

## REVIEW

GENUS *RUELLIA*: PHARMACOLOGICAL AND PHYTOCHEMICAL IMPORTANCE IN ETHNOPHARMACOLOGYKHURRAM AFZAL<sup>1\*</sup>, MUHAMMAD UZAIR<sup>1</sup>, BASHIR AHMAD CHAUDHARY<sup>1</sup>,  
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**Abstract:** *Ruellia* is a genus of flowering plants commonly known as *Ruellias* or Wild Petunias which belongs to the family Acanthaceae. It contains about 250 genera and 2500 species. Most of these are shrubs, or twining vines; some are epiphytes. Only a few species are distributed in temperate regions. They are distributed in Indonesia and Malaysia, Africa, Brazil, Central America and Pakistan. Some of these are used as medicinal plants. Many species of the genus has antinociceptive, antioxidant, analgesic, antispasmodic, antiulcer, antidiabetic and anti-inflammatory properties. The phytochemicals constituents: glycosides, alkaloids, flavonoids and triterpenoids are present. The genus has been traditionally claimed to be used for the treatment of flu, asthma, fever, bronchitis, high blood pressure, eczema, and diabetes. The objective of this review article is to summarize all the pharmacological and phytochemical evaluations or investigations to find area of gap and endorse this genus a step towards commercial drug. Hence, further work required is to isolate and characterize the active compounds responsible for these activities in this plant and bring this genus plants to commercial health market to serve community with their potential benefits.

**Keywords:** phytochemical constituents, biological, *Ruellia*, Acanthaceae

Plants are being used as medicines since the beginning of human civilization; healing powers are reported to be present in plants and therefore, it is assumed that they have medicinal properties. The flora of Pakistan due to its diverse climate, soil conditions and many ecological regions is very rich in medicinal plants. According to a survey of Pakistan, about 6000 species of flowering plants have been existing, out of 6000 about 400-600 are medicinally important species (1). From near past, it has been discovered that properties of medicinal plants are due to its active chemical compounds (2). The discovery of drugs from medicinal plants started from the era when the isolation of drugs such as digitoxin, quinine, cocaine, and codeine has begun. The family Acanthaceae (Acanthus family) is a taxon of dicotyledonous flowering plants containing almost 250 genera and about 2500 species. Most of these are tropical herbs, shrubs, or twining vines; some are epiphytes. Only a few species are distributed in temperate regions. Indonesia, Malaysia, Africa, Brazil and Central America are the main producers. *Ruellia* is a genus of flowering plants commonly known as *Ruellias* or wild petunias (1). It is a genus of 250

species, distributed in tropical and temperate regions of both the hemispheres, which is also present in Pakistan by 5 species, of which 3 are native (3).

Present review paper summarizes all the information relating to biological, phytochemical constituents and folk medicinal uses of genus *Ruellia*. These are popular ornamental plants. Some of them are used as medicinal plants. One of the species, *Ruellia tuberosa* has been extensively used as diuretic, anti-diabetic, antipyretic, analgesic, antioxidant (4), anti-hypertensive, gastroprotective (5) and to treat gonorrhoea (3). The phytochemical properties of *Ruellia tuberosa* has been investigated revealing the presence of alkaloids, triterpenoids, saponins, sterols and flavonoids (6). *Ruellia asperula* was used in bronchitis, asthma, flu, fever and uterus inflammation (7). *Ruellia prostrata* leaf is used in the treatment of chronic rheumatism, eczema, facial paralysis, cephalgia and hemiplegia. Leaf juice is an efficient remedy in colic of children (8). The fresh leaf of the plant *Ruellia patula* is pounded and then soaked in water until the solution turns black. It is decanted and the solution applied to the ear (9). *Ruellia hygrophila* has antispasmodic, analgesic activity.

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### Taxonomy

The family Acanthaceae, Class Eudicots and order Lamiales includes 250 genera and 2500 species (10). In Pakistan it is represented by 18 genera and 60 specific and infra specific taxa, of which 44 are native (11). The first palynological study was investigated few taxa (12). However, forthcoming studies (13) carried out detailed study and recognized for the first time 11 pollen types within the family Acanthaceae.

### Folk medicinal uses of genus *Ruellia*

The whole parts of genus *Ruellia* are used in bladder stones and in bronchitis. Paste of leaves is also used for skin diseases and boils. Roots are used as anthelmintic. Syrup is used for whooping cough. Tuber powder is used for stomach ache. *Ruellia tuberosa* has been extensively used for the treatment of emesis, analgesia, nociceptive pain, inflammation, renopathy and syphilis (14). *Ruellia tuberosa* is used in stomach cancer.

In folk medicine and Ayurvedic medicine the genus *Ruellia* has been used as diuretic, anti-diabetic (15) antipyretic, analgesic, antioxidant (4) anti-hypertensive, gastroprotective (8) agent and was also used to treat gonorrhoea (16).

### Scientific studies of genus *Ruellia*

#### Antioxidant activity

The antioxidant activity of different extracts of stem of *Ruellia tuberosa* were investigated by various *in vitro* methods like 2,2-diphenyl-1-picrylhydrazyl (DPPH), free radical-scavenging assays and the hydrogen peroxide induced luminol chemiluminescence assay. The methanol extract and its four fractions of water, ethyl acetate, chloroform, and *n*-hexane were evaluated for antioxidant activity. The results revealed that *Ruellia tuberosa* possesses potent antioxidant activity (4).

It has been reported by other authors that the aerial parts of plant *Ruellia prostrata* showed antioxidant potential. Different concentrations of methanolic extract and *n*-butanolic fraction were subjected to antioxidant assay by DPPH method, nitric oxide scavenging activity and reducing power assay. Both the *n*-butanolic and methanolic extract showed the antioxidant potential but the antioxidant potential of *n*-butanolic fraction is far higher than the methanolic extract (5).

#### Gastroprotective and analgesic activity

It was reported that aqueous extract of *Ruellia tuberosa* roots showed a strong and dose dependent gastroprotective activity in alcohol-

induced gastric lesion of rats. The extract also had a mild erythropoietic and moderate analgesic activity. It was concluded from the data that *Ruellia tuberosa* root extracts have gastroprotective activity (6).

#### Anti-ulcer activity

Preliminary ethyl acetate extract of *Ruellia tuberosa* was studied for the acute oral toxicity, according to the economic cooperation and development guidelines, based on which two doses were selected, 250 mg/kg (low dose) and 500 mg/kg (high dose). Ranitidine was used as the standard drug (20 mg/kg). The ethyl acetate extract showed significant decrease in gastric volume, total acidity and free acidity. There was a significant ( $p < 0.01$ ) increase in gastric pH only at high dose (500 mg/kg), when compared to control group. The value of ulcer index decreased in a dose dependent manner, when compared to control group (17).

#### *In vitro* purgative and cholinergic activity

Methanolic, ethyl acetate and aqueous extracts of *Ruellia tuberosa* produced contractions on electrically induced contracted ileum tissue strip at the dose of 30  $\mu$ g/mL. Methanolic extract of *Ruellia tuberosa* was investigated on uterus and gestation by using 350 mg/kg/day and was found to increase the number of implantation (8). This study demonstrated that estrogenic effect may be due to flavonoid and sterol while cholinergic effect may be due to iridoid glycosides.

#### Antimicrobial activity

The antibacterial activities of *n*-hexane, dichloromethane, ethyl acetate and methanol extracts of *Ruellia tuberosa* were explored against Gram positive and Gram negative bacteria. The ethyl acetate and methanol fractions exhibited the highest rates of antibacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa* (18).

#### Anticancer activity

The methanol extract of aerial part of herb *Ruellia tuberosa* possessed cytotoxicity. The minimum inhibitory concentration ( $IC_{50}$ ) for methanol extract was found to be 3.5 and 1.9  $\mu$ g/mL in H460 and MDA-MB231 cancer cells, respectively. Tylocrebrine was isolated from *Ruellia tuberosa* through bioassay directed column chromatography and elucidated its anticancer and anti-inflammatory potential (19).

#### Antinociceptive and anti-inflammatory activity

The ethanol extract of *Ruellia tuberosa* was

evaluated for its antinociceptive and anti-inflammatory properties in experimental mice and rat models. In the hot plate test, the group that received a dose of 300 mg/kg for mice showed maximum time needed for the response against thermal stimuli and maximum possible analgesic was similar to that of diclofenac sodium. The extract at 500 and 250 mg/kg doses showed significant reduction in acetic acid-induced writhing in mice, which was similar to diclofenac sodium. The extract also demonstrated significant inhibition in serotonin and egg albumin-induced hind paw edema in rats at the doses of 100, 200 and 300 mg/kg. The anti-inflammatory properties exhibited by the extract were comparable to that of indomethacin at a dose of 5 mg/kg (20).

#### Cardiovascular and hypertensive activity

In pharmacological investigation, extracts of *Ruellia brittoniana* and *Ruellia patula* were used for cardiovascular screening. The cardiovascular experiments were carried out *in vitro* and *in vivo*. In *in vitro* studies rabbit heart was used while for *in vivo*, anesthetized rats were used. In *in vivo* experiment, extracts of *Ruellia brittoniana* and *Ruellia patula* showed a hypertensive activity in pentothal sodium anesthetized rats (21).

#### Antispermatic activity

Aqueous extract of tuberous roots of *Ruellia tuberosa* administered orally at the dose of 50, 100 and 150 mg/kg body weight for 21 days resulted in significantly decreased sperm count in male albino rats. The results suggested that the aqueous extract of *R. tuberosa* produces antispermatic effect in male albino rats (22).

#### Antidiabetic, antihyperlipidemic and hepatoprotective activity

The methanol extract of *Ruellia tuberosa* leaves at a dose of 100 and 200 mg/kg of body weight was administered at single dose per day to diabetes-induced rats for a period of 14 days. The methanol extract of *Ruellia tuberosa* leaves elicited significant reductions of blood glucose ( $p < 0.05$ ), lipid parameters except HDL-C, serum enzymes and significantly increased HDL-C at the dose of 200 mg/kg when compared with the standard drug glibenclamide (5 g/kg). From the above result, it may be concluded that methanol extract of *Ruellia tuberosa* leaves possesses significant antidiabetic, antihyperlipidemic and hepatoprotective effects in alloxan-induced diabetic rats (8).

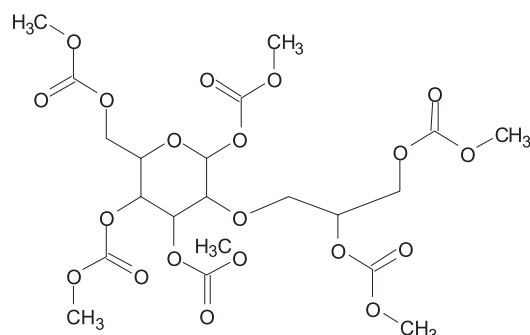
### Phytochemical constituents of *Ruellia* genus

#### Preliminary phytochemical screening

Preliminary phytochemical screening of ethyl acetate extract of *Ruellia tuberosa* reveals the presence of saponins, tannins, and flavonoids, which may be responsible for its activity (18).

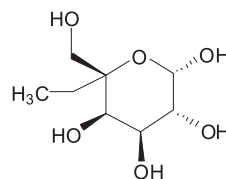
#### Glycosides

Extract of the whole plant of *Ruellia brittoniana* has afforded the new glycoside 2-O- $\alpha$ -galactopyranosyl glycerol hexaacetate.

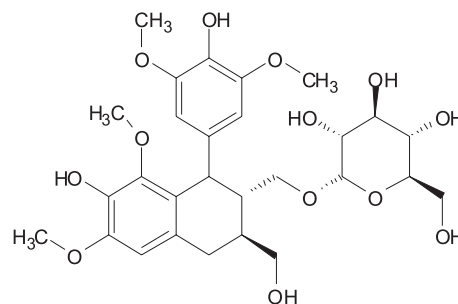


2-O- $\alpha$ -galactopyranosyl glycerol hexaacetate

Two lignan glycosides identified as 5,5'-dimethoxyariciresinol-9- $\alpha$ -D-glucopyranoside (reupaside) and lyoniresinol-9'- $\alpha$ -D-glucopyranoside with ethyl- $\alpha$ -D-galactopyranoside,  $\alpha$ - and  $\beta$ -D-glucose and  $\beta$ -D-fructose have been isolated from *Ruellia patula* (23, 24).

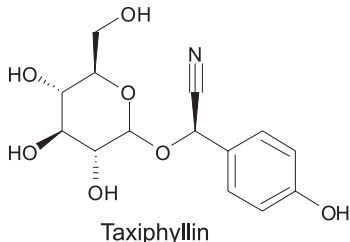
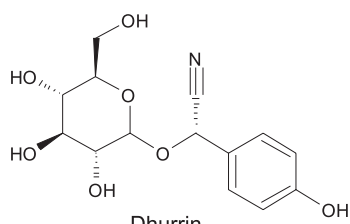


Ethyl-  $\alpha$ -D-galactopyranose

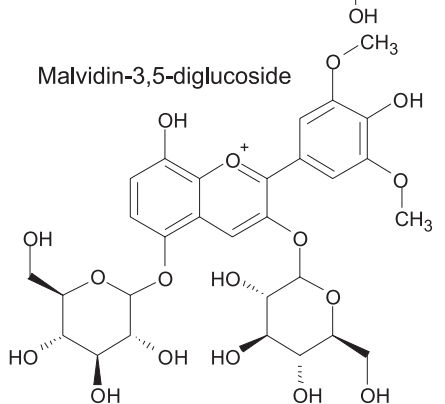
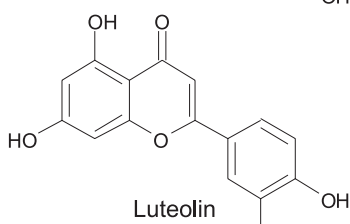
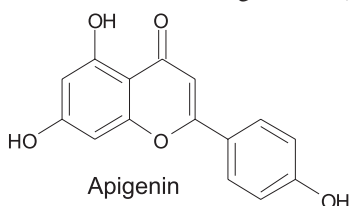


Lyoniresinol-3- $\beta$ -glucopyranose

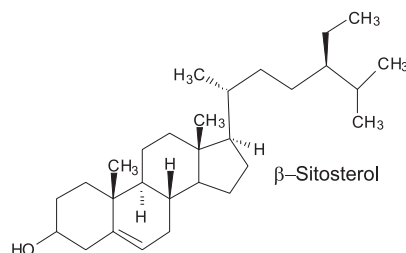
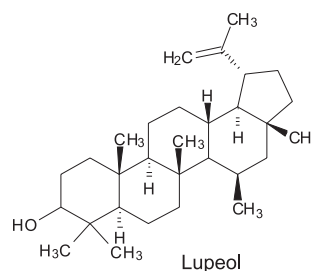
A cyanogenic glucoside was isolated from *Ruellia rosea* and showed the presence of a p-hydroxyphenyl moiety indicating that the compound was either taxiphyllin or the diastereomer dhurrin (25, 26).



The leaves contained only traces of apigenin and luteolin, while in flowers was malvidin-3,5-diglucoside in appreciable quantity. The flowers buds contained the maximum proportion of flavonoids (3% apigenin-7-O-glucuronide and the other flavones were identified as apigenin-7-O-glucoside, apigenin-7-O-rutinoside and luteolin-7-O-glucoside (26, 27).



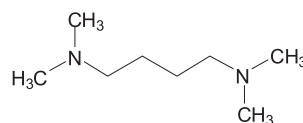
From *Ruellia patula*, nine compounds were isolated. A new lignan glycoside 5,5-dimethoxylariciresinol-9-O-β-D-glucopyranoside, apigenin-7-O-rutinoside, β-sitosterol, lupeol, α-D-glucose, β-D-glucose, and β-D-fructose (21).



### Alkaloids

Tetramethylputrescine was isolated from the roots and aerial parts of *Ruellia rosea* (28).

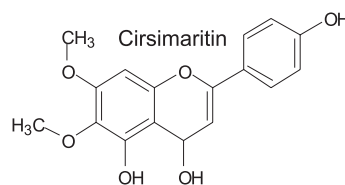
Tylocrebrine, a phenanthrene alkaloid, was reported from aerial parts of *Ruellia tuberosa* and found its anti-cancer and anti-inflammatory potential (13).

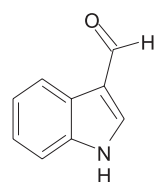
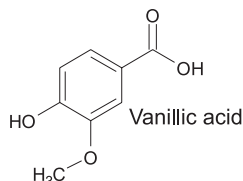
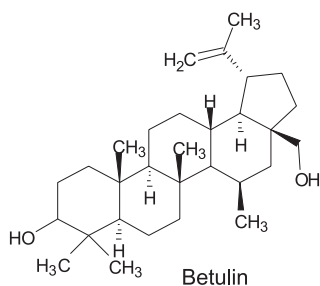
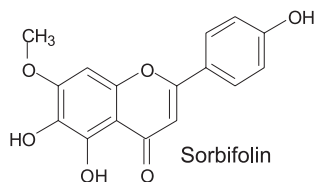
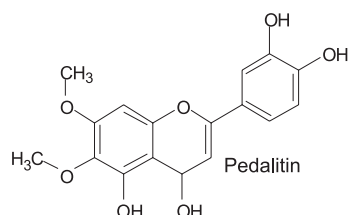
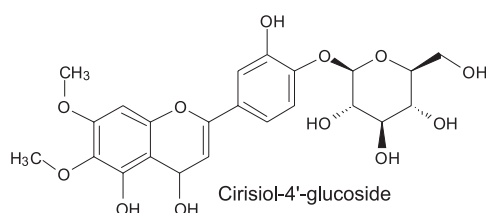
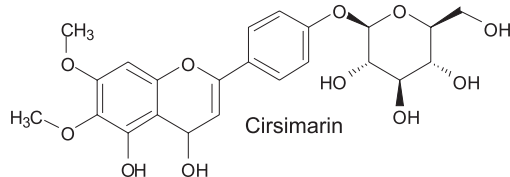


### Flavonoids

### Flavonoids

Five flavonoids: cirsimaritin, cirsimarin, cirsil-*iol*-4'-glucoside, sorbifolin and pedaltin along with betulin, vanillic acid and indole-3-carboxaldehyde were isolated from the ethyl acetate extracts of *Ruellia tuberosa* (14).





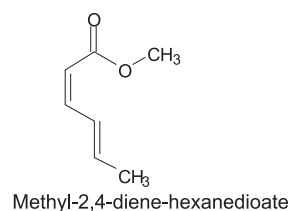
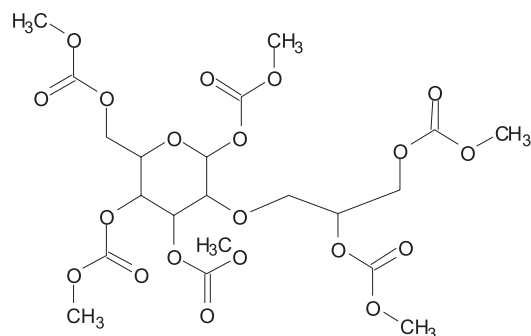
Three new flavonoid glycosides: demethoxycentaureidin 7-O- $\beta$ -D-galacturonopyranoside, pectolinarigenin 7-O- $\alpha$ -L-rhamnopyranosyl-(1''',4'')- $\beta$ -D-glucopyranoside and 7-O- $\alpha$ -L-rhamnopyranosyl-(1''',4'')- $\beta$ -D-glucuronopyranoside, a new megastig-

mane glucoside, byzantionoside B 6'-O-sulfate, and a new (Z)-hex-3-en-1-ol O- $\beta$ -D-xylopyranosyl-(1'',2'')- $\beta$ -D-glucopyranoside, were isolated from leaves of *Ruellia patula* JACQ., together with 12 known compounds,  $\beta$ -sitosterol glucoside, vanilloside, bioside (decaffeoylverbascoside), acteoside (verbascoside), syringin, benzyl alcohol O- $\beta$ -D-xylopyranosyl-(1'',2'')- $\beta$ -D-glucopyranoside, cistanoside E, roseoside, phenethyl alcohol O- $\beta$ -D-xylopyranosyl-(1'',2'')- $\beta$ -D-glucopyranoside, (+)-lyoniresinol 3- $\alpha$ -O- $\beta$ -D-glucopyranoside, isoacteoside and 3,4,5-trimethoxyphenol O- $\alpha$ -L-rhamnopyranosyl-(1'',6'')- $\beta$ -D-glucopyranoside. Their structures were elucidated by means of spectroscopic analyses.

### Other compounds

A triterpenoid, 21-methyl dammer-22-en-3,18,27-triol was isolated from the aerial parts of *Ruellia tuberosa* (30).

From *Ruellia brittoniana*, five compounds of different classes were isolated. Two new compounds: 2-O- $\alpha$ -D-galactopyranosyl glycerol hexaacetate and dimer of methyl-2,4-diene-hexanedioate were obtained. In addition to these new compounds, three reported compounds, hyoniresinol-9-O- $\beta$ -D-glucopyranoside,  $\alpha$ -ethyl-galactose and paramethoxybenzoic acid were isolated for the first time from this plant (31).



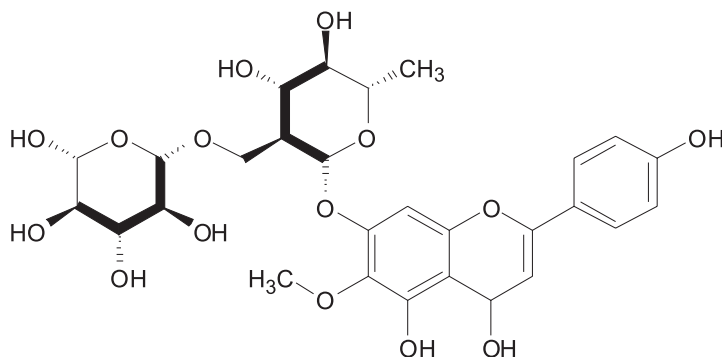
A new phenylethanoid glycoside, isocassifoliosid, and two new flavone glycosides: hispidulin 7-O- $\alpha$ -L-rhamnopyranosyl-(1''',2'')-O- $\beta$ -D-glucuronopyranoside and pectolinarigenin 7-O- $\alpha$ -L-rhamnopyranosyl-(1''',2'')-O- $\beta$ -D-glucuronopyranoside were isolated from the aerial portions of *Ruellia tuberosa*, together with verbascoside, isover-

bascoside, nuomioside, isonuomioside and forsythoside B.

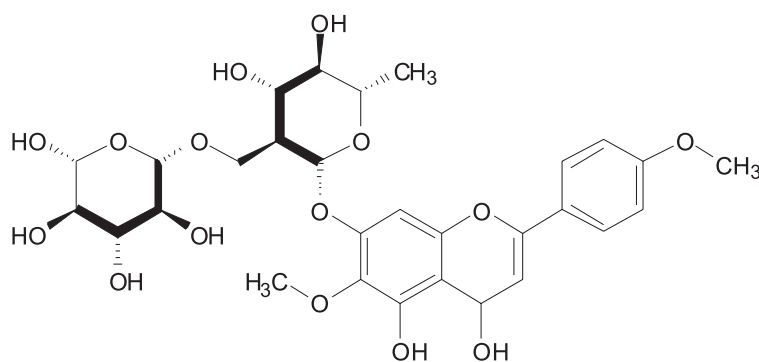
## CONCLUSION

The review place emphasis on genus *Ruellia* and elaborates the biological and phytochemical studies and medicinal uses in various ailments. This

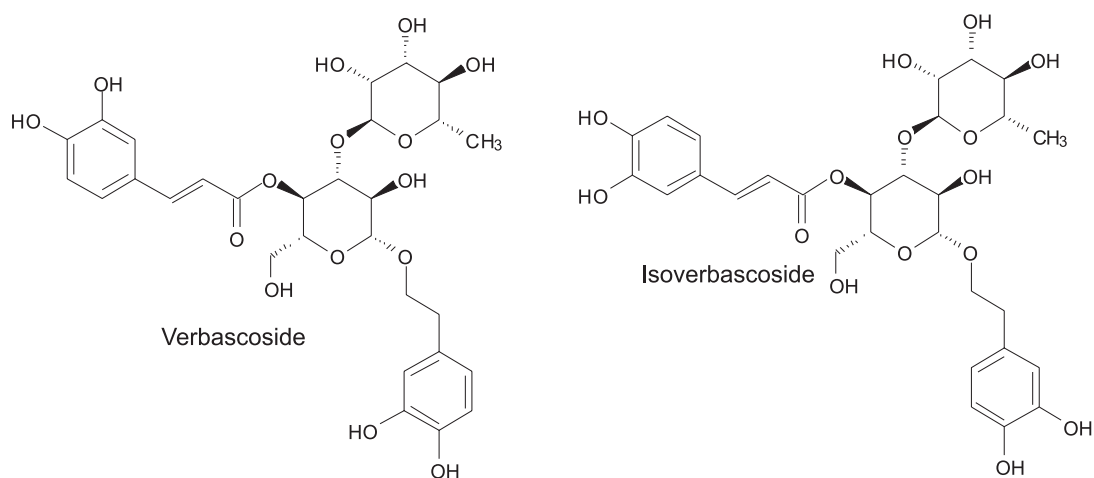
genus is well studied in its biological and phytochemical aspects. The future work required is to isolate the active biological compounds which are responsible for these activities and may serve as drugs for different ailments. Now it is time to bring genus *Ruellia* from herbal market to health commercial market.



Hispidulin-7-O- $\alpha$ -L-rhamnopyranosyl-(1'-2'')-O- $\beta$ -D-glucuronopyranoside



Pectolarigenin-7-O- $\alpha$ -L-rhamnopyranosyl-(1'-2'')-O- $\beta$ -D-glucuronopyranoside



Verbascoside

Isoverbascoside

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