Bangladesh Pharmaceutical Journal ***19****(2): 237-253, 2016* **- Review paper**

Constituents of *Erythrina* - a Potential Source of Secondary Metabolities: A Review

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Abstract

The genus *Erythrina* is a potential source of chemical constituents, many of which medicinal properties. Although some reviews on chemical constituents of particular *Erythrina* species could be found, no detailed review covering the chemistry of different *Erythrina* species has been reported to the best of my knowledge. Therefore, the aim of this review was to compile the phytoconstituents reported from various species of *Erythrina*. A total of 155 secondary metabolites have been published from 15 species of *Erythrina*. Among them *E. subumbrans* and *E. variegata* consist of the highest number of chemical constituents.

Key words: *Erythrina*, Phytoconstituents, Alkaloids, Flavonoids, Pterocarpans, Steroids, Triterpenes

Introduction

The genus *Erythrina* (Leguminosae) consists of 110 species of trees and shrubs. Among them, 15 different species have been thoroughly analyzed in this review. *E. addisoniae* is a wild tree, small to medium sized and contains good quantity of potassium salts in its fruits. *E. americana* is a 5 m tall tree and its branches are widely spread. *E. caribaea* and *E. indica* are medium sized tree, normally grow 6 - 9 m in height and its leaves are trifoliate, bright-emerald green. *E. latissima* is 9 - 24 m in height with root and stem burnt (Wanjala *et al*., 2002). *E. melanacantha* has smaller leaves and shorter, standard calyx (Gillett, 1972). *E. mildbraedii* grows upto 30 m in height and is native in West Africa. *E. poeppigiana* is a roadside tree having 8 - 12 m height with orange colored flowers (Tanaka *et al*., 2003). *E. stricta* Roxb is a midsize tree with cracked cork bark having pale yellow prickle branches (Hussain *et al*., 2011). *E. subumbrans* is a deciduous, medium sized tree (5 - 25 m tall). Three leaflets are present in leaves at alternate arrangement and its bark is whitish. *E. variegata* is a first growing deciduous tree with 15-18 m tall and leaves are 6 inches long having spiny branches (Kumar *et al*., 2010). *E. vespertilio* is an ambiguous tree (common name: bean tree) and indigenous to North Australia. *E. velutina* is a leguminous tall tree that grows upto 10 m and indigenous to Brazil.

E. zeberi and *E. zeyheri* are deciduous subshurb trees growing upto 60 cm height having glabrous, trifoliolate leaves with large leaflets armed. The species of *Erythrina* have been used as traditional medicaments as sedative, antiasthmatic, antiepileptic, anticonvulsant, antipyretic, antiinflammation, antibacterial, insomnia, helminthiasis, cough, cuts and wounds (Kumar *et al.*, 2010).

Although some reviews carring chemical constituents of particular *Erythrina* species have been found, no detailed review was found on different *Erythrina* species. Thus, this paper will assist the researchers working on *Erythrina* species around the globe.

Phytoconstituents

A total of 15 species of *Erythrina* have been analyzed and 155 (**1-155**) molecules were reported in this review as phytoconstituents. The species are *E.*

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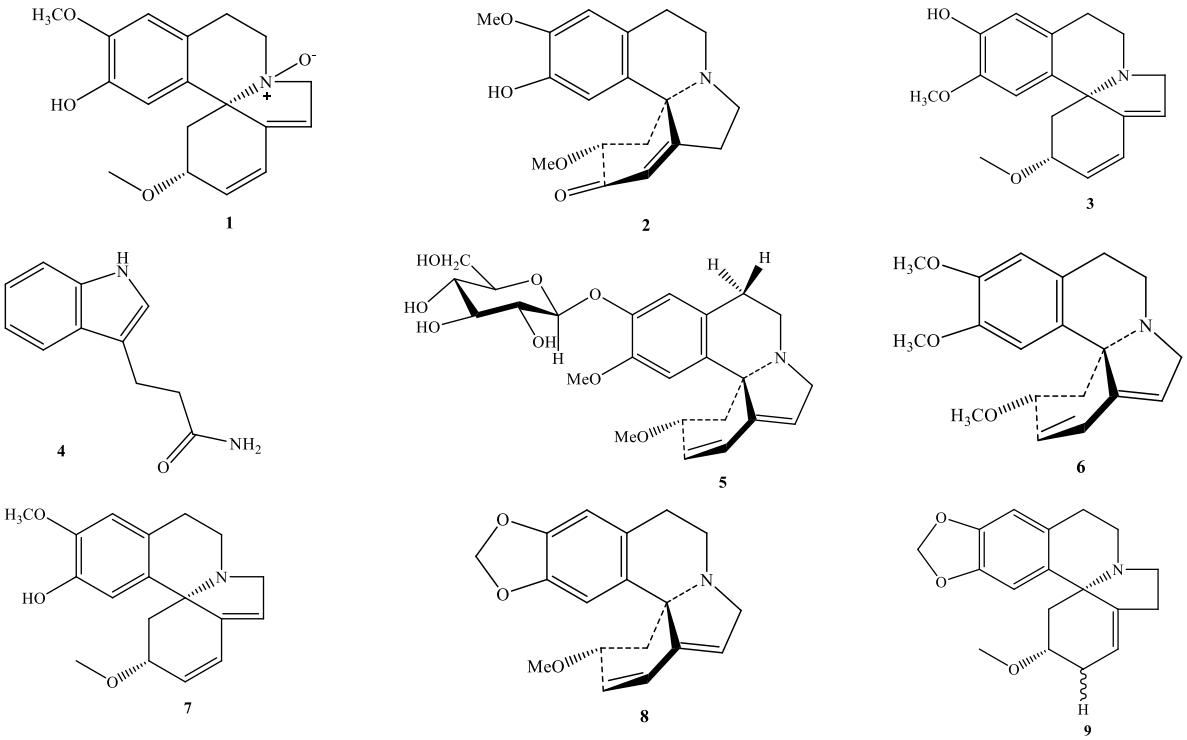
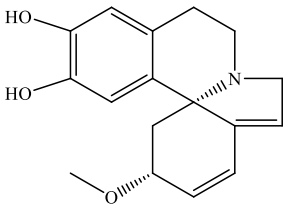
addisoniae, E. caribaea, E. indica, E. lattisima, E. melanacantha, E. mildbraedii, E. poeppigiana, E. stricta, E. subumbrans, E. veriagata, E. vespertilio, E. velutina, E. zeberi, E. zeyheri and *E. americana.* Different chemical constituents such as – alkaloids, flavonoids, pterocarpans, triterpenes and steroids were extracted from these compounds. *Erythrina* is a prominent source of alkaloid. A bunch of alkaloids are isolated from these fifteen species of *Erythrina* such as - Erysovine-*N*-oxide (**1**), Erysosalvinone (**2**), Erysodine (**3**), 1*H*-indole-3-propanamide (**4**), Glucoerysodine (**5**), Erysotrine (**6**), Erysovine (**7**), Erythraline (**8**), Erythramine (**9**), Erysopine (**10**), Erythrocarine (**11**), Erythrinine (**17**), 10, 11-Dioxyerysotrine (**34**), Erysosalvine (**41**), Erymelanthine (**43**), Melanacanthine (**43**), 8-Oxa-*α*-erythroidine (**54**), 8-Oxo-*α*-erythroidine epoxide (**61**), 8-Oxo-*α*-erythroidine (**62**), 8-Oxo-erythraline epoxide (**63**), 11-Hydroxyepierythratidine (**66**), Erythrinan (**67**), 11-Acetryl erysotrine (**68**), Erythratidinone (**69**), 10,11-dioxo- erythrartine (**79**), 10,11-dioxoepierythrstidine (**80**), 10,11-erythratidinone (**81**), Epierythratine (**94**), 11-Hydroxyerythratine (**95**), 11-Hydroxyepierythratine (**96**), Erythritol (**99**), Isococolinine (**103**), Erythratidinone (**106**), Demethoxyerythratidinone (**107**), Erythramine (**108**), Erysopitine (**109**), Erysodienone (**110**), 11-Methoxyerythraline (**141**) and E-erythsotin (**142**), Sodium erysovine 15-*O*-sulfate (**143**), Erysopine 15-*O*-sulfate (**144**), 16-*O*-*β*-D-Glucopyranosyl coccoline (**145**), Sodium erysovine *N*-oxy-15-*O*-sulfate (**146**), 11-Oxoerythraline (**147**), *β*-erythroidine (**153**), Dihydro-*β*-erythroidine (**154**) and Wilsonine (**155**) (Figure 1) (Amer *et al*., 1991; Boland *et al*., 1998; Cui *et al*., 2009; Faria *et al*., 2007; Garin-Aguilar *et al*., 2000; Haggins *et al*., 1981; Hauschild *et al*., 2010; Hussain, 2002; Jang *et al*, 2008; Kabenei *et al*., 2011; Kumar *et al*., 2010; Soto-Hernadez *et al*., 2012; Lundquist, 1973; Miyazawa *et al*, 2006; Nakayama *et al*, 1978; Ozawa *et al*., 2011; Rodriguez *et al*., 2004; Watjen *et al*., 2008; Rahman *et al*., 2007; Rahman *et al*., 2010; Rodriguez *et al*., 2004; Rukachaisirikul *et al*., 2007; Rukachaisirikul *et al*., 2008; Soto-Hernadez *et al*, 2012; Tanaka *et al*., 2001; Tanaka *et al*., 2003; Wanjala *et al*, 2002; Zheng *et al*., 2013; Zhou *et al*., 2011).





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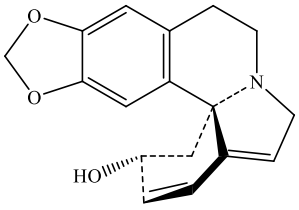

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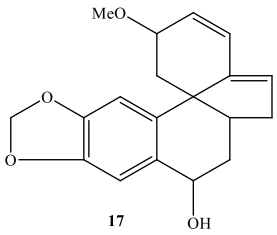

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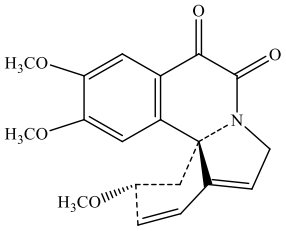

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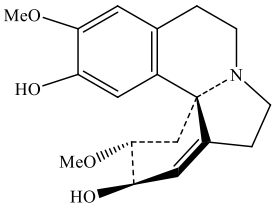

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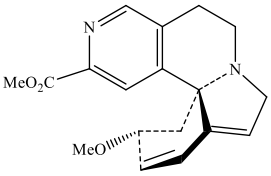

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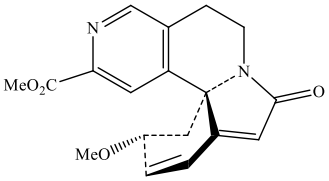

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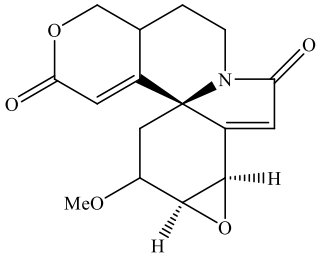

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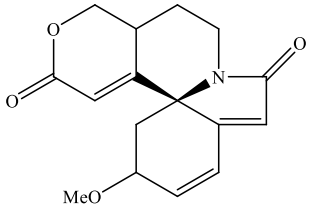

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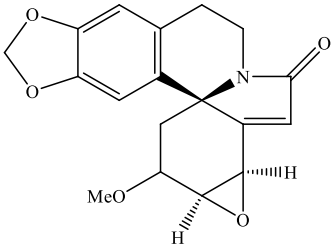

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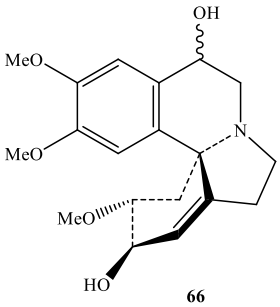

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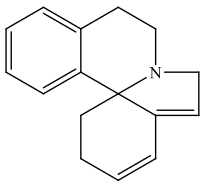

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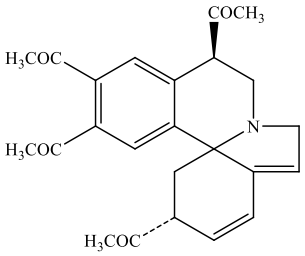

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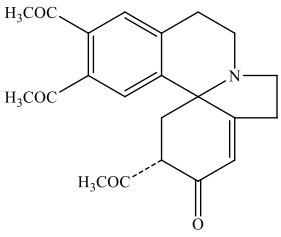

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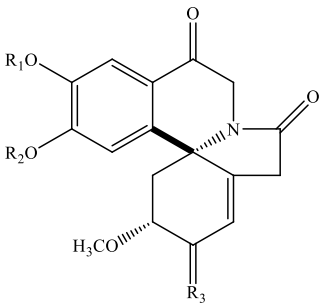
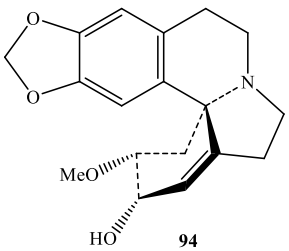


79: R_1+ R_2 = CH_2, R_3 = Beta-OH, H
80: R_1 = R_2 = CH_3, R_3 = Beta-OH, H
81: R_1 = R_2 = CH_3, R_3= O



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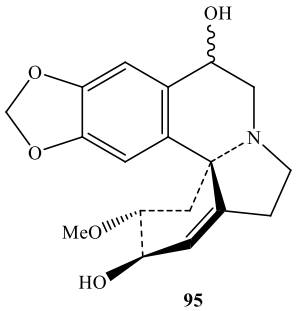

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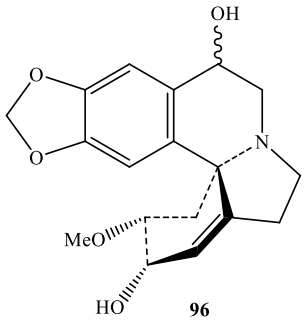

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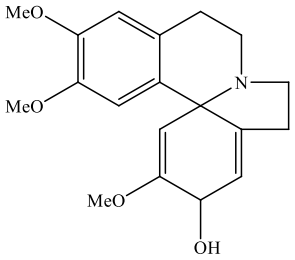

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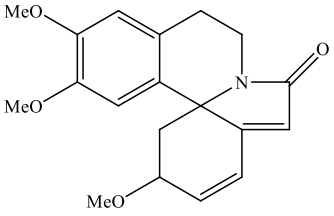

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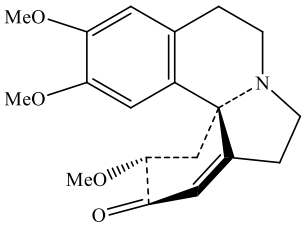

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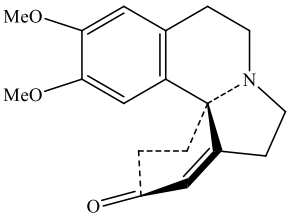

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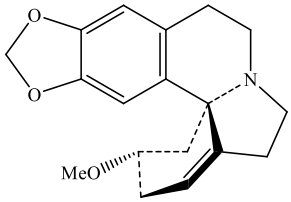

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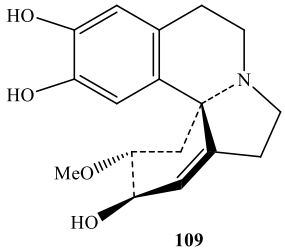

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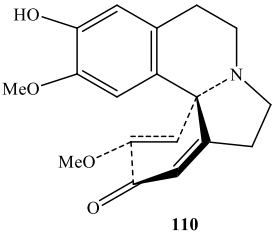

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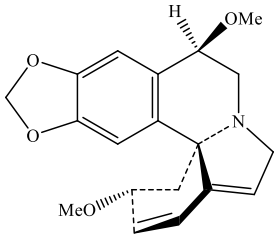

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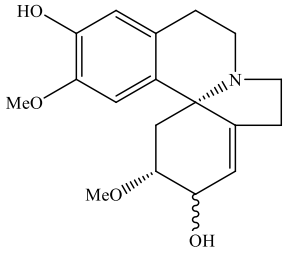

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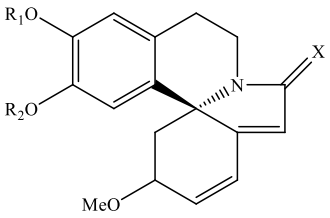
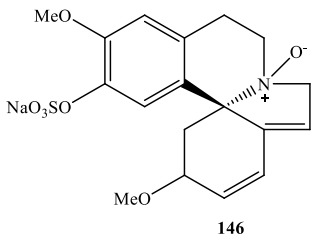


143: R_1 = Me, R_2 = SO_3Na, X = H_2
144: R_1 = H, R_2 = SO_3H, X = H_2
145: R_1 = Beta-D-Glc, R_2 = Me, X = O



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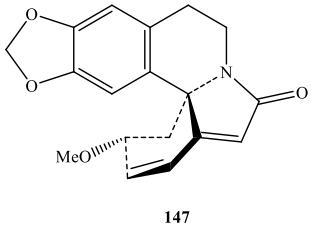

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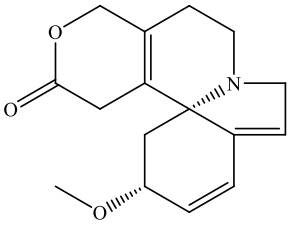

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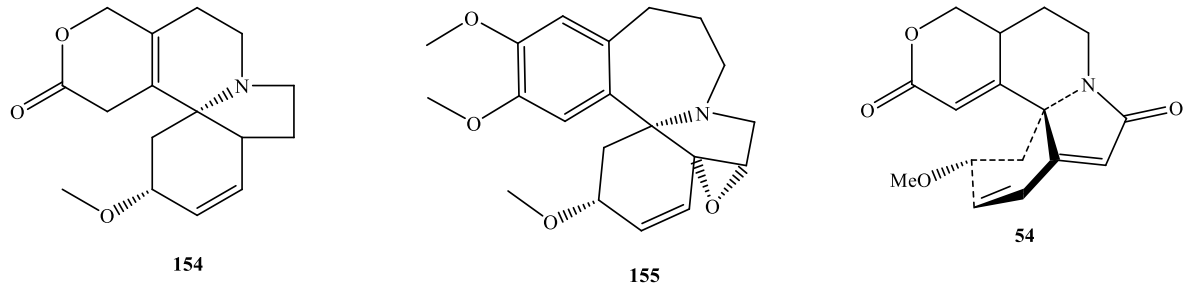
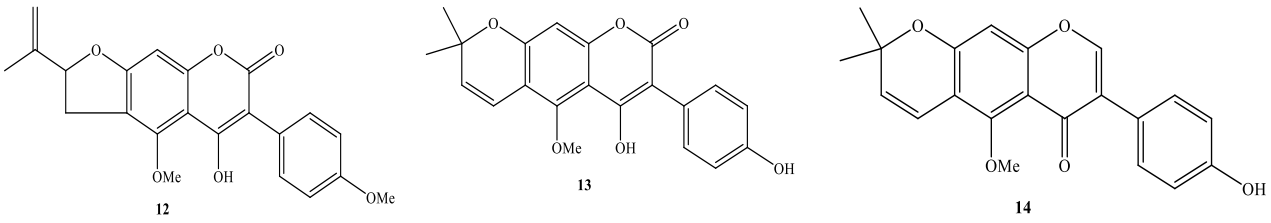
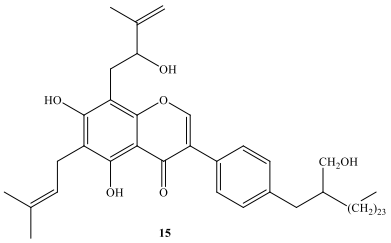


Figure 1. Alkaloids from different species of *Erythrina*.

Many falvonoids have been derived from these 15 species of *Erythrina* such as - Indicanine A (**12**), Indicanine B (**13**), Indicanine C (**14**), Indicanine D (**15**), Indicanine E (**16**), Wighteone (**18**), Alpinumisoflavone (**19**), Dimethylalpinumisoflavone (**20**), Erythrinin C (**21**), Erysenegalensein E (**22**), Abyssinone IV (**28**), Erylatissin A (**29**), Erylatissin B (**30**), Erylatissin C (**31**), Erythrinin B (**33**), Neobavaisoflavone (**37**), Licoflavone-4´-O-methyl ether (**44**), 2´,7-Dihydroxy-4´-methoxy-5´-(3-methylbut-2-enyl)isoflavone (**45**), (3R)-2´,7-Dihydroxy-3´-(3-methylbut-2-enyl)-2´´´, 2´´´ dimethylpyrano [5´´´,6´´´,4´,5´] isoflavan (**46**), Abyssinin II (**47**), Parvisoflavone B (**48**), Erypoegin G (**50**), Erysubin F (**57**), 5-Hydroxysophoranone (**75**), Abyssinone V (**78**), Lespedezaflavanone B (**87**), Glabrol (**91**), Vogelin C (**93**), Erythrinins A (**100**), 6-Hydroxygenistein (**101**), Eryvarin B (**111**), Eryvarin F (**112**), Eryvarin M (**114**), Eryvarin N (**115**), Eryvarin O (**116**), Scandenone (**123**), 5,7,4´-trihydroxy-6,8-diprenylisoflavone (**124**), 4´,5,7-Trihydroxy-8-prenylisoflavone (**125**), 4´,5,7-Trihydroxy-8-methylisoflavone (**126**), Isobavachin (**128**), 5,4´-Dihydroxy-8-(3,3-dimethylallyl)-2´´-methoxyisopropyl furano[4,5:6,7]isoflavone (**132**), 5,7,4´-Trihydroxy-6-(3,3- dimethylallyloxiranylmethyl) isoflavone (**133**), 5,4´-Dihydroxy-8-(3,3-dimethylallyl)-2´´-hydroxy-methyl-2´´-methylpyrano[5,6:6,7] isoflavone (**134**), 5,4´-Dihydroxy-2´-methoxy-8-(3,3-dimethyl-allyl)-2´´,2´´-dimethylpyrano[5,6:6,7] isoflavone (**135**), Euchrenone b_{10} (**136**), Isoerysenegalensein E (**137**), Laburnetin (**138**), Lupiwighteone (**139**), Eryzerin A (**148**), Eryzerin B (**149**), Eryzerin C (**150**), Eryzerin D (**151**) (Figure 2) (Boland *et al*., 1998; Chacha *et al.*, 2005; Hussain *et al*., 2008; Hussain *et al*., 2011; Jang *et al*., 2008; Kobayashi *et al*., 1997; Koo *et al*., 2013; Kumar *et al*., 2010; Lundquist, 1973; Miyazawa *et al.*, 2006; Nakayama *et al.*, 1978; Nkengfack *et al*., 2001; Rahman *et al*., 2007; Rahman *et al*., 2010; Rodriguez *et al*., 2004; Rukachaisirikul *et al*., 2007; Rukachaisirikul *et al*., 2007; Sato *et al*., 2003; Soto-Hernadez *et al*., 2012; Talikepali *et al*., 1990; Tanaka *et al*., 2001; Tanaka *et al*., 2002; Tanaka *et al*., 2003; Tanaka *et al*., 2004; Tanaka *et al*, 2011; Tchokouaha *et al*., 2010; Waffo *et al*., 2000; Wanjala *et al*., 2002; Watjen *et al*., 2008; Xiaoli *et al*., 2006; Zheng *et al*., 2013; Zhou *et al*., 2011).





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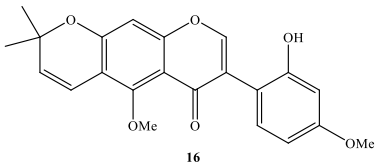

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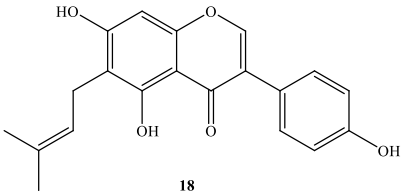

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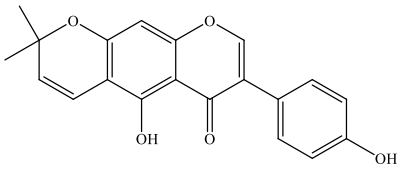

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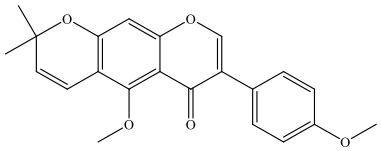

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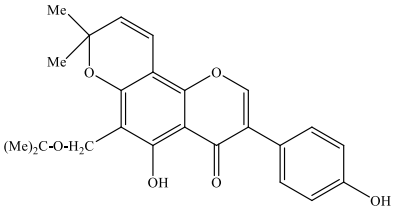

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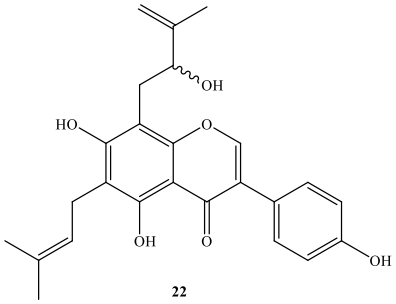

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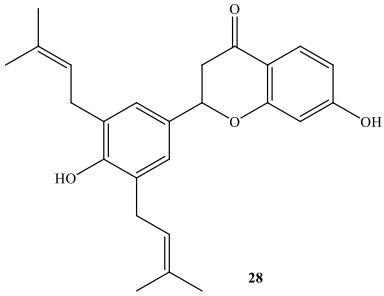

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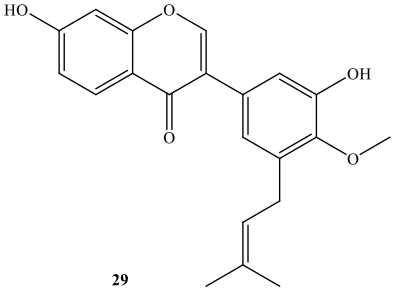

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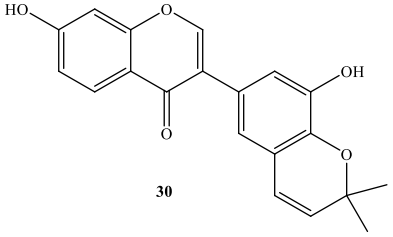

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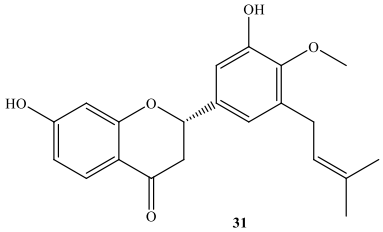

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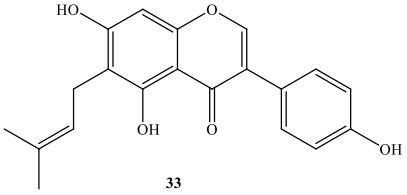

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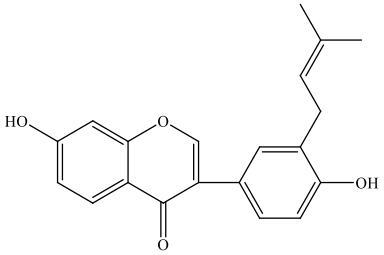

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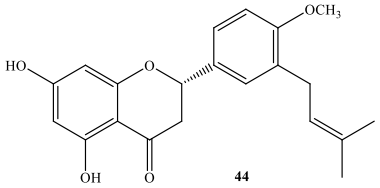

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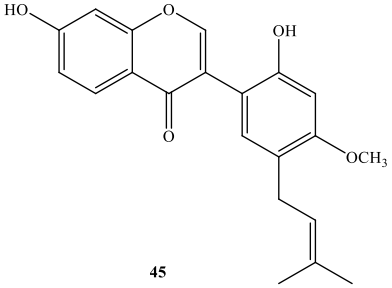

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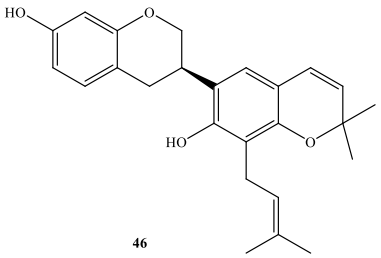

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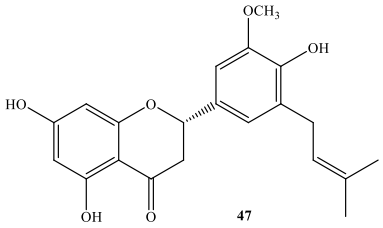

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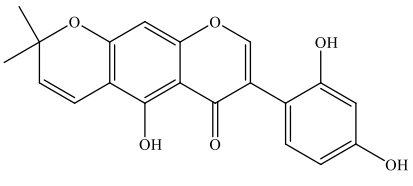

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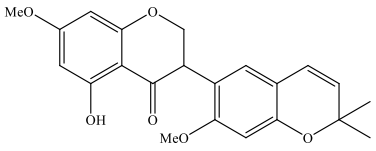

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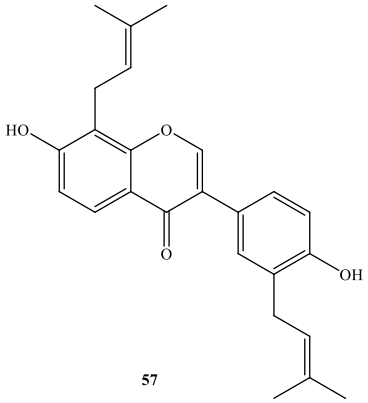

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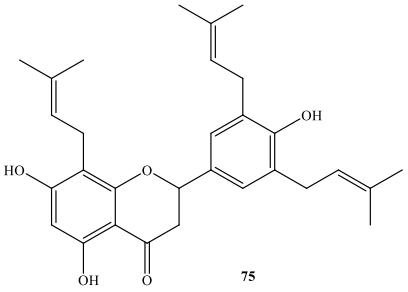

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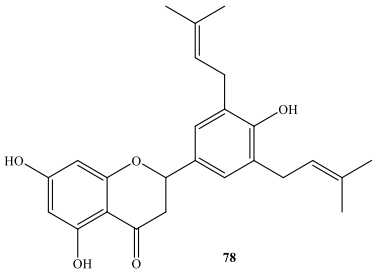

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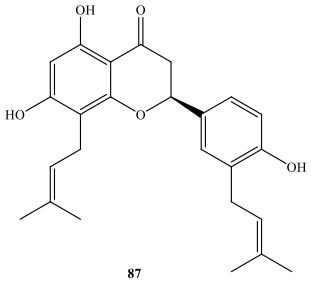

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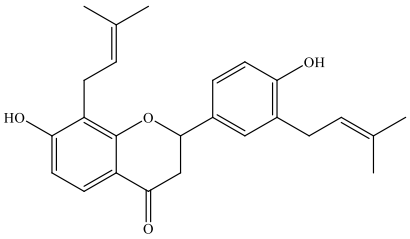

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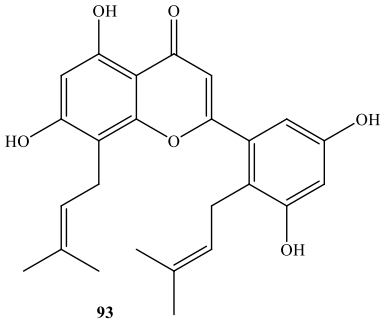

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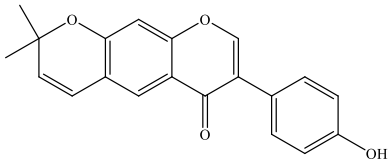

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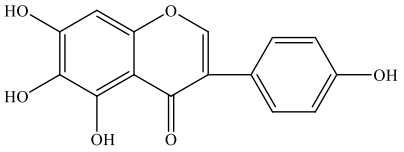

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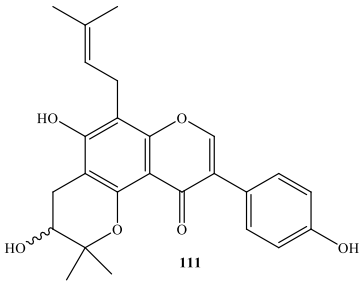

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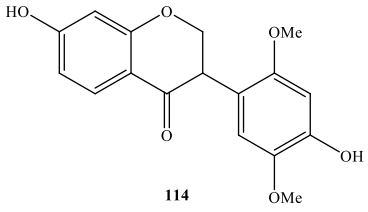

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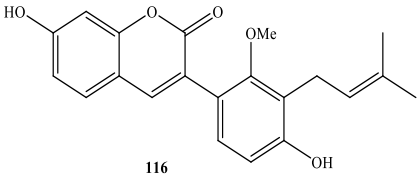

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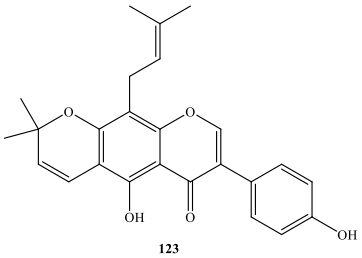

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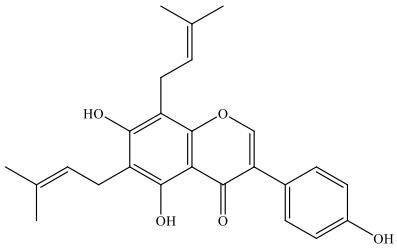

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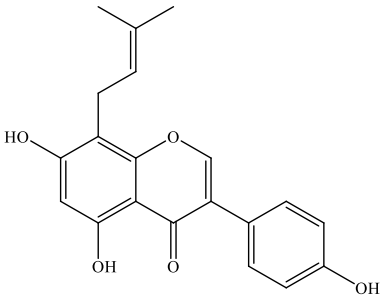

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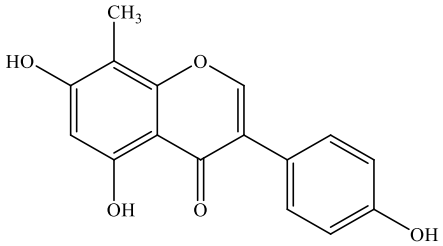

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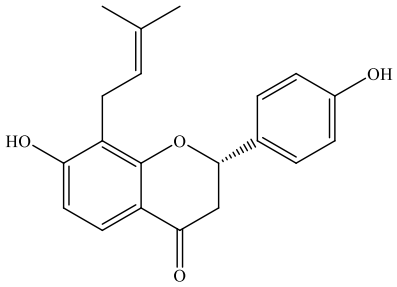

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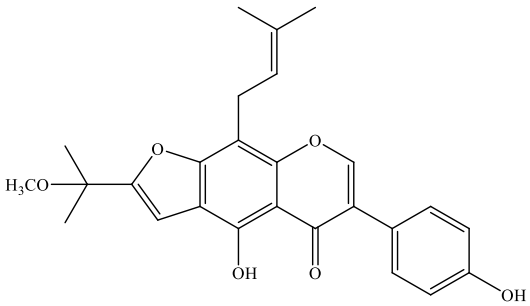

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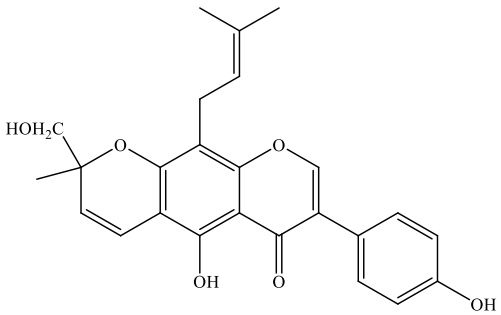

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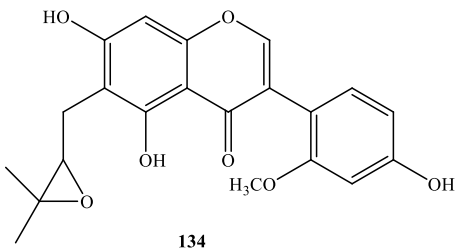

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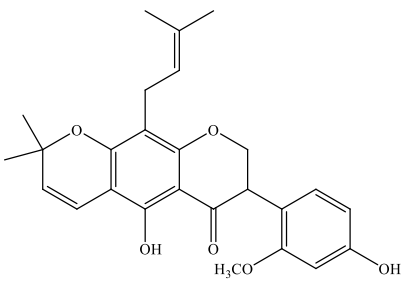

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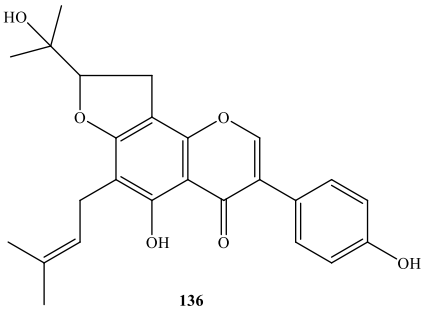

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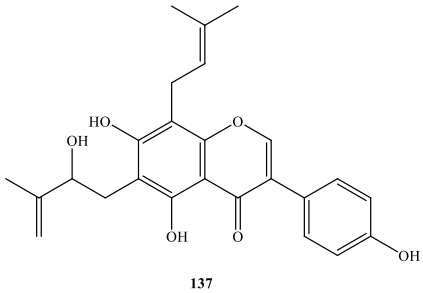

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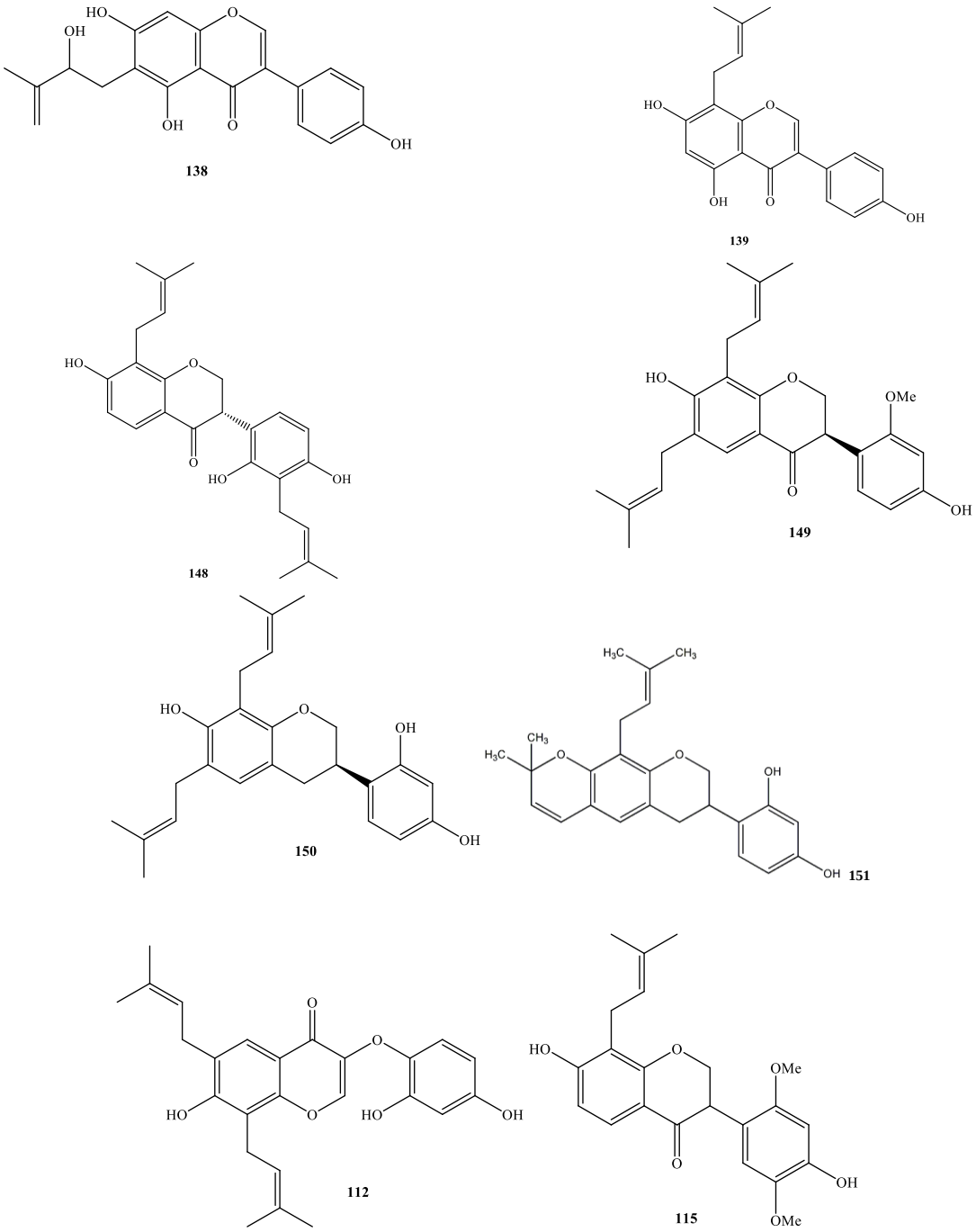
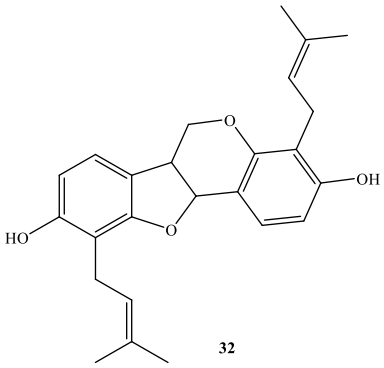


Figure 2. Flavonoids reported from *Erythrina* species.

The plant belonging to the genus *Erythrina* contain a number of pterocarpans such as - Erybraedin A (**32**), 2-(5´-Hydroxy-3-methoxyphenyl)-6-hydroxy-5-methoxybenzofuran (**35**), Isoneorautenol (**38**), Erymelanthine (**42**), Erypoegin F (**49**), Erypoegin H (**51**), Erypoegin I (**52**), Erypoegin J (**53**), Cristacaprin (**55**), Dimethylmedicaprin (**56**), Eryvarin D (**58**), Folitenol (**59**), Erystagallin C (**64**), Eryvarin A (**65**), Erystagallin A (**76**), Erycristagallin (**77**), 1-Methoxyerythrabissin (**82**), Erythrabissin-I (**83**), Erythrabissin-II (**84**), Erybraedin B (**85**), Hydroxycristacarpone (**86**), Phaseollin (**89**), Eryvarin E (**90**), Dihydrofolinin (**97**), Orientanol-B (**104**), Phaseollidin (**127**) and Eryzerins E (**152**) (Figure 3) (Amir *et al*., 2011; Boland *et al.*, 1998;

Hauschild *et al.*, 2010; Innok *et al*., 2010; Kabenei *et al*., 2011; Kobayashi *et al*., 1997; Lundquist, 1973; Miyazawa *et al.*, 2006; Soto-Hernadez *et al*., 2012; Rahman *et al*., 2007; Rukachaisirikul *et al*., 2007; Rukachaisirikul *et al*., 2008; Tanaka *et al*., 1996; Tanaka *et al*., 2002; Tanaka *et al*., 2002; Zheng *et al*., 2013; Zhou *et al*., 2011).



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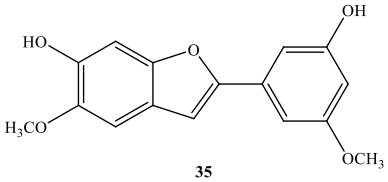

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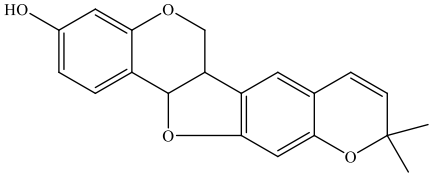

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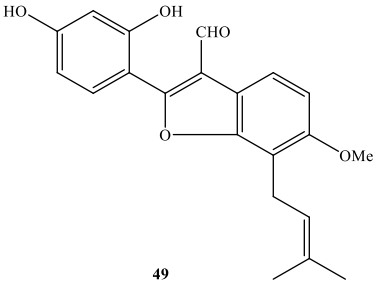

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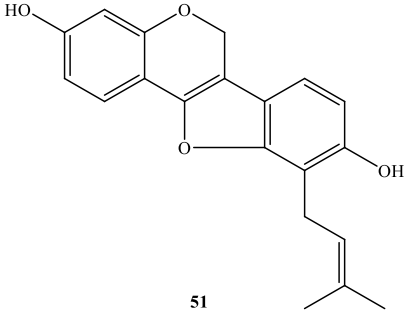

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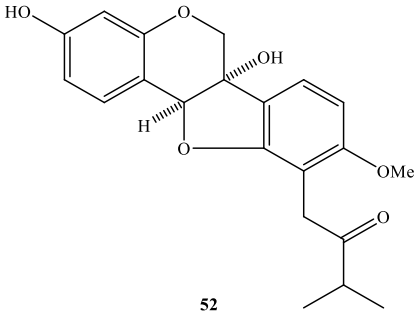

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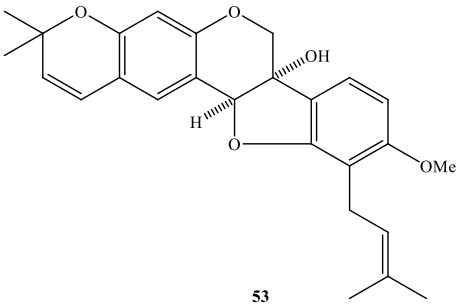

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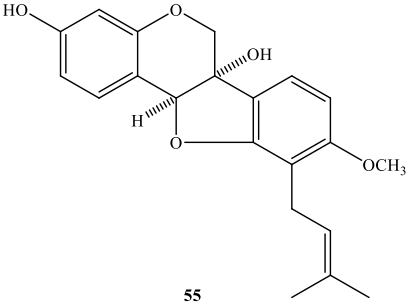

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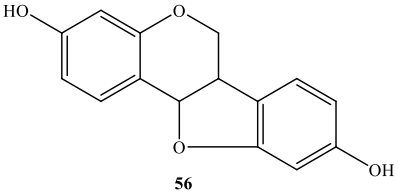

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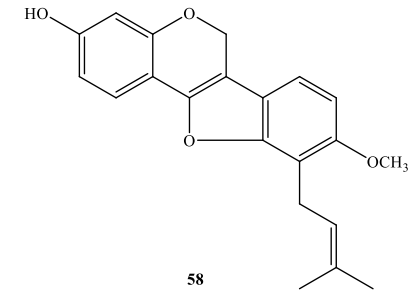

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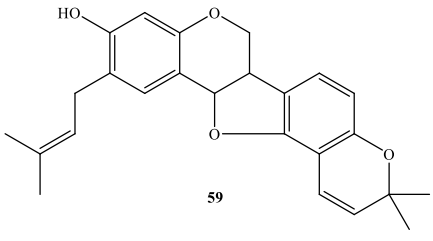

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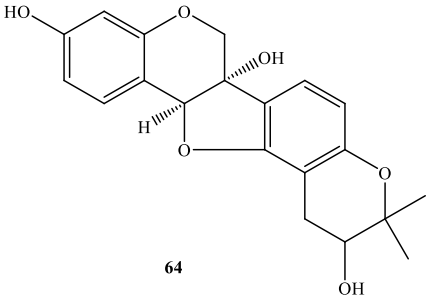

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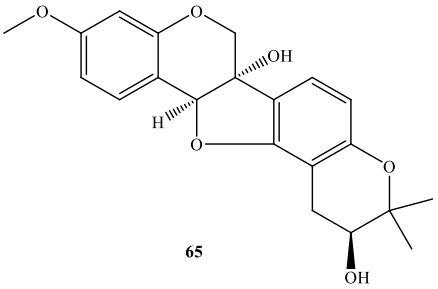

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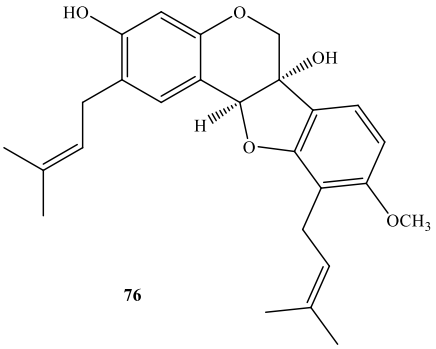

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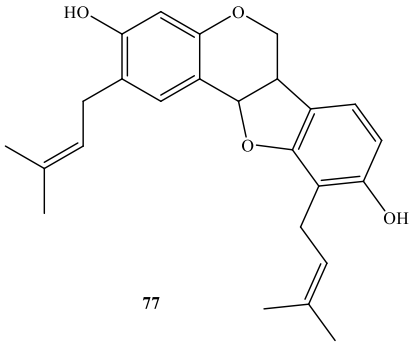

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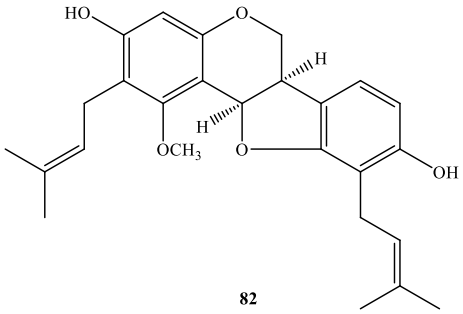

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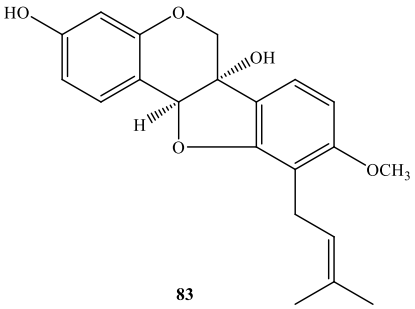

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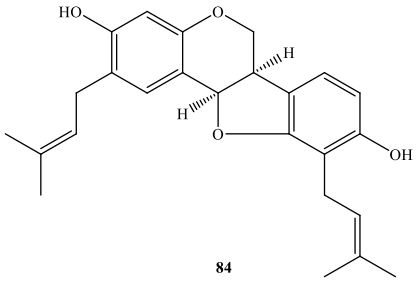

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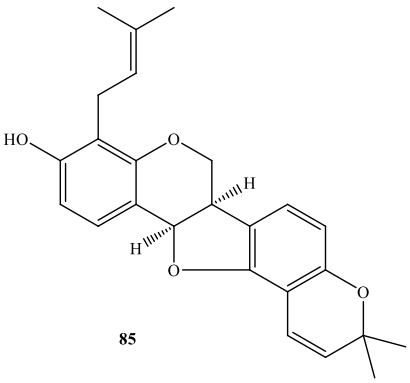

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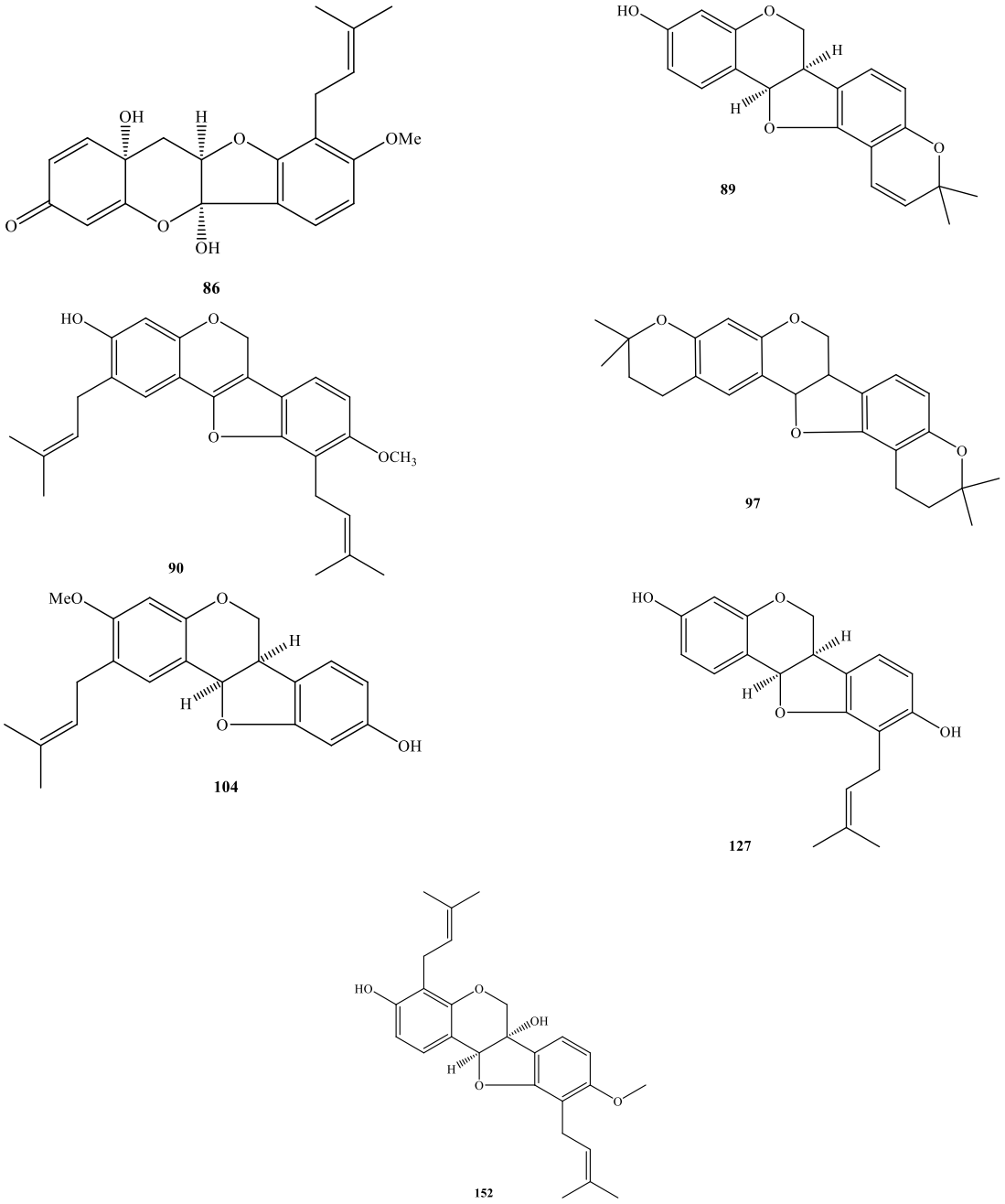


Figure 3. Pterocarpans from fifteen species of *Erythrina.*

Erithrina species contain some triterpenes and steroids. These are - Oleanolic acid (**24**), Erythrodiol (**25**), Stigmasterol (**26**), Sophoradiol (**70**), Stigmasta-4-en-3-one (**71**), Stigmasta-4,22-dien-3-one (**72**), 3*β*-hydroxystigmasta-5,22-dien-7-one (**73**), Melilotigenin C (**74**), Lupeol (**88**), Soyasapogenol B (**92**), Epilupeol (**98**) and 3*β*-28-dihydroxyolean-12-ene (**102**) (Figure 4) (Amir *et al*., 2011; Boland *et al*., 1998; Hauschild *et. al*., 2010; Kobayashi *et al*., 1997; Lundquist, 1973; Miyazawa *et al*., 2006; Soto-Hernadez *et al*., 2012; Tanaka *et al*., 2002; Zheng *et al*., 2013; Zhou *et al*., 2011).

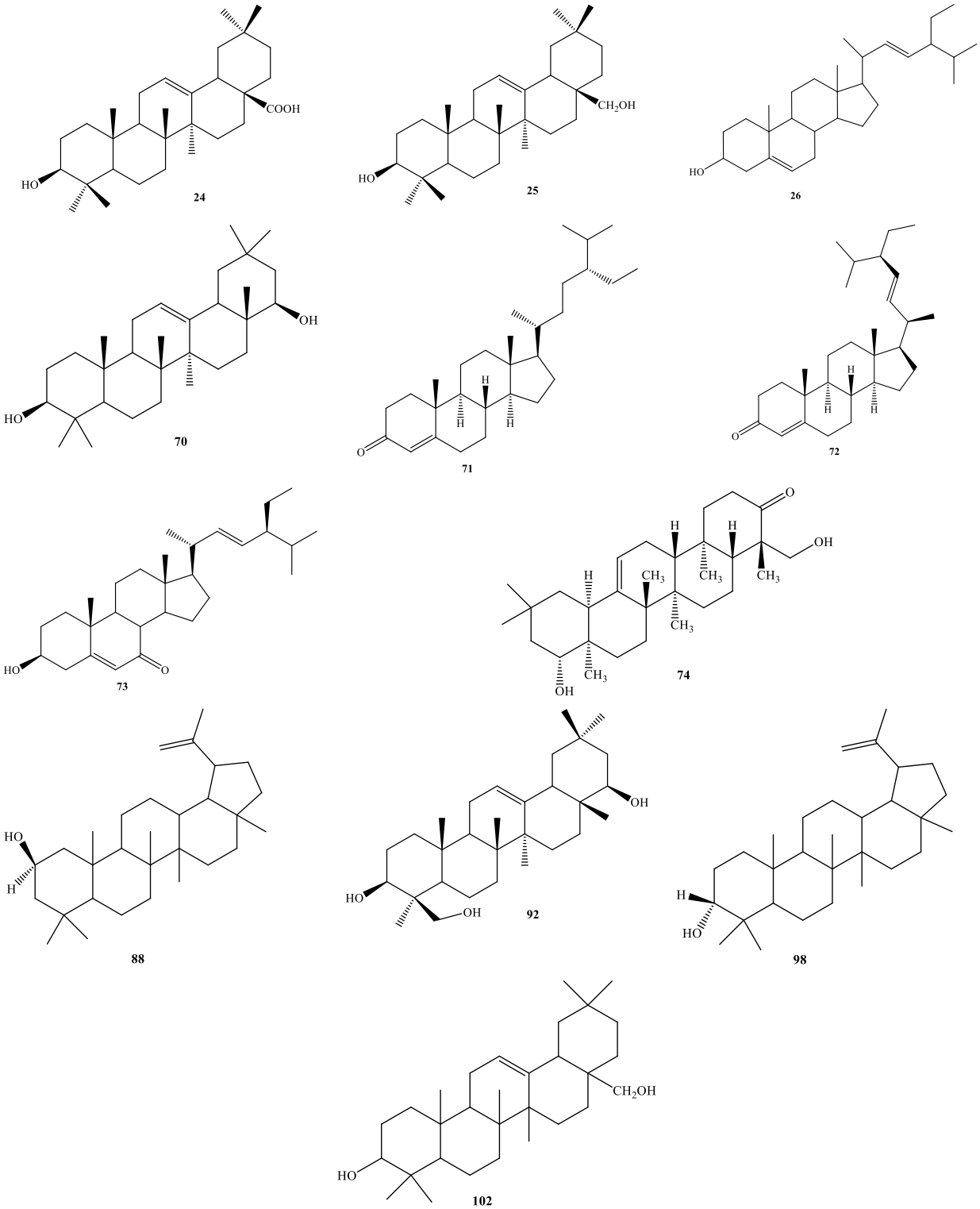
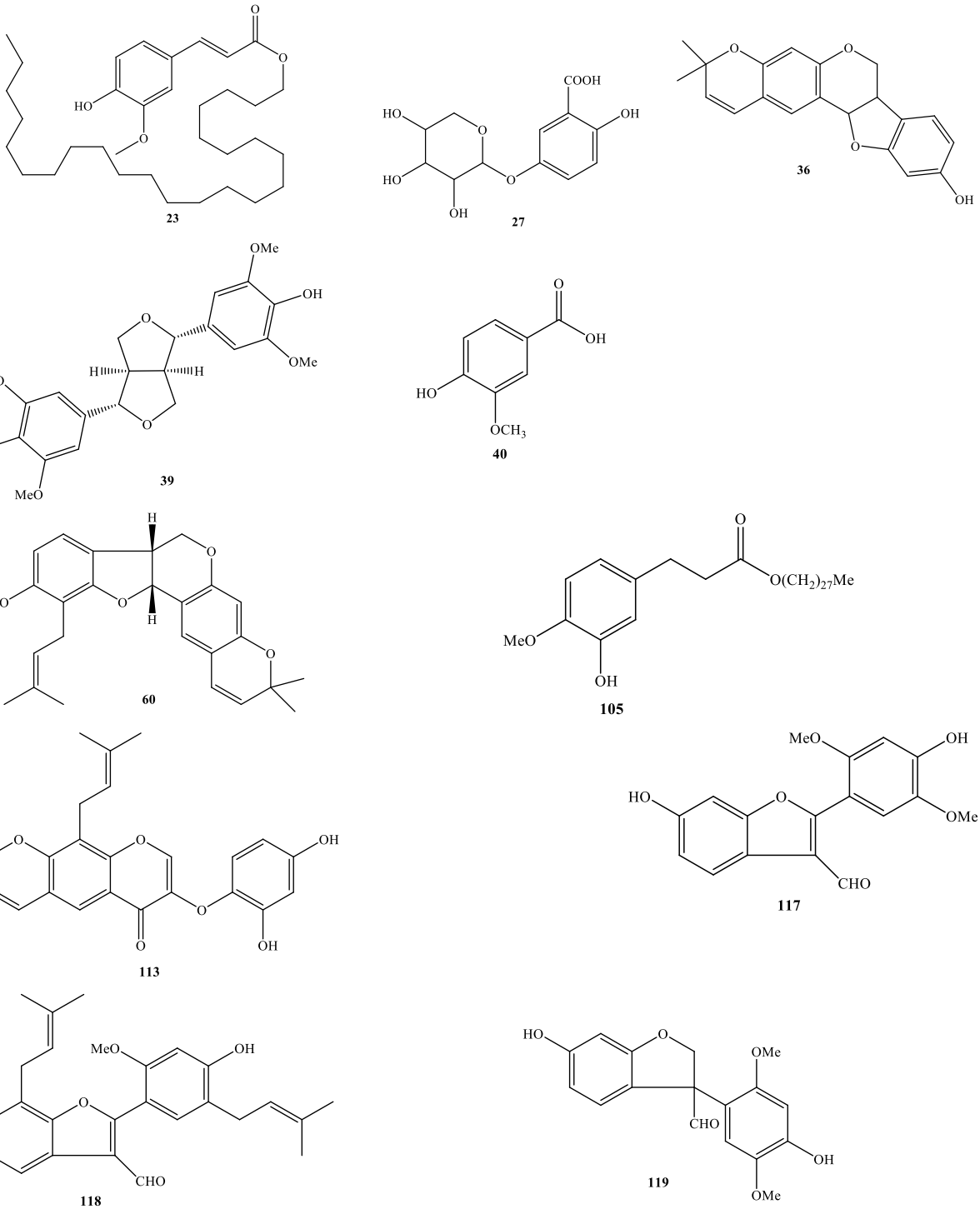


Figure 4. Triterpenes and steroids from different species of *Erythrina*.

A good number of miscellaneous classes of compounds were also extracted from these fifteen species of *Erythrina*, including Erythrinassinate B (**23**), 5-*O*-*β*-D-xylo-pyranoside (**27**), Neorautenol (**36**),

Syringaresinol (**39**), Vanillic acid (**40**), Orientanol C (**60**), Octacosyl ferulate (**105**), Eryvarin G (**113**), Eryvarin P (**117**), Eryvarin Q (**118**), Eryvarin R (**119**), Eryvarin V (**120**), Eryvarin W (**121**), Eryvarin X (**122**), Eryvaiestyrene (**129**), Eryvarinol A (**130**), Eryvarinol B (**131**), Eryvarin H (**140**) (Figure 5) (Amir *et al*., 2011; Boland *et al*., 1998; Koo *et al*., 2013; Lundquist, 1973; Miyazawa *et al*., 2006; Rahman *et al*., 2007; Soto-Hernadez *et al*., 2012; Zheng *et al*., 2013; Zhou *et al*., 2011).



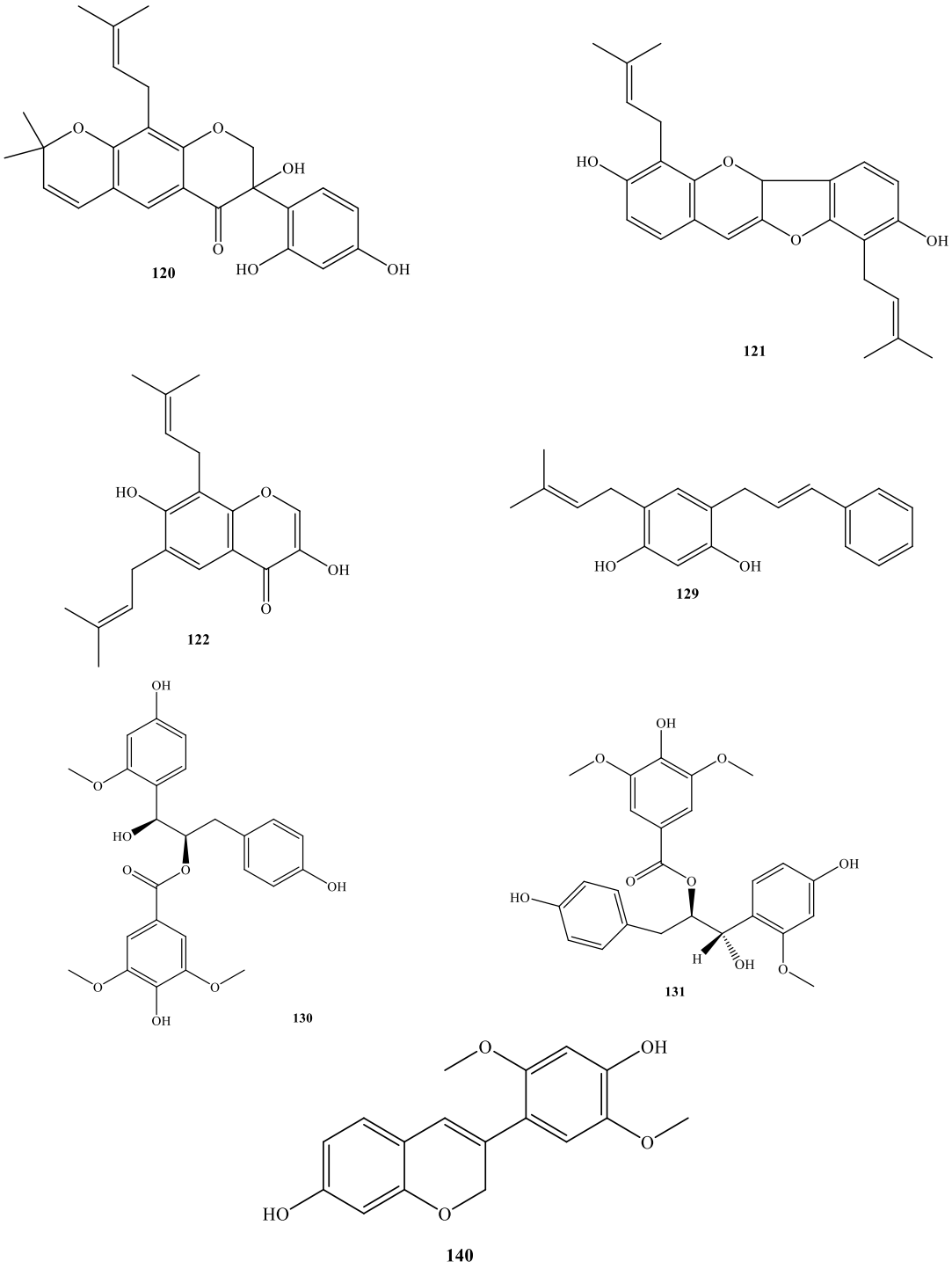


Figure 5. Miscellaneous chemical constituents from *Erythrina* species.

Conclusion

The chemical compounds from 15 species of *Erythrina* have been reviewed. Structurally unique along with many diversified compounds have been observed from this genus. Our study revealed that *Erythrina* can be a prominent source of phytoconstituens as well as medicinal agents, and therefore other species of this genus need to be investigated for secondary metabolites.

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