

Review Article

A comprehensive review on *Polygonum glabrum*

Raja S*¹, Ramya I¹

*Corresponding author:

Raja S

¹Department of pharmaceutical chemistry
GITAM Institute of Pharmacy
GITAM University, Andhra Pradesh,
India.

Abstract

Polygonum glabrum commonly called as dense flower knotweed is a perennial plant. It is an amphibious shrub with pink flowers and glossy brown seeds found in most parts of India. Various parts of the plant like leaves, stem, flowers and roots are used in traditional system of medicine. Traditionally, different decoctions/infusions are prepared using the plant parts and given for the treatment of rheumatism, jaundice, piles etc. From pharmacological point, the plant has been effectively screened for antihepatotoxic, antinephrotoxic, antimicrobial, anticancer, antidepressant, analgesic and antioxidant activities. The plant contains many flavonoids including diosmetin, rutin, hyperin and quercitrin. The lanceolate leaves are rich in essential oil which contains many compounds like 6, 6-dimethyl-1, 3-heptadien-5-ol, oleic acid, 9-octadecenamide, isodecyl octyl ester and 1,2,3-benzenetriol. Compounds like aliphatic, alicyclic compounds, sesquiterpenes, sterols, phenolic acids as well as other trace elements have been identified in the plant. This review provides morphological, ethnomedical, pharmacological and phytochemical data of the plant *Polygonum glabrum*.

Key words: *Polygonum glabrum*, Pinocembrin, Drimanes, Phytoconstituents, Ethnomedical, Taxonomical.

Introduction

Polygonum glabrum which is commonly called as dense flower knotweed is a semi aquatic perennial plant. It belongs to the family polygonaceae and genus *polygonum* [1]. This particular genus consists of more than hundred species out of which nearly seventy are present in marshy lands of India. *Polygonum glabrum* is erect, about 3-4 feet high with a chromosome number of 2n=66 [2]. The surface of leaves is without hairs and encompasses different

stomatal complexes. This wetland plant has clusters of beautiful pink flowers which usually attract butterflies and insects. The plant is considered as a good source for botanical bioremediation as it can accumulate heavy metals like nickel and arsenic in the tissues. The most distinctive feature of the plant is the presence of membranous or hyaline sheath uniting the stipules [3]. Taxonomical classification of *Polygonum glabrum* is given in Table 1.

Table 1: Taxonomical classification of *Polygonum glabrum*

	Taxonomical classification
Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Caryophyllales
Family	Polygonaceae
Genus	Polygonum
Species	glabrum

Scientific name: *Polygonum glabrum*

Synonym : *Periscaria glabrum*.

Common name: Dense flower Knotweed.

Vernacular names

Pakistan	Basirjoush
Sudan	Timsahiya
India	
Marathi	Sheral
Tamil	Attalaree
Karnataka	Niru kanigalu
Malayalam	Chavanna mudela mukcum
Bengali	Bihagni
Gujarati	Rakta-rohidaa

History and Habitat

Polygonum glabrum is an amphibious plant which grows in or near water bodies. This glabrous plant is found throughout the world. In Polynesian countries *Polygonum glabrum* is seen in swamps and dominates the marsh vegetation. This wetland plant is also found in Africa, Argentina, Antigua, Bahamas, North South America and Pacific Islands [4]. In Iran it is present as a weedy habitat along river banks. *Polygonum glabrum* is found in AbuHamed (sudan) only breeding on banks of shallow slow running water [5]. In Bangladesh *Polygonum glabrum* is found in marshy soil, wet lands, ditches and other places of Chittagong. In Pakistan it is usually present on the sides of marshy areas, river and streamside's. It grows in East Asian countries like Thailand, Vietnam, Philippines etc. In India the plant is distributed from Assam to uttarhand [6]. Jannapura Lake in Bhadravathi taluk of Karnataka and riverbanks in Tirumala district of Andhra pradesh have marshy amphibious macrophytes like *Polygonum glabrum* [7].

Morphology

Polygonum glabrum is an annual herb which is spread in moist habitat like river banks, channels, tank beds etc. It is glabrous throughout with dilated nodes. It is distributed throughout India. Stem: Rarely branched stems with swollen nodes are present.

They are genticulate, ascending with 5-15 cm length and red in color. Generally rooting is seen in the nodes [8].

Leaves: They are simple, alternate and stipulate. The stipules are united in to a sheath clasping the stem above the base of the leaf. Leaves apices are narrowly acuminate. Leaves are generally lanceolate or oblong lanceolate in shape with an entire margin, acute base and spiral arrangement. Petiole is robust with 8-9mm in size. The leaf stalk is 0.5-2.5 cm long, ocreae tubular, sometimes with a few small bristles [3].

Flowers: The plant blossoms in the month of June. Flowers are bracteates, pedicellate and usually bisexual. Spicate terminal with many panicle like dense spikes are seen. The bracts are funnel shaped, usually each 3- or 4-flowered. Long articulate pedicels are present. Flowers are white or pinkish with parted petals. Elliptic slender veins which are furcated at apex are seen. Six to eight stamens, two styles, connate to below middle are seen [9].

Fruits and seeds: The plant bears fruit in the month of September. The fruits are lens shaped and angular. Triangular achenes with perianth are seen. Seeds have numerous endosperms and a curved embryo. They are glossy and dark brown in colour.

Ethnomedical information of *Polygonum glabrum*

Family polygonaceae consists of large number of medicinal plants and is well known for its use in ethnomedicine. The glabrum species of the genus *polygonum* provide a variety of traditional properties. The tribes of chattisgarh use the root paste as a medicine for snake bite [10]. In some areas the root stock is used for the treatment of jaundice and piles [11]. The leaves are used as an antimalarial agent in sudan [12]. In south India *Polygonum glabrum* leaves are used for the treatment of dysentery [13]. A decoction of the leaves and seeds are used as cardiotoxic, astringent and anthelmintic [14]. The whole plant decoction is used as a remedy for colic pain, pneumonia and the boiled paste is applied in cuts and wounds [15]. Apart from medicinal use, the whole plant is powdered and used as bait for fishing. Peels from stem are used for treating rheumatism [16]. The ethnomedicinal uses of *Polygonum glabrum* are listed in Table 2.

Table 2: Ethnomedical uses of *Polygonum glabrum*

Plant parts	Route of administration	Uses	Ref
Roots	Juice, paste	Snakebite, Jaundice, Febrifuge, Piles	[10],[11]
Leaves	Extract is boiled with common salt and used	Dysentery, antimalarial	[12],[13]
Seeds,leaves	Decoction	Cardiotonic, astringent, anthelmintic	[14]
Whole Plant	Infusion, Boiled paste	Pneumonia, cuts and wounds, colic pain	[15]
Stem	Peels from stem	Rheumatism	[16]

Pharmacological activities of *Polygonum glabrum*

Owing to its traditional use *Polygonum glabrum* has been studied for different types of pharmacological activities. Numerous in vitro studies and in vivo studies on different cell lines and in animals

have been reported. However, there is no clear mechanism of actions. The present review is focused to give an overview of the pharmacological activities that have been reported on *Polygonum glabrum* in the past and present. The data on pharmacological action of *Polygonum glabrum* is listed in Table 3.

Anti depressant activity

The aqueous extract of leaves of *Polygonum glabrum* was studied for their anti depressant activity in different models like behavioural despair test, tail suspension test and L-dopa induced hyperactivity & aggressive behavior test. Neurochemical studies were also carried out in hippocampus, cortex and hypothalamus of brain. The antidepressant activity of the plant was found to be mediated through monoamines like dopamine, nor-epinephrine systems [4].

Anti leishmanial activity

Aqueous extract of whole plant of *Polygonum glabrum* was investigated for its in vitro anti leishmanial activity. Flat bottoms 96 well ELISA plate was used for the assay and amphotericin B was used as the standard drug. Promastigotes of *Leishmania tropica* strain were used. The percentage mortality was studied at different concentration from 0.05 ug/ml, 0.5 ug/ml, 5 ug/ml, 50 ug/ml, and 500ug/ml. The LC₅₀ and LC90 for the assay were found to be 7.25 ug/ml and 227.4ug/ml [17].

Cytotoxic, membrane stabilizing and thrombolytic activities

The methanol extract of leaves of *Polygonum glabrum* was tested for their in vitro cytotoxic, membrane stabilizing and thrombolytic activities. The extract showed a high clot lysis value of 35.17 ± 0.42% in the assay of thrombolytic activity. The extract also inhibited hemolysis of human erythrocyte by 79.21 ± 0.44% and 84.87±0.23% in hypotonic solution- and heat- induced factors. Apart from this the methanol extract showed optimum cytotoxic activity at LC₅₀ value 0.74 ± 0.045 µg/ml [18].

Antihepatotoxic activity

The ethanol extract of leaves of *Polygonum glabrum* was screened for its hepatoprotective activity. Albino rats were used for the study and carbon tetra chloride was used to induce hepatic injury. The extract was reported to provide hepato protection by maintaining the altered biochemical parameters like ALT, AST, ALP to normalcy [19].

Analgesic activity

The aqueous extract of leaves of *Polygonum glabrum* was investigated for its analgesic activity. Albino rats and wister mice were used for the experiment. Validated models like acetic acid-induced writhing test, tail flick latent period, hot plate reaction time and formalin-induced paw licking test were studied for analgesic activity. The extract was used in various concentrations like 12.5, 25, 50 and 100 mg/kg for analgesic activity and the result was

found to be mediated by both central and peripheral mechanisms [20].

Antiinflammatory activity

The aqueous and ethanol extracts of stems of *Polygonum glabrum* were studied for its anti inflammatory activity in various test models viz acute carrageenan-induced paw oedema, granuloma pouch test, formaldehyde arthritis test and adjuvant-induced polyarthritis test. The study reported that both the aqueous and ethanol extracts were effective in parenteral route than oral route [21].

Antioxidant activity

The methanol extract of leaves of *Polygonum glabrum* was investigated for its in vitro anti oxidant activity. The radical scavenging activity of extract was determined by using DPPH (2, 2-diphenyl-1-picrylhydrazyl) assay. Radical scavenging activity was found to be in the range of 28.6% - 62.6%. The study reported that *Polygonum glabrum* showed remarkable antioxidant potency in invitro study [19].

Antimicrobial activity

The methanol extract of leaves of *Polygonum glabrum* was studied for its antibacterial and anti fungal activities. The extract showed maximum activity against all the studied pathogens such as *Staphylococcus aureus*, *Micrococcus luteus*, *Pseudomonas aeruginosa* with a maximum Zone of inhibition of 15, 11, 12 and 18mm. The maximum inhibition was recorded against *P. aeruginosa* followed by *S. aureus*, and *M. luteus*. The antifungal potential of the extracts was also found to be significant, as the extract showed inhibition of 11mm against both *Candida albicans* and *Candida tropicalis* [22].

Antipyretic activity

The methanol extract of whole plant of *Polygonum glabrum* was tested for its antipyretic activity by using Brewer's yeast induced pyrexia in rats. A significant reduction in the yeast elevated temperature was noted in the experiment which supports the anti pyretic effect [8].

Antinephrotoxic activity

Methanol extract of whole plant of *Polygonum glabrum* was studied for its nephro protective activity. Cisplatin and gentamycin were used to inflict renal injury. The study reported that an oral administration of extract produced significant improvement in the rats at a dose of 200mg/kg and 400mg/kg [23].



Table 3: Pharmacological profile of *Polygonum glabrum*

Parts of Plant	Type of extract	Animal model/Microorganism	Uses	References
Leaves	Aqueous	Rat and mice	Anti depressant	[4]
Whole plant	Aqueous	Microorganism-Leishmania tropica strain	antileishmanial activity	[17]
Leaves	Methanol	Shrimp -Artemia salina	Cytotoxic activity	[18]
Leaves	Ethanol	Albino rat	Antihepatotoxic activity	[19]
Leaves	Aqueous	Rat and mice	analgesic activity	[20]
Stem	Aqueous, ethanol	Rat	Antiinflammatory activity	[21]
Leaves	Methanol	Invitro test	Antioxidant activity	[19]
Leaves	Methanol	Micrororganism- <i>Staphylococcus aureus</i> , <i>Micrococcus luteus</i> <i>Pseudomonas aeruginosa</i>	Antimicrobial activity	[22]
Whole plant	Methanol	Rat	Anti pyretic activity	[8]
Whole plant	Methanol	Rat	Antinephrotoxic activity	[23]

Phytoconstituents in *Polygonum glabrum*

Flavonoids

Flavonoids are a group of secondary metabolites with remarkable antioxidant property. They provide various benefits to our body. Quercetin, kaempferol, gallic acid, hyperin, quercitrin, vanillic acid, syringic acid, parahydroxy benzoic acid, protocatechuic acid, cis cinnamic acid and trans cinnamic acid were isolated from the methanolic extract of seeds of *Polygonum glabrum* [24]. All the compounds were isolated from both water soluble and ether soluble fractions of mother liquor of methanol extract. Flavonoids like avicularin, rhamnetin, diosmetin, cyanidin 3 5-diglucoside and delphinidin3, 5, diglucoside were isolated from the methanol extract of leaves and flowers of *Polygonum glabrum* [25]. Rutin and isoquercetin were isolated from the seeds and flowers of the plant [26], [27].

Sesquiterpenes

Drimanes are bicyclic sesquiterpenes which forms as a parent nucleus in many natural compounds. Straight phase and reverse phase chromatography of methanol extracts of leaves of *Polygonum glabrum* led to the isolation of four new sesquiterpene diesters namely 2alpha,3 beta-Diangelyloxyisodrimeninol,2alpha-angeloyloxy-3beta-2' methylbutanoyloxyisodrimeninol, 2 alpha angeloyloxy3 beta2' methylpent2' enoyloxyisodrimeninol and 2 alpha angeloyloxy3 beta2' methylpentanoyloxyisodrimeninol.[28]

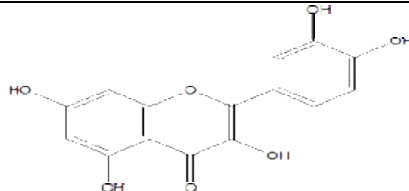
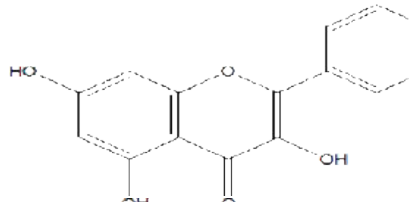
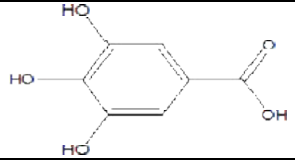
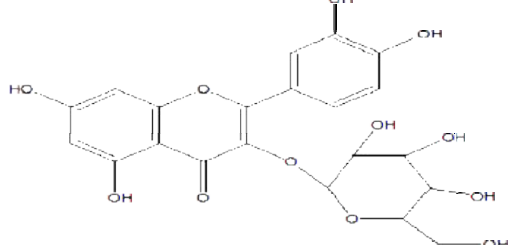
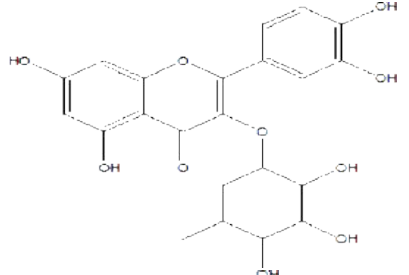
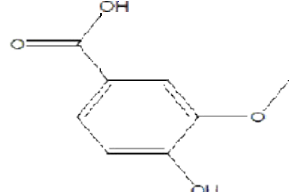
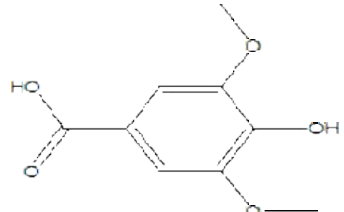
GC-MS analysis

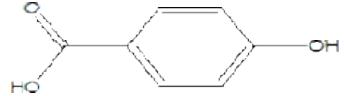
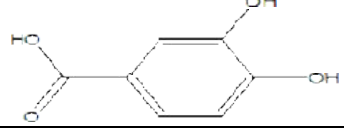

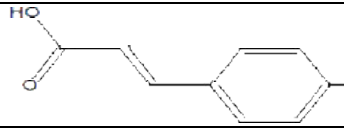
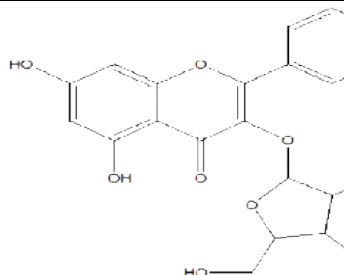
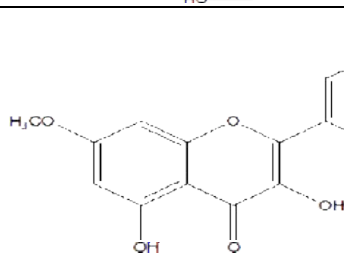
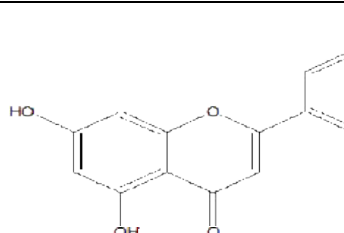
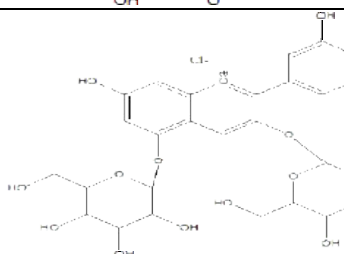
Ethanol extract of whole plant *Polygonum glabrum* was subjected to GC-MS analysis. The extract revealed the presence of compounds like -propane 1,1-diethoxy, -2-Heptane, 5-ethyl-2,4-dimethyl, Thiophene – 2 – Carboxamide, N-(2-Furfuryl), 1,14 – Tetra – decanediol, 1,2 – Benzenedi carboxylic acid, isodecyl octyl ester and 1,2,3 – Benzenetriol [29]. Similarly another study of GC-MS done with methanolic leaves extract of this plant led to the detection of compounds like 2-(4-Methoxyphenyl) Benzoic Acid, Hexadecane, 3,4-Bis (3, 4, 5-trimethoxyphenyl)-1-[2-(4-methoxyphenyl) ethyl]pyrrole-2, 5-dicarboxylic acid, Hexadecanoic acid, methyl ester Dibromoschizandrin, and (2RS)-1,3,8-trimethyl-4-propyl-5-ethyl-2-(1-hydroxyethyl)-7-methoxy carbonyl ethyl – gamma – methylenecarbonyl –porphine, [30]. The compounds were identified by comparing their retention time, peak area and by interpretation of mass spectra. In another study, the cuticular wax from leaves of *Polygonum glabrum* were removed by cold maceration and subjected to GC-MS. Analysis. The study reported the detection of compounds like 6,6-dimethyl-1,3-heptadien-5-ol , oleic acid, 9-octadecenamide, (Z), 1,2,3-propanetriol diacetate and Octacosane in epicuticular wax .

Miscellaneous compounds

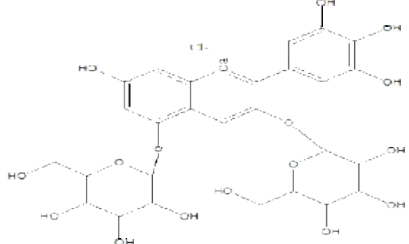
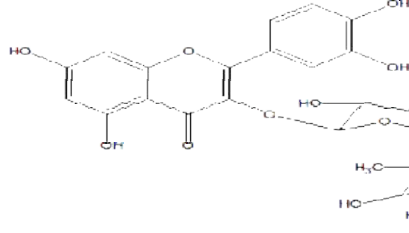
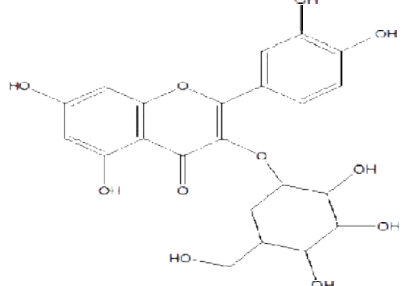
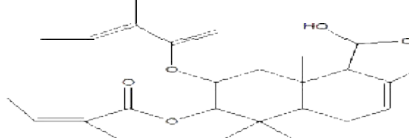
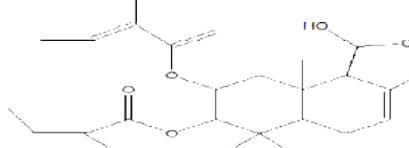
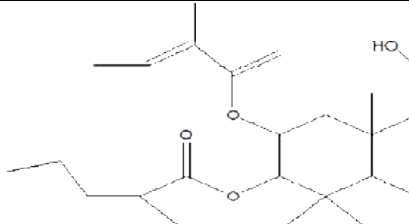
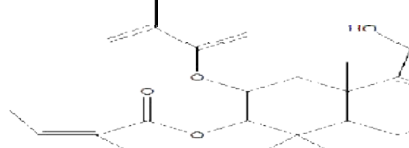
A new product (2)-2-methoxy-2-butenolide-3-cinnamate along with six known compounds namely(2)-2-Methoxy-2-Butenolide-3-Cinnamate, beta-hydroxyfriedalanol, 3-hydroxy-5-methoxystilbene, pinocembrin, (-) pinocembrin-5-methyl ether, sitosterol-3-O-b-Dglucopyranoside and sitosterol-(6'-O-palmitoyl)-3-O-b-Dglucopyranoside, were isolated from the methanol extract of aerial parts of *Polygonum glabrum*. [31]. The structures of different active constituents present in the *Polygonum glabrum* are given in Table 4.

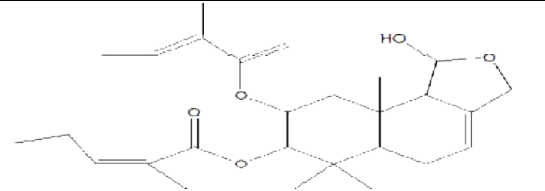

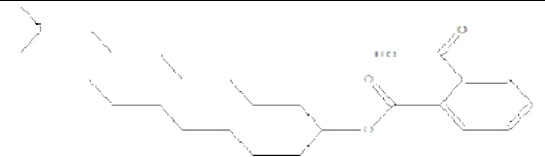

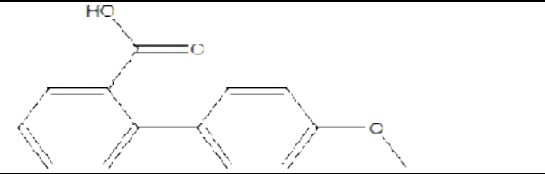

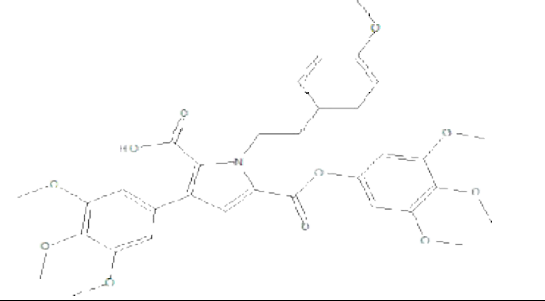

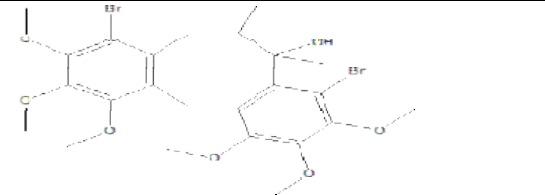
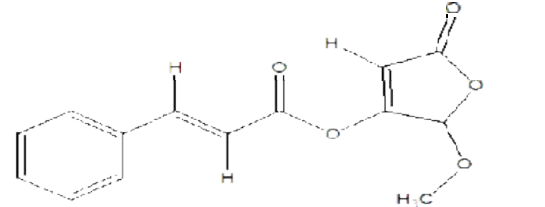
Table 4-Chemical Constituents Identified, Isolated From *Polygonum glabrum*

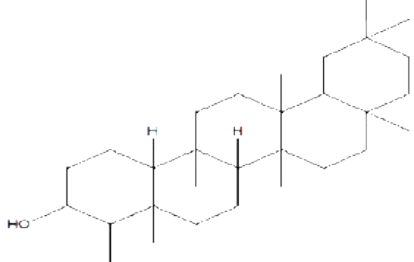
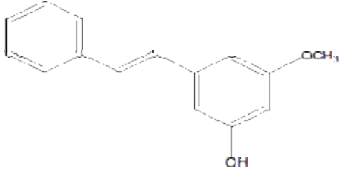
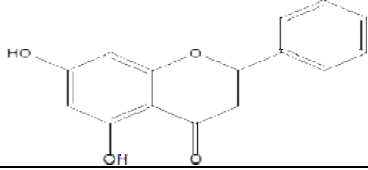
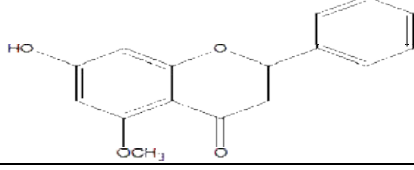
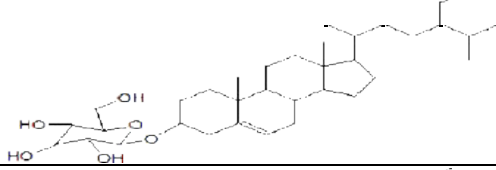
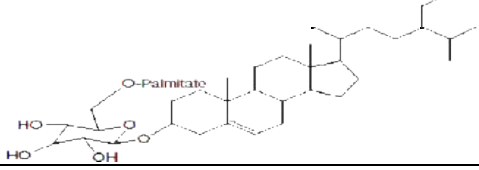
Phytoconstituents	Parts of plant	Structure	Class	Ref
Quercetin	Seeds		Flavonol	[24]
Kaempferol	Seeds		Flavonol	[24]
Gallic acid	Seeds		phenolic acid	[24]
Hyperin	Leaves		Flavonoid	[24]
Quercitrin	Seeds		Flavonol	[24]
Vanillic acid	Seeds		phenolic acid	[24]
Syringic acid	Seeds		phenolic acid	[24]

P-Hydroxy benzoic acid	Seeds		phenolic acid	[24]
Proto catechuic acid	Seeds		phenolic acid	[24]
Cis coumaric acid	Seeds		phenolic acid	[24]
Trans coumaric acid	Seeds		phenolic acid	[24]
Avicularin	Flowers		Flavonol	[25]
Rhamnetin	Seeds		Flavonol	[25]
Diosmetin	Leaves		Flavonoid	[25]
Cyanidin 3 5-diglucoside	Flowers		Flavonoid	[25]



Delphinidin 3,5-diglucoside.	Flowers		Flavonoid	[25]
Rutin	Seeds		Flavonol	[26]
Isoquercetin	Flowers		Flavonoid	[27]
2alpha,3 beta-diangeloyloxyisodrimeninol	Leaves		Sesque terpene	[28]
2alpha-angeloyloxy-3beta-2'-methylbutanoyloxyisodrimeninol.	Leaves		Sesque terpene	[28]
2 alpha angeloyloxy3 beta2'methylpentanoyloxyisodrimeninol	Leaves		Sesque terpene	[28]
2alpha3 beta-ditigloyloxyisodrimeninol	Leaves		Sesque terpene	[28]

2 alpha angeloyloxy3 beta2'methylpent2'enyloxyisodrimeninol	Leaves		Sesque terpene	[28]
1,14-tetradecanediol	Whole Plant		Alkenol	[29]
1,2-benzenedicarboxylic acid, isodecyloctyl ester	Whole plant		Lipids	[29]
1,2,3-benzenetriol	Whole plant		Poly hydroxy phenol	[29]
2-(4-methoxyphenyl) benzoic acid	Leaves		Benzenoid	[30]
Hexadecane	Leaves		Aliphatic	[30]
3,4-bis (3,4,5-trimethoxyphenyl)-1-[2-(4-methoxyphenyl) Ethyl] pyrrole-2,5-dicarboxylic acid	Leaves		Benzenoid	[30]
Hexadecanoic acid, methyl ester	Leaves		Lipid	[30]
Dibromoschizandrin	Leaves		lignan	[30]
(2)-2-methoxy-2-butenolide-3-cinnamate	Aerial parts		Gum	[31]

Beta-hydroxyfriedalanol	Aerial parts		Terpenoid	[31]
3-hydroxy-5-methoxystilbene	Aerial parts		Glycoside	[31]
Pinocembrin	Aerial parts		Flavonoid	[31]
Pinocembrin-5-methyl ether	Aerial parts		Flavonoid	[31]
Sitosterol-3-O-B-D-glucopyranoside	Aerial parts		Sterol	[31]
Sitosterol-(6-O-palmitoyl)-3-O-B-D-glucopyranoside	Aerial parts		Sterol	[31]

Conclusion

According to ethnomedical study *Polygonum glabrum* is very effective and safe for medicinal uses. Qualitative and quantitative analysis reported the presence of many bioactive constituents. Currently, some of the phytoconstituents have been isolated and identified from *Polygonum glabrum*. These compounds and crude extracts have been screened for pharmacological activities by in vivo and invitro models. The structural activity relation between isolated compounds and their target sites in human body should be meticulously studied further. Analytical characterization of active principle, developing new strategies in clinical trials and product development will facilitate *Polygonum glabrum* to be considered as

a potent herbal drug for the treatment of various chronic diseases in near future.

Acknowledgements

The authors are thankful to the management of GITAM University, Visakhapatnam, Andhra Pradesh, India, for providing the necessary facilities to carry out the research work.

Conflicts of interests

The authors declare no conflicts of interests.

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