-(2,3-b) indol-3a-ol**[42]**,N-acetyl tryptamineA**[43]** was identified from the leaves of the *Aegiceras Corniculatum* in 2008[7].

2.4 Flavonoids

Science 2013 Isorhamnetin **[44]** was identified from the bark of the *Aegiceras Corniculatum* [11].

2.5 *Saponnins***:**

From the stems and twigs of the *Aegiceras Corniculatum* four new saponnin type compounds namely 2-methoxy-3-nonyl resorcinol**[45]**,5-o-ethylembelin**[46]**,2-o-acetyl-5-o-methylembelin**[47]**,3,7-dihydroxy 2,5-di undecyl napthaquinone**[48]** have been established in 2004 [12].

2.6 *Tannins*

From the Aerial parts of the *Aegiceras Corniculatum* seven new condenced Tannins type compounds namely gallocatechin**[49]**, epi-gallocatechin**[50]**, epi-gallocatechin-3-o-gallote**[51]**, epi-catechin-3-o-gallate**[52]**, epi-gallocatechi benzylthioether**[53]**,epi-catechin benzylthioether**[54]**,benzylmercaptan**[55]** have been established in 2012[6].

2.7 *Acids*

Six new tetramic acids derivatives, Pencillenols A1,A2,B1,B2,C1,C2**,[56-61]** was identified by the bark of the Aegiceras Corniculatum in 2008 [3].And four new P-aminoacetophenonic acids named (2E)-11-(4'-aminophenyl)-5,9-dihydroxy-4,6,8-trimethyl-11-oxo-undec-2-enoicacid**[62]**,9-(4'-aminophenyl)-3,7-dihydroxy-2,4,6-trimethyl-9-oxo-nonic acid**[63]**,(2E)-11(4'-amino phenyl)-5,9-o-cyclo-4,6,8-trimethyl-11-oxo-undec-2-enoic acid**[64]**,9-(4'-aminophenyl)-3,7-o-cyclo-2,4,6-trimethyl-9-oxo-nonoicacid**[65]** was identified from the leaves of *Aegiceras Corniculatum* in 2010[8].And then it is found that in leaves and stems of the species the fatty acids in Arachidic acid**[66]**, Heneicosanoic acid **[67]**, myristoleic acid**[68]**, linolelaidic acid**[69]**, linoleic acid**[70]**, Cis-4,7,11,14,17-eicosa pentaenoic acid**[71]**, myristic acid**[72]**,palmitic acid**[73]**,linolenic acid**[74]**,Cis-11,14,17-eicosatrienoic acid**[75]**, arachidonic acid**[76]**,have been established in 2012 [10].And then bark of the *Aegiceras Corniculatum* in gallic acid**[77]** and syringic acid**[78]** in 2013[11].

2.8 Others

2.8.1 Poly *ketides*

Four polyketides was identified from the bark of *AegicerasCorniculatum* in Leptosphaerone C**[79]**, Penicillenone **[80]**, Arugosin I**[81]**,9-demethyl FR-9o1235**[82]**and Oxa phenalenone dimmers in Bacillosporin A**[83]**,Bacillosporin C**[84]**,SequoiamonascinD **[85]**,Sequoia tone A**[86]**, Sequoia tone B**[87]** have been identified in 2008 [2].

2.8.2 Macrolides:

Four new isomeric macrolides was identified from the bark of *Aegiceras Corniculatum* in Isocorniculatolide A **[88]**, 11-o-methyl isocorniculatolide A **[90]**, 11-0-methyl corniculatolide**[91]**, 12-hydroxy-11-0-methyl Corniculatolide A**[92]**, corniculatolide**[93]** .The relative configuration of IsocorniculatolideA**[88]** was confirmed by Single crystal X-Ray diffraction analysis in 2012 [5]. In comparative studies derivative of the Isocorniculatolide A **[88]** is 11-acetoxy isocorniculatolide A **[89]** and other one is CorniculatolideA **[92]** derivative is 11-acetoxy corniculatolide **[94]** in 2012[5].

Biological Activities

3.1 Antibacterial activity

This study was conducted to investigate the bioactive potential of mangrove plants to develop alternative drug development for the treatment of bacterial urinary tract infections (UTIS) which are frequent infections in the outpatient as well as in the nosocomial setting. Parts were investigated to evaluate the antibacterial activity against bacterial UTIS pathogens. The plant *Aegiceras Corniculatum* exhibited excellent antibacterial activity in2012[14].

3.2 Analgesic activity

The leaves of *Aegiceras Corniculatum* were extracted in absolute methonal to determine their analgesic activity.This study was showed better analgesic effect than the reference drug and at the dose level of 1000 mg /kg the duration and intensity of analgesia was also greater than acetylsalicylicacid. In 2010 [15].

3.3 Antidiabetic activity

Earlier ethno pharmacological records divulged the traditional usages of Mangrove Aegiceras Corniculatum (Linn) Blanco distributed in costal and estuarine areas of southeast India. Excluding scientific knowledge of *Aegiceras Corniculatum* against diabetes an including liver of control and alloxan-diabetic rats. As a result, *Aegiceras Corniculatum* leaf suspension showed moderate reduction in blood glucose (from 382±34 to 105±35), glycosyla ted haemoglobin, a decrease in the activities of glucose-6-phosphatase and fructose 1, 6-disphosphatase, and an increase activity of extract on 100 mg/kg. The present finding support promising results in terms of anti diabetic activities establishing its candidacy for further purification of individual compound in order to understand their mechanism of action. In [2012] [16].

3.4 Anti-inflammatory activity

This plant part tested in MeoH extract of stem stimulated with Ca (2+)-ionophore A23,87 leading to the production of various proinflammatory metabolites, that is 12-HTT,12-HETE and LTB(4) and 5-HETE. And then formalin-induced paw licking and hot plate test in mice. And then n-Hexane, EtoAc of stem was Acetic-acid-induced [Antinociceptive activity] 2012 [17].

3.5 Antiproliferation and Cytotoxicity Assay

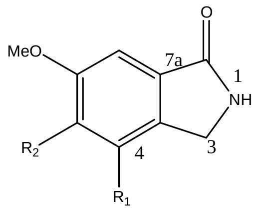
Compounds were assayed against human umbilical vein endothelial cells (HUVEC) and K562 human chronic myeloid leukemia cells (DSM ACC 10) for their antiproliferative effect (GI_{50}) and against Hela human cervix carcinoma cells (DMS ACC 57) for their cytotoxic (CC_{50}) effect as previously described. The hibitory concentration needed to reduce the growth (GI_{50}; the concentration needed to reduce the growth of treated cells to half that of untreated cells) or 50% cytotoxic concentration ($CC_{50;}$ the concentration that kills 50% of treated cells).Compounds **[35], [37], [38]** are exhibit weak Antiproliferative and Cytotoxic activities. In 2012 [4].

3.6 Antioxidant activity

The quality of the antioxidants about the Condensed Tannins **[49-55]** from different parts of *Aegiceras Corniculatum* was determined by the IC_{50} values .These values of Aerial parts (Leaf, Stem bark, Root bark, Ascorbic acid, BHA) compared with leaf and stem bark were significantly lower than those of root bark, ascorbic acid and BHA, indicating the condensed tannins from leaf and stem bark exhibited a higher radical scavenging effect than the remainder. The scavenging effect on the DPPH radical followed the order. Leaf ≈ Stem bark > Ascorbic acid > Root bark > BHA. 2011 [6].

4. In vitro blocking activity, Cytotoxicity

Our results indicated that few Flavan-3-ol polymers reacted with proteins in hypocotyls of Aegiceras Corniculatum associated with the deteriorating reactions during the dry storage. In 2010[13]. Compound **[33]** showed in vitro cytotoxicity. (Against the HL-60) 2004 [12].And then these compounds are **[18], [19], [21]** exhibit significant in vitro blocking activity. 2007 [9]. Compounds **[56], [58]** showed cytotoxicities against HL-60 cell line with IC_{50} values of 0.76 µm and 3.20 µm respectively.Laptosphaerone **[79]** showed cytotoxicity against A-549 cells with an IC_{50} value of 1.45µm,while **[80]** Compound showed cytotoxicity against P 388 cells with an IC_{50} value of 1.38µm. 2008 [2]. The anti-influenza A viral (H_1N_1) activities of eight **[1-8]** compounds were also evaluated using the cytopathic effect (CPE) inhibition assay.2011 [1]. And then compound **[65]** showed no inhibitory on HCV protease and Sec A ATPase and wasn't active against VSVG/HIV –Luc pseudo typing Virus. 2010 [8].



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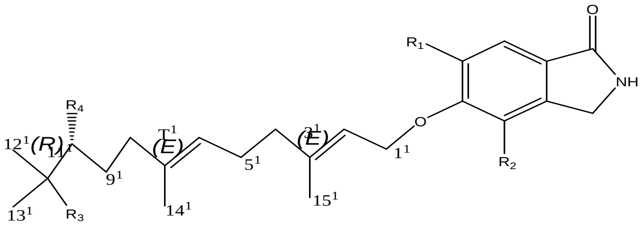

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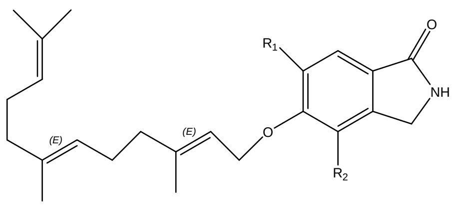

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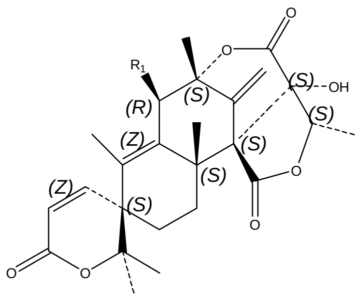

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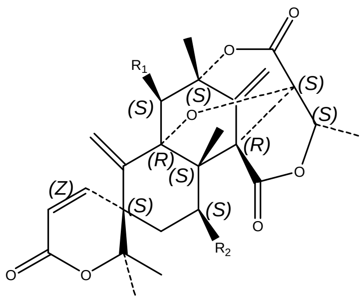

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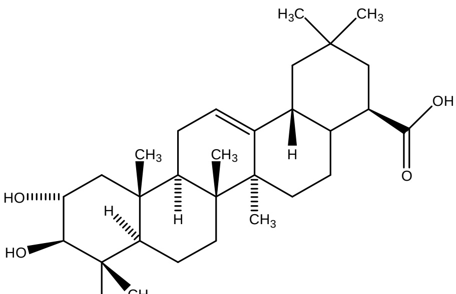
12: R_1=OAc, R_2=OAc



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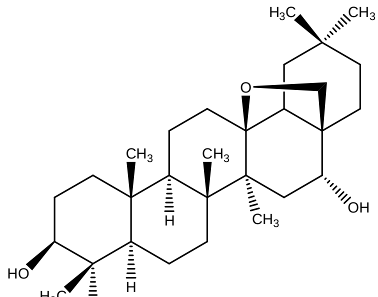

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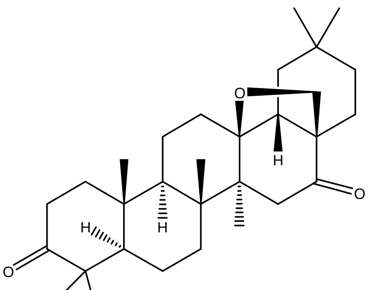

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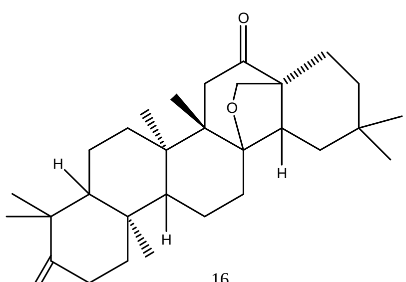

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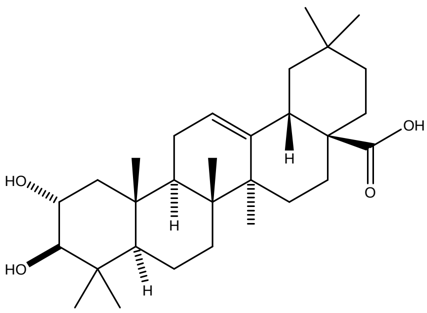

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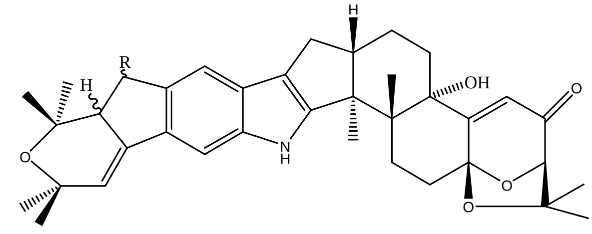

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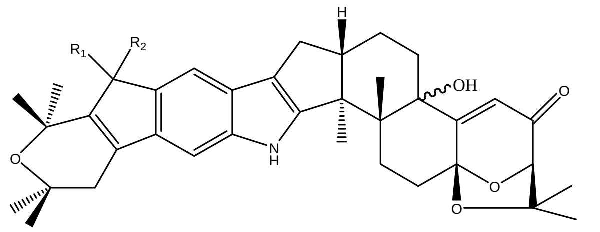
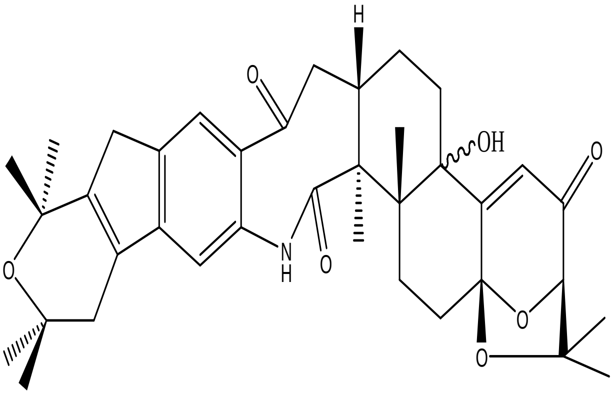
19 R=OME
26 R=H



20 $R_1=R_2=H$
21 $R_1=R_2=O$



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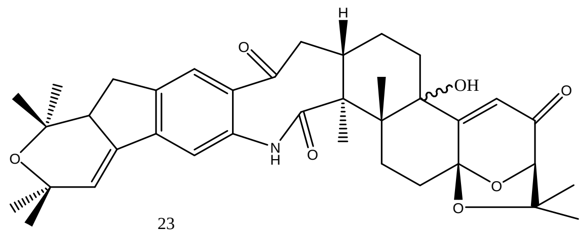

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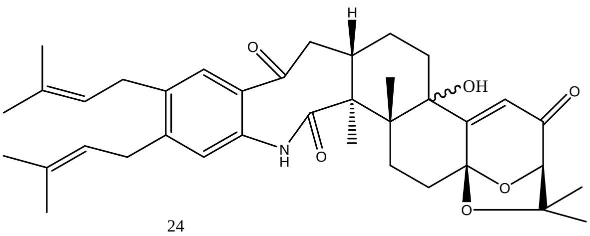

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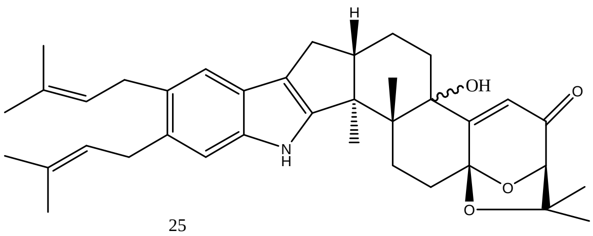

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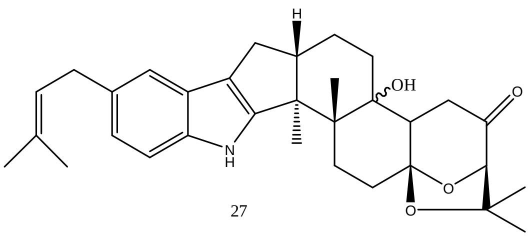

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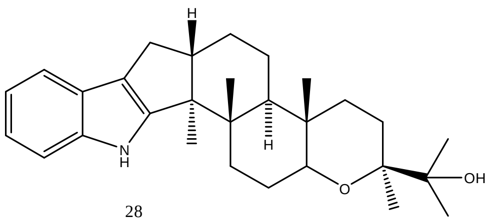

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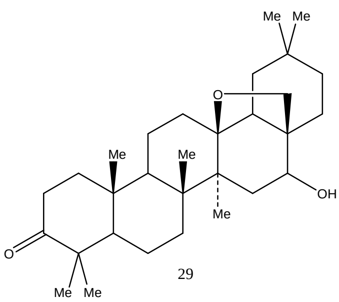

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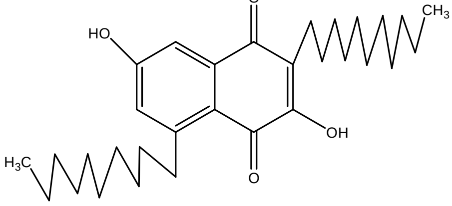

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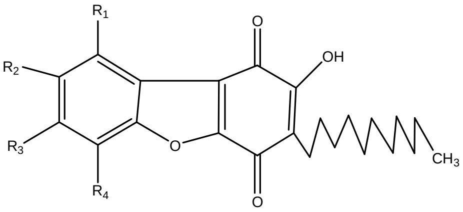
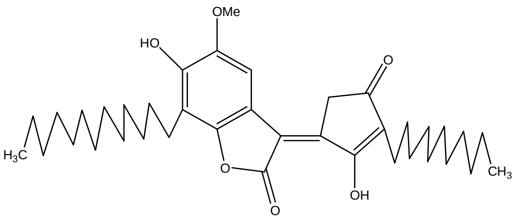


31 R_1=H,R_2=OCH_3,R_3=OH,R_4= n-$C_{11}H_{23}$
32 R_1= n-$C_{11}H_{23}$, R_2=OH,R_3=OCH_3,R_4=H



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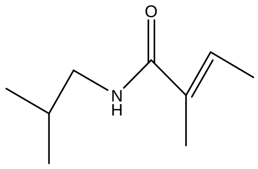

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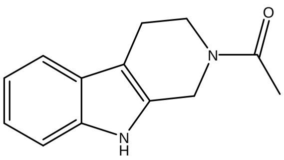

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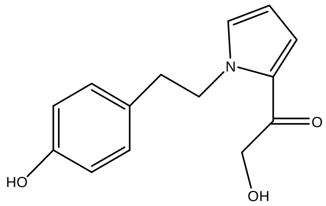

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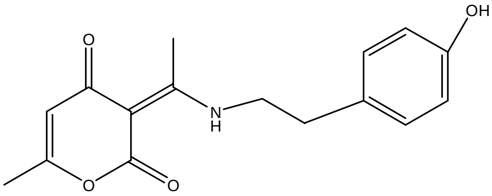

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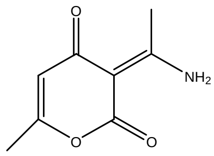

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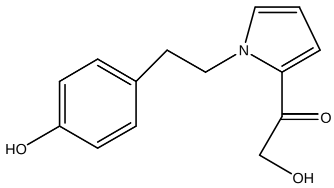

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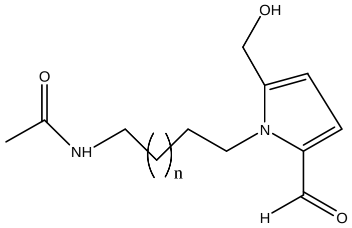

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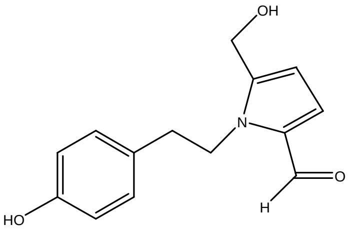

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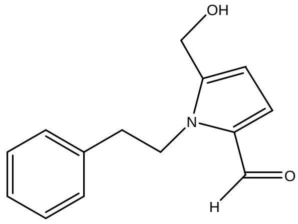

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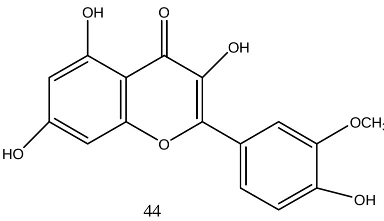

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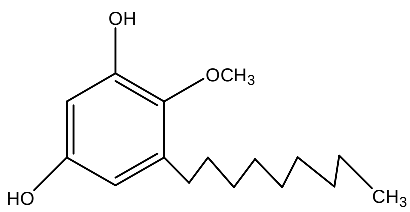

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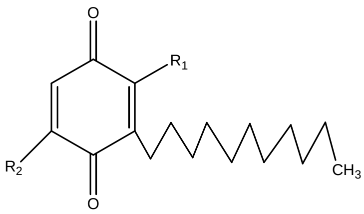

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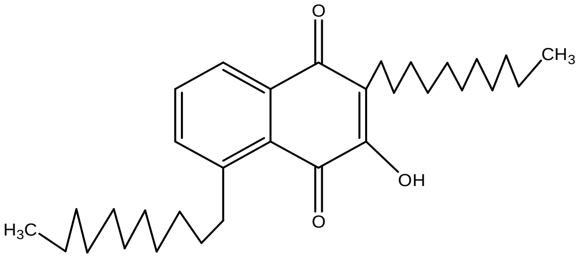
47 R_1=$OCOCH_3$, R_2=OCH_3



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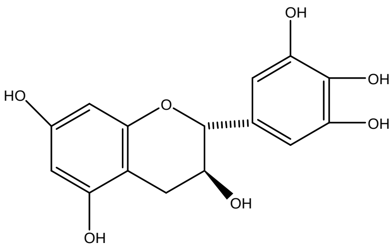

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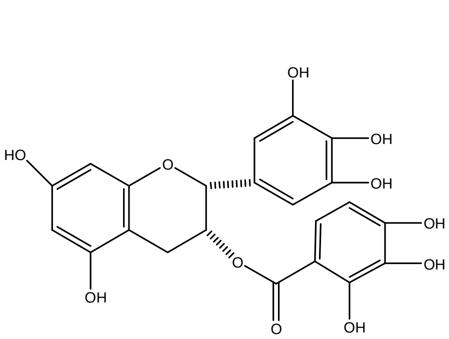

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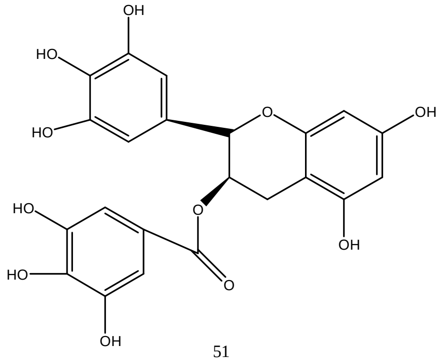

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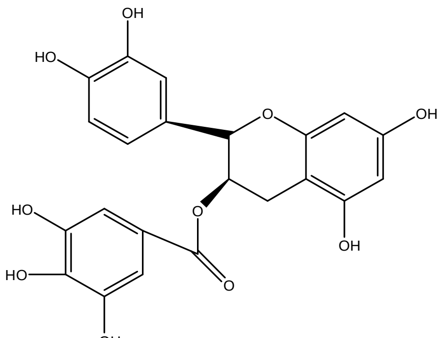

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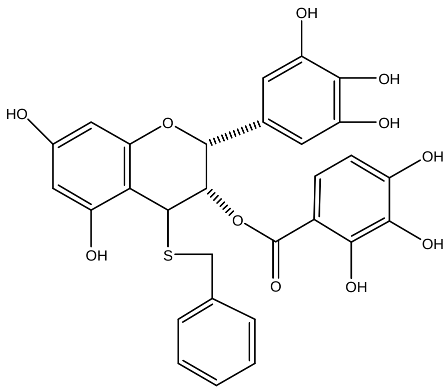

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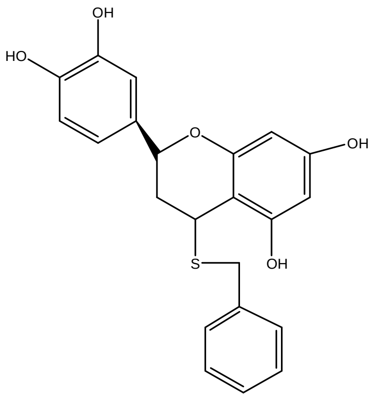

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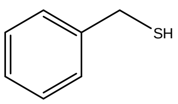

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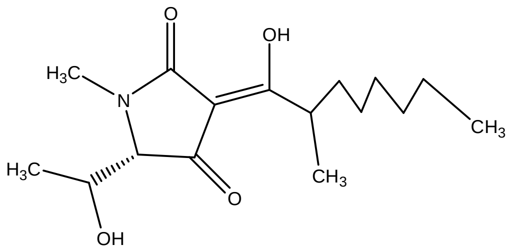
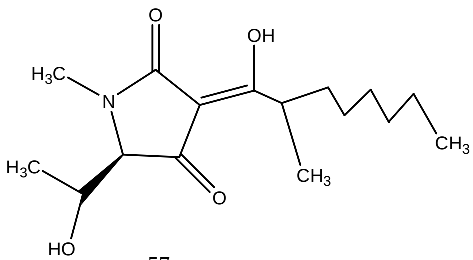
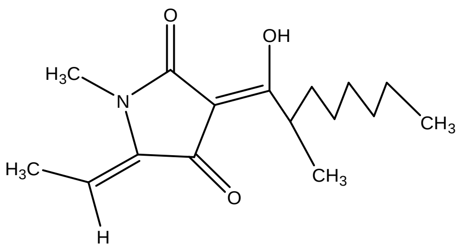


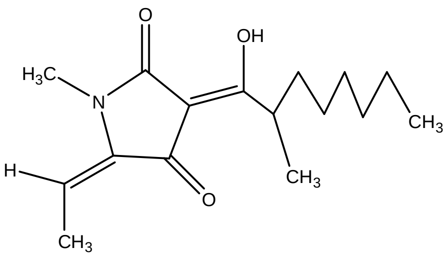
56 Penicillenol A_1



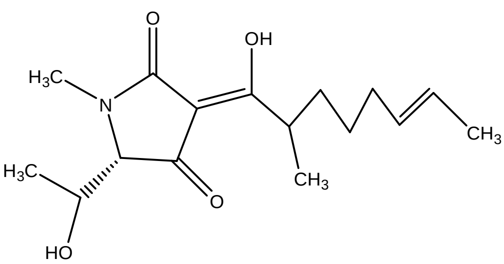
57 Penicillenol A_2



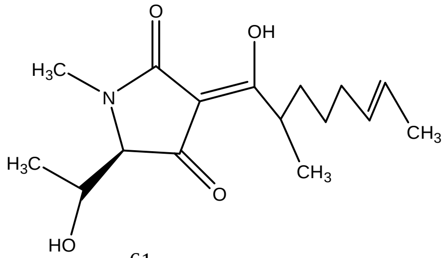
58 Penicillenol B_1



59 Penicillenol B_2



60 Penicillenol C_1



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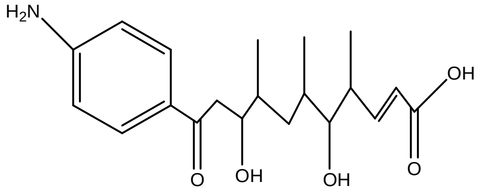

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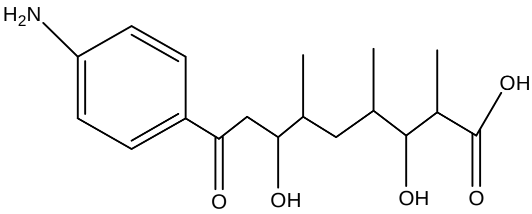

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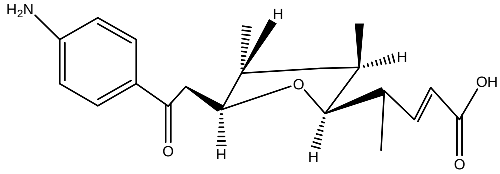

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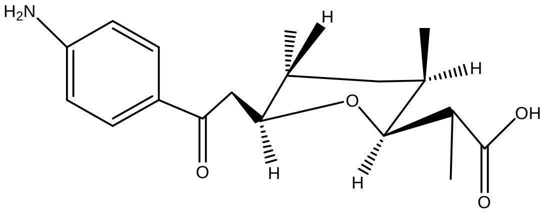

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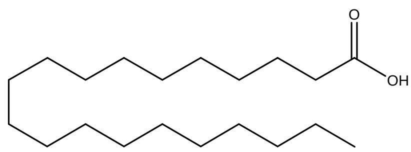

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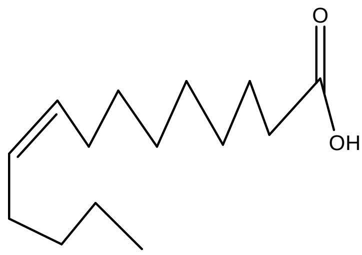

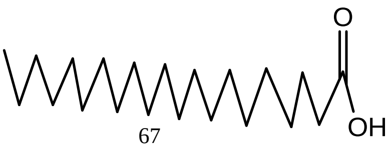

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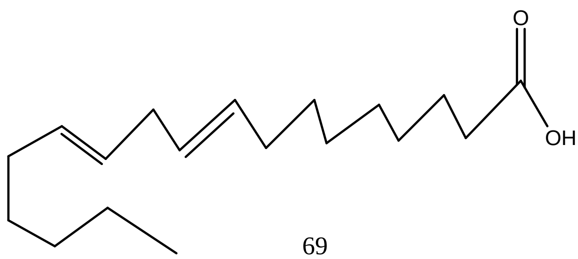

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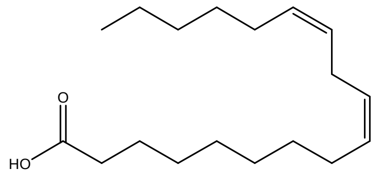

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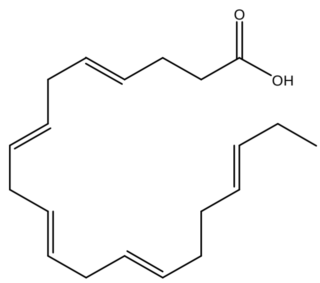

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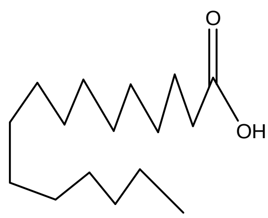

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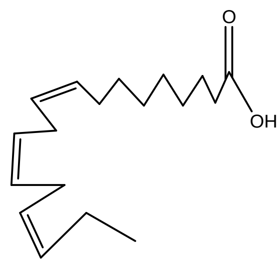

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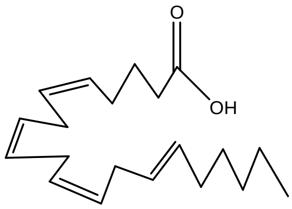

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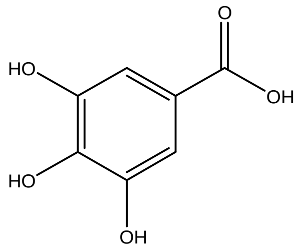

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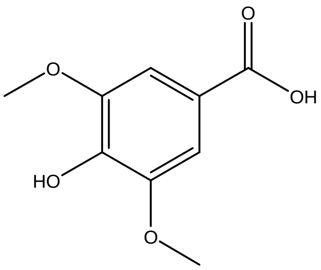

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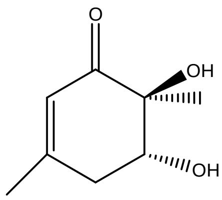

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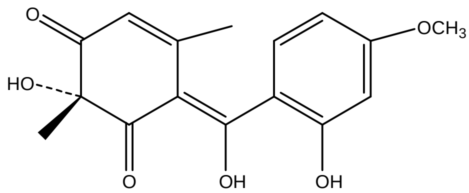

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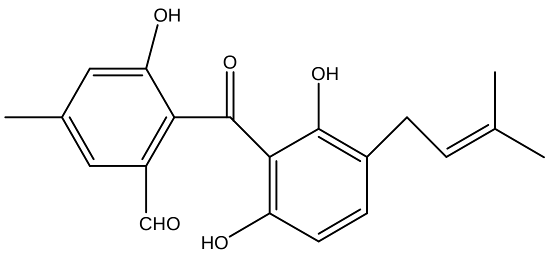

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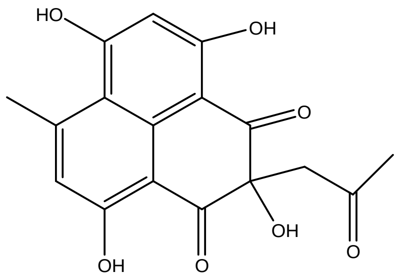

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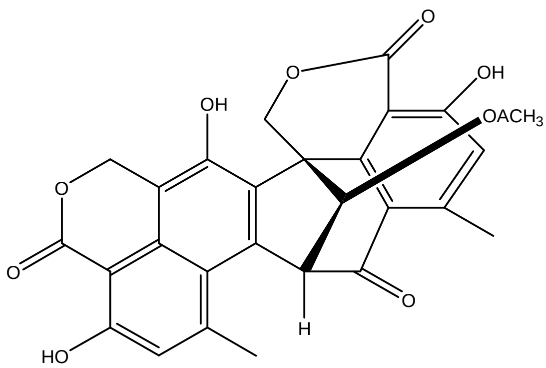

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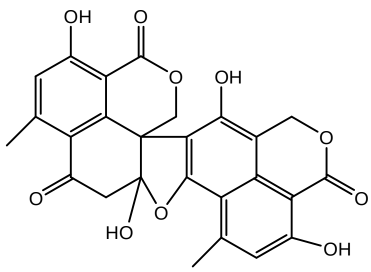

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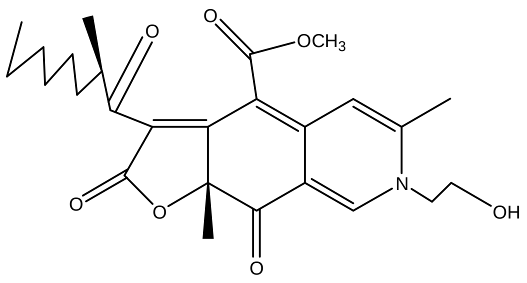

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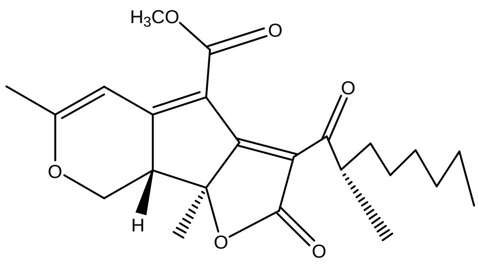

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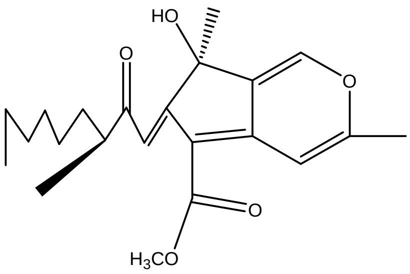

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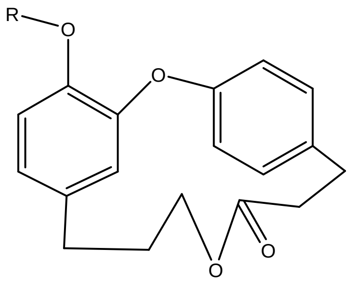
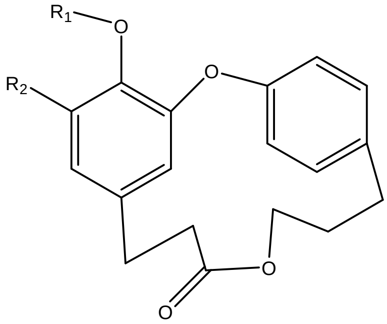


88 R=H
89 R=Ac
90 R=Me



91 R_1=Me R_2=H
92 R_1=Me R_2=OH
93 R_1=R_2=H
94 R_1=Ac R_2=H

NO	Compound Class and name	Source	Part of the plant	Ref
	Terpenoids			
1	Emerimidine A	Aegi-ceras	Bark	[1]
2	Emerimidine B		Bark	[1]
3	Emeriphenolicin A		Bark	[1]
4	Emeriphenolicin B		Bark	[1]
5	Emeriphenolicin C		Bark	[1]
6	Emeriphenolicin D		Bark	[1]
7	Emeriphenolicin E		Bark	[1]
8	Emeriphenolicin F		Bark	[1]
	Mono Terpenoids			
9	Aspernidine A	Aegi-ceras	Bark	[1]
10	Aspernidine B		Bark	[1]
11	Austin		Bark	[1]
12	Dehydro Austin		Bark	[1]
	Tri Terpenoids			
13	Arjunolic acid	Aegi-ceras	Bark	[5]
14	Protoprimulagenin		Bark	[11]
15	Aegicerin		Bark	[11]
16	Embelinone		Bark	[11]
	Terpenes			
17	Maslinic acid	Aegi-ceras	Bark	[5]
	Tri Terpenes			
18	Shearinine D	Aegi-ceras	Stem	[9]
19	Shearinine E		Stem	[9]
20	Shearinine F		Stem	[9]
21	Shearinine G		Stem	[9]
22	Shearinine H		Stem	[9]
23	Shearinine I		Stem	[9]
24	Shearinine J		Stem	[9]
25	Shearinine K		Stem	[9]
26	Shearinine A		Stem	[9]
27	Paspalitrem A		Stem	[9]
28	paspaline E		Stem	[9]
29	16α-hydroxy-13,28-epoxy oleanan-3-one		Stem	[11]
30	2,7-dihydroxy-8-methoxy-3,6-di undecyl di benzofuran-1,4-dione		Stems and Twigs	[12]
31	2,8-dihydroxy-7-methoxy-3,9-di undecyl di benzofuran-1,4-dione		Stems and Twigs	[12]
32	10-hydroxy-4,0-methyl-2,11-di undecyl gomphilactone		Stems and Twigs	[12]
33	5-o-methyl embelin		Stems and Twigs	[12]

	Alkaloids			
34	N-2-methyl propyl-2-methyl butenamide	Aegi-ceras	Fruits	[4]
35	2-acetyl-1,2,3,4-tetrahydro-β-carboline		Fruits	[4]
36	Fusarine		Fruits	[4]
37	3-(1-amino ethylidene)-6-methyl-2H-Pyran-2,4(3H)-dione		Fruits	[4]
38	Fusamine		Fruits	[4]
39	N-[4-(2-Formyl-5-hydroxy methyl pyrrol-1-yl)butyl]-acetamide		Leaves	[7]
40	N-[5-(2-Formyl-5-hydroxy methyl pyrrol-1-yl)-pentyl]-acetamide		Leaves	[7]
41	(3aR,8aR)-3a-acetoxyl-1,2,3,3a,8,8a-hexahydro pyrrolo-(2,3-b) indol		Leaves	[7]
42	(3aR,8aS)-1-acetyl-1,3,3a,8,8a-hexahydro pyrrolo-(2,3-b) indol-3a-ol		Leaves	[7]
43	N-acetyl tryptamine A		Leaves	[7]
	Flavonoids	Aegi-ceras	Bark	[11]
44	Iso rhamnetin			
	Saponins			
45	2-methoxy-3-nonyl resorcinol	Aegi-ceras	Stems and Twigs	[12]
46	5-0 ethyl embelin		Stems and Twigs	[12]
47	2-o-acetyl-5-o-methyl embelin		Stems and Twigs	[12]
48	3,7-dihydroxy 2,5-diundecyl napthaquinone		Stems and Twigs	[12]
	Tannins			
49	Gallocatechin	Aegi-ceras	Aerial parts	[6]
50	Epi gallocatechin		Aerial parts	[6]
51	Epi gallocatechin-3-o-gallate		Aerial parts	[6]
52	Epi catechin-3-o-gallate		Aerial parts	[6]
53	Epi gallocatechin benzylthioether		Aerial parts	[6]
54	Epi catechin benzylthioether		Aerial parts	[6]
55	Benzyl mercaptan		Aerial parts	[6]
	Acids			
56	Pencillenol A1	Aegi-ceras	Bark	[3]
57	Pencillenol A2		Bark	[3]
58	Pencillenol B1		Bark	[3]
59	Pencillenol B2		Bark	[3]
60	Pencillenol C1		Bark	[3]
61	Pencillenol C2		Bark	[3]
62	(2E)-11-(4'-aminophenyl)-5,9-dihydroxy-4,6,8-tri methyl-11-oxo-undec-2-enoic acid		Leaves	[8]
63	9-(4'-aminophenyl)-3,7-dihydroxy-2,4,6-trimethyl-9-oxo-nonic acid		Leaves	[8]
64	(2E)-11-(4'-aminophenyl)-5,9-o-cyclo-4,6,8-trimethyl-11-oxo-undec-2-enoic acid		Leaves	[8]
65	9-(4'-aminophenyl)-3,7-o-cyclo-2,4,6-trimethyl-9-oxo-nonoic acid		Leaves	[8]
66	Arachidic acid		Leaves	[10]
67	Heneicosanoic acid		Leaves	[10]
68	Myristoleic acid		Leaves	[10]
69	Linolelaidic acid		Leaves	[10]
70	Linoleic acid		Leaves	[10]
71	Cis-4,7,11,14,17-Eicosa pentanoic acid		Leaves	[10]
72	Myristic acid		Leaves	[10]
73	Palmitic acid		Leaves	[10]
74	Linolenic acid		Leaves	[10]
75	Cis-11,14,17-Eicosa trienoic acid		Leaves	[10]
76	Arachidonic acid		Leaves	[10]
77	Gallic acid		Bark	[11]
78	Syringic acid		Bark	[11]
	Others			
	Poly ketides			
79	Leptosphaerone C	Aegi-ceras	Bark	[2]
80	Penicillenone		Bark	[2]
81	Arugosin I		Bark	[2]
82	9-Demethyl FR-901235		Bark	[2]
83	Bacillosporin A		Bark	[2]
84	Bacillosporin C		Bark	[2]
85	Sequoiamonascin D		Bark	[2]
86	Sequoiatone A		Bark	[2]
87	Sequoiatone B		Bark	[2]
	Macrolides			
88	Iso Corniculatolide A		Bark	[5]
89	11-Acetoxy iso corniculatolide A		Bark	[5]
90	11-o-methyl iso corniculatolide A		Bark	[5]
91	11-o-methyl corniculatolide A		Bark	[5]
92	12-hydroxy-11-o-methyl corniculatolide A		Bark	[5]
93	Corniculatolide A		Bark	[5]
94	11-Acetoxy corniculatolide A		Bark	[5]

CONCLUSION

Natural products may be useful as a source of novel chemical structures for Anti-inflammatory, Analgesic, Antidiabetic, and Antioxidant

Acknowledgement
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