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Phytochemical and Ethnomedicinal Uses of Family Violaceae

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ABSTRACT

The genus Viola (Violaceae) consists of approximately 500 species widely distributed throughout the world. Phytochemically, different groups of compounds have been isolated from various species of this genus like cyclotide alkaloids, flavonoids, caffeic acid derivatives, salicylic acid and triterpenoids. Traditional knowledge when tested pharmacologically and phytochemically could provide new effective therapeutic agents. The family Violaceae having an important medicinal herb, mentioned in traditional medicine for a variety of therapeutic applications including purification of blood and the treatment of bruises and ulcers in the Chinese system of medicine it is recommended for use against cancer disorders. The genus mostly used in the traditional medicinal system for cough, cold, flu, fever, malaria and is also given as anticancerous drug. The article reviews is an attempt to compile and documented information on different aspect of *Viola* species pharmacological properties and highlight the need for research and their potential development.

Key words: Viola, therapeutic, traditional medicine and pharmacological

INTRODUCTION

The family Violaceae (alternatively known as Alsodeiacae or Leoniaceae or Retrosepalaceae) comprise of twenty genera and about 800 species (Mabberley, 1987). The plants of this family are perennial herbs or shrubs with simple leaves (alternator opposite) which are palmate or deep dissected shaped, the flowers are bisexual, zygomorphic or actinomorphic, calyx-5, corolla of 5 petals, anterior petal large and spurred. Androecium of 5 stamens. Gynoecium a compound pistil of 3 united carpels, ovules superior and fruit capsule. The family is of little economic importance (Perveen and Qaiser, 2009). It is found naturally in various countries of the world like India, Nepal, Sri Lanka, China, Malaysia, Pakistan and Australia. There is list of some of the *Viola* species and their worldwide distribution in the Table 1.

In India it is found in various states like Uttarakhand, Utter Pradesh, Himanchal Pradesh, Jammu, Kashmir and Meghalaya etc. *Viola* species and their distribution in India as in the Table 2.

In India, *Viola canescens* is found in Pangi Valley of Chamba District in the cold desert of Himalaya also known as Trans Himalayan region (Rana *et al*., 2010). The presence of *V. canescens* was also reported in Garhwal region of Himalaya located in Uttarakhand, India at an altitude of 1600-2000 m. It is also present in Uttarakhand in the areas of Nanda Devi National Park and Nainital catchment area (Agnihotri *et al*., 2012; Shah *et al*., 2014; Dua *et al*., 2011). *Viola odorata* sweet violet is indigenous to India and found in Kashmir (Kangra), Himachal Pradesh (Chamba) and Kumaon hills (Salve *et al*., 2014).

Table 1: List of some of the *Viola* species and their worldwide distribution

Species	Geographical distribution
Viola betonicifolia	India, Nepal, Sri Lanka, Pakistan, Burma, Indo-China, China, S. Japan, Malaysia, Australia
Viola biflora	Europe, Central Asia, Pakistan and India
Viola canescens	India, Pakistan, Nepal and Bhutan
Viola falconeri	India and Pakistan
Viola kashmiriana	India, Pakistan and Afghanistan
Viola kunawurensis	India, Afghanistan, Pakistan, Turkestan, Nepal, Tibet and W. China
Viola odorata	India, Pakistan, Nepal, Iran Afghanistan, Iraq, Mediterranean region and Caucasiav
Viola pilosa/Viola serpens	India, Pakistan, Ceylon, Nepal, China and Java
Viola stocksii	India, Pakistan, Afghanistan and Iran
Viola mandshurica	Nepal
Viola arvensis	Romania

Table 2: List of *Viola* species and their distribution in India

Species	Geographical distribution
Viola serpens	Meghalaya, Nagaland, Manipur, Orissa, Himachal Pradesh, Uttar Pradesh, Karnataka, Tamilnadu and Uttarakhand
Viola betonicifolia	Jammu and Kashmir
Viola biflora	Jammu, Kashmir, Uttarakhand and Himanchal Pradesh
Viola canescens	Jammu, Kashmir, Uttarakhand and Himachal Pradesh
Viola pilosa	Uttarakhand
Viola odorata	Kashmir and western Himalayan

The main aim of this article is to highlight the latest review of scientifically proved ethnomedicinal uses and secondary metabolites of different species of the Viola.

ETHNOMEDICINAL USES

A large number of ethnobotanical uses of different species of the Viola genus have been documented in literature. After the though literature survey we tabulated the plants name and their uses in Table 3.

Essential oils can be extracted from plant materials by several methods, steam distillation, expression and so on. Among all methods, for example, steam distillation method has been widely used, especially for commercial scale production (Cassel and Vargas, 2006; Di leo Lira *et al*., 2009). Essential oils have been widely used as food flavors (Burt, 2004).

In the essential oil obtained from fresh aerial parts of *V. tricolor* has reported 35 compounds representing 97.76% of the total oil as follows: 8 sesquiterpenes, 17 aliphatics, 6 shikimic acid derivatives and 4 monoterpenes. Sesquiterpenes were the major component (59.27%), followed by aliphatics (29.81%), shikimic acid derivatives (8.05%) and monoterpenes (0.30%). The main volatile components found were bisabolone oxide (43.25%), trans-β-farnesene (4.01%) and bisabolol oxide A and B (7.78 and 2.28%) (Anca *et al*., 2009).

In the essential oil obtained from dried aerial parts of *V. tricolor* has reported 24 compounds representing 60.53% of the total oil as follows: 14 aliphatics, 4 shikimic acid derivatives, 2 sesquiterpenes and 4 monoterpenes. The main volatile components found were hexahydrofarnesyl acetone (4.06%), methyl salicylate (1.22%) and β-ionone (1.00%). Aliphatic were the major components (42.21%), followed by shikimic acid derivatives (11.20%), sesquiterpenes (4.79%) and monoterpenes (2.32%) (Anca *et al*., 2009).

The GC-MS analysis of essential oils of the leaves of *Viola odorata* has reported with 26 volatile components representing 72.13% of the total essential oil obtained from dried aerial parts of *V. arvensis* as follows: 18 aliphatics, 5 shikimic acid derivatives, 2 monoterpenes and 1 sesquiterpene. Aliphatics were the major components (59.94%), followed by shikimic acid

Table 3: Ethnobotanical uses of different species of the *Viola*

Species	Part used	Medicinal uses
Viola patrinii	Whole plant	Purification of blood and the treatment of bruises and ulcers in the Chinese system of medicine it is recommended for use against cancer disorders. The dried flowers are used as a purgative and for cough and cold (Bachheti *et al*., 2014)
Viola canescens	Whole plant	It is mostly used in the traditional medicinal system for cough, cold, flu, fever, malaria and is also given as anti cancerous drug (Masood *et al*., 2014)
Viola serpens	Whole plant	It is one of the most useful medicinal plants and used as antipyretic, demulcent, diaphoretic and diuretic drug. It is useful in asthma, bleeding piles, cancer of throat, constipation, cough, fever, skin diseases and headache (Kumar and Digvijay, 2014)
Viola biflora	Whole plant	It is antiseptic, antispasmodic, cold, cough, diaphoretic, emetic, fever, laxative, leucoderma, psoriasis and skin disease (Rana and Samant, 2011), Fruits paste consumed with water is useful during diaphoretic and intestinal pain
Viola arvensis	Aerial parts	Anti-inflammatory, expectorant and diuretic also used in skin conditions, bronchitis, cystitis and rheumatism (Anca *et al*., 2009)
Viola tricolor	Aerial parts	The aerial parts are used as anti-inflammatory, expectorant and diuretic also used in skin conditions, bronchitis, cystitis and rheumatism (Anca *et al*., 2009)
Viola odorata	Whole plant	Fresh leaves have been used internally and externally in the treatment of cancer. Flowers used dry, valued as diuretic and expectorant and as purgative in bilious disorders. Decoction of dried flowers used for fever. Syrup of the violet is used for cough and hoarseness. Seeds were used as purgative and diuretic. Plant poultice also used for headaches, coughs, colds, bronchitis, nervousness and general debility. In South Africa, leaves chewed as anticancer (Salve *et al*., 2014), diaphoretic, febrifuge, infantile disorder and lung troubles (Ahmad *et al*., 2009). The syrup made from the leaves and flowers of *Viola* were used as an alternative medicine mainly for respiratory ailments associated with congestion, coughing and sore throat (Singh *et al*., 1983)
Viola hondoensis	Whole plant	Expectorant, a diuretic and an anti-inflammatory for bronchitis, rheumatism, skin eruptions and eczema (Moon *et al*., 2004)
Viola falconeri	Flower and roots	Flower are used for cough and cold while, roots are used in jaundice (Saqib and Sultan, 2004)
Viola cinerea	Whole plant	Aphrodisiac (Marwat *et al*., 2008)
Viola betonicifolia	Leaves, flower and whole plant	The whole plant is used as astringent, diaphoretic, antipyretic, anticancer and purgative (Shinwari, 2010). It is also used in epilepsy and various nervous disorders. Flower and leaves are used for sinusitis, skin and blood disorders, cough and pharyngitis (Bhatt and Negi, 2006). It is also used as an astringent, diuretic having cooling effect, laxative and purgative (Husain *et al*., 2008). Roots and fruits are used for kidney diseases, pneumonia and bronchitis. Leaves are useful for the healing of boils (Husain *et al*., 2008)

derivatives (8.35%), monoterpenes (2.15%) and sesquiterpenes (1.69%). The main volatile components found were 2-pentyl-furan (5.48%), β-ionone (2.09%) and hexahydrofarnesyl acetone (1.69%) (Anca *et al*., 2009).

The essential oil of *Viola odorata* flowers contained high percentages of the group of monoterpenes and sesquiterpene. The dominant components were 1-phenyl butanone (22.43%), linalool (7.33%), benzyl alcohol (5.65%), α-cadinol (4.91%), globulol (4.32%) and viridiflorol (3.51%). pulegone (3.33%), epi-α-cadinol (3.05%), terpinen-4-ol (2.31%), germacrene A (1.99%) and paramethyl anisole (1.09%) were also found to be minor components of the *V. odorata* L. flower oil (Hammami *et al*., 2011).

The analysis of essential oil composition of the leaves of *Viola odorata* L. revealed the presence of 25 identified compounds, representing 92.77% of the oil with butyl-2-ethylhexylphthalate (30.10%) and 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-2(4H)-benzofuranone (12.03%) being the two main components (Akhbari *et al*., 2012).

The flowers of *Viola odorata* contain a colouring matter and traces of a volatile oil, three acids and an emetic principle called violin, probably identical with emetine, viola quercitrin, closely related but not identical with quercitrin or rutin and sugar. Essential oil from flowers used in perfumery. Pigment extract from flowers used for litmus testing strips. Makes excellent ground cover (Salve *et al*., 2014). The sweet scent of this flower has proved popular throughout the generations and has consequently been used in the production of many cosmetic fragrances and perfumes companies.

Preliminary phytochemical profile: The methanolic extract of the leaves of *Viola odorata* was found to contain 15 total phenolic (35.4 mg g^{-1}) and total flavonoid (22.8 mg g^{-1}) contents (Ebrahimzadeh *et al*., 2010). Various phytochemical constitutes (alkaloids, steroids, tannins, flavonoids and saponins) has been reported in aerial parts of *Viola odorata n*-hexane, butanolic, methanolic and aqueous extracts (Vishal *et al*., 2009). The Methanolic extract of the whole plant of *Viola betonicifolia* has been reported as rich source of alkaloids, flavonoids, tannins, proteins, phenolic compounds, saponins, sterols and triterpenoids (Muhammad and Saeed, 2011). The dichloromethane, ethyl acetate and methanolic extract of *Viola tricolor* whole plant has been reported as rich source of terpenoids, phenolic compounds, flavonoids and saponins (Witkowska-Banaszczak *et al*., 2005). The methanolic extract of *Viola tricolor* has been investigated for their flavonoid contents through LC-MS, HPLC and NMR and five minor flavonoids were identified (Vukics *et al*., 2008a). Various species of *Viola* has been tested for their cyclotides contents and all were proved a rich source of cyclotides. The leaves of *Viola canescens* reported to have alkaloids, phenolic compounds, tannins, saponins, phytosterols and flavonoids as phytochemical constitutes (Barkatullah *et al*., 2012).

Phytochemical studies: The roots of *Viola serpens* contains glucoside (methyl salicylate) (Fig. 1), alkaloid (violin) and a glycoside (*viola* quercitrin) (Fig. 2) (Anonymous, 1978). The Whole plant of

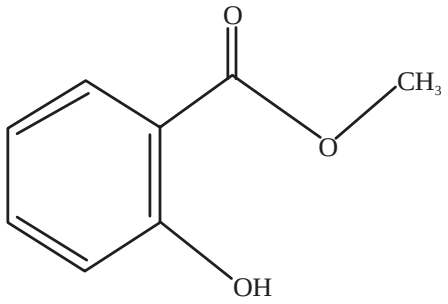

Fig. 1: Methyl salicylate

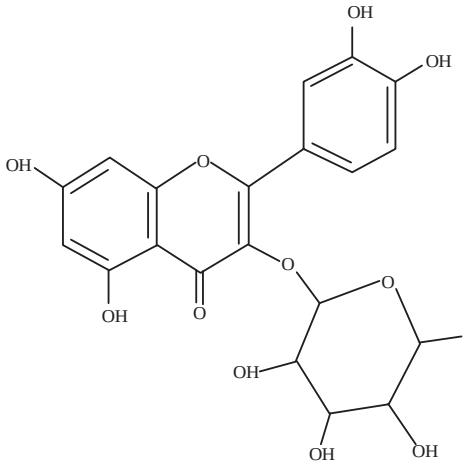

Fig. 2: Quercitrin

Viola serpens containing glycoside methyl salicylate, *viola* quercitrin, alkaloid voiline gum, mucilage, sugar and saponin (Prajapati *et al*., 2006). The *Viola cornuta* (violet) flowers contain volatile oil, rutin, syanyn, bright pigment, methyl salicylate glycosides and anthocyanins. *Viola odorata* contains alkaloids, glycosides, saponins, methyl salicylate, mucilage and vitamin C (Stuart, 1989). About 30 cyclotides are identified from the aerial parts and roots of *Viola odorata*, 13 of which are novel sequences (Ireland *et al*., 2006). The aqueous preparations of *Viola odorata* flowering tops have anthocyanins (Karioti *et al*., 2011).

Two isoflavonoids, tectorigenin-7-O-β-D-glucoside and luteolin-7-O-β-D-glucurono pyranoside were isolated from ethyl acetate fraction of *Viola patrinii* fermentation extracts. (Bachheti *et al*., 2014). Sources of violae herba include *Viola patrinii*, *V. hederacea, V. arvensis and V. odorata*. Previous phytochemical studies of *Viola* species have reported the isolation of cyclotides and several flavonoid glycosides (Kim *et al*., 2010; Svangard *et al*., 2003; Carnat *et al*., 1998).

The *viola* is rich in secondary metabolites including, flavonoids, alkaloid (violin, v*iola* quercitin), essential oils including (ionones, *α*-ionone, β-ionone, β-dihydroionone, hydroquinone dimethyl ether and linolenic), extensively used in diuretic, anti-inflammatory, purogative properties, abdominal pain, skin disorders and upper respiratory complications (cough, sore throat and harash) (Svangard *et al*., 2004; Walter *et al.,* 2011). Abbasi *et al.* (2009) had discovered *Viola serpens* containing glycoside methyl salicylate, quercitrin, alkaloid, voiline gum, mucilage, sugar and saponin. Many research studies have been carried out to figure out the exact number of chemicals in *V. canescens*. Qualitative testing of ethanolic and methanolic extract of this plant revealed the presence of various compounds. The phytochemicals found in *V. canescens* include methyl salicylate, alkaloid violin, glycoside *viola* quercitrin, saponins and glucosides (Rana *et al*., 2010). An alkaloid was discovered by Dumas and Boullay (1828) in the roots known as violin which are similar to emetine (Fig. 3) but possessing different properties from emetine. It exists in the plant in combined form with malic acid. Some scientists believe that it is remarkably active and may be poisonous. The chemical constituents of *viola serpens* are alkaloids, saponins, tannins, amino acids, terpenoids, reducing sugars, glycosides and flavonoids (Kumar *et al*., 2011). It also contains volatile oils such as rutin, cyamin and saponin etc. (Kumar and Digvijay, 2014).

Viola odorata yields saponins, salicylates, alkaloids, flavonoids, saponins, tannins, phenolics and coumarins. Phenolic glycosides, gaultherin, violutoside, saponins, flavonoids and aodoratine (Salve *et al*., 2014). The literature survey of the genus *Viola* proved that a large number of pharmacologically active compounds have been isolated from different species. The genus *Viola* is

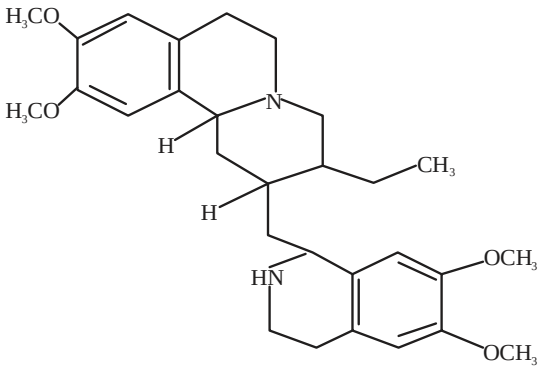

Fig. 3: Emetine

Table 4: Secondary metabolites of different species of the *Viola*

Plant	Isolated compounds	Reference
Viola etrusca	IsoViolanthin, (1→2)-[α-L-rhamnopyranosyl-(1→6)]-β-D-glucopyranoside], 4'-O-α-L-rhamnopyranoside ($C_{40}H_{52}O_{24}$)	Flamini (2007)
Viola odarata	2,2,6,6-Tetramethyl-4-piperidinone ($C_9H_{17}NO$)	Rodrigues *et al*. (2007) Ireland *et al*. (2006)
	Violacin A ($C_{129}H_{193}N_{33}O_{38}S_6$)	Svangard *et al*. (2004)
	Vitri peptide A ($C_{134}H_{215}N_{37}O_{39}S_6$)	Craik *et al*. (1999)
	Vodo peptide M	Svangard *et al*. (2004)
	Vodo peptide N	Svangard *et al*. (2003)
Viola cornuta	2-Hydroxybenzoic acid; O-[a-L-Arabinopyranosyl-(1®6)-b-Dglucopyranoside], Me ester ($C_{19}H_{26}O_{12}$)	Kanchanapoom (2007)
Viola hederaceae	CycloViolacin H_4 ($C_{133}H_{206}N_{34}O_{41}S_6$)	Chen *et al*. (2006)
	CycloViolacin H_2 ($C_{133}H_{201}N_{37}O_{38}S_6$)	Chen *et al*. (2005)
	CycloViolacin H_3 ($C_{129}H_{190}N_{36}O_{40}S_6$)	Craik *et al*. (1999)
	CycloViolacin H_1 ($C_{132}H_{208}N_{36}O_{40}S_6$)	
Viola hondoensis	4',5,7-Trihydroxy-6-methoxyisoflavone; 4',7-Di-O-b-Dglucopyranoside ($C_{28}H_{32}O_{16}$)	Moon *et al*. (2005)
Viola arvensis	Varv peptide A ($C_{116}H_{183}N_{35}O_{39}S_6$)	Svangard *et al*. (2004)
Viola tricolor	Violaxanthin; (all-*E*) ($C_{40}H_{56}O_4$)	Molnar *et al*. (2004)
	Vitri peptide A ($C_{134}H_{215}N_{37}O_{39}S_6$)	Craik *et al*. (1999)
	Varv peptide A ($C_{116}H_{183}N_{35}O_{39}S_6$)	Svangard *et al*. (2004)
Viola yedoensis	6-Arabinopyranosyl-4',5,7-trihydroxy-8-xylopyranosylflavone ($C_{25}H_{26}O_{13}$)	Chopin *et al*. (1982)
Viola cotyledon	*Viola cotyledon* cyclic peptides	Goransson and Craik (2003)
Viola prionantha	Prionanthoside ($C_{17}H_{18}O_{10}$)	Jakupovic *et al*. (1988)
Viola spp.	3,3',4',5,5',7-Hexahydroxyflavone; 3-O-[a-L-Rhamnopyranosyl-(1→6)-b -D-glucopyranoside], 7-O-a-L-rhamnopyranoside ($C_{33}H_{40}O_{21}$)	Henrick and Jefferies (1964)

a rich source of different classes of natural products like cyclotide alkaloids (Chen *et al*., 2005), flavonoids (Vukics *et al*., 2008a, b), caffeic acid, derivatives, salicylic acid (Toiu *et al*., 2008) and triterpenoids (Tabba *et al*., 1989) etc., the list of secondary metabolites is presented in Table 4.

CONCLUSION

From the above discussion, it is clear that the family Violaceae is an important plant family with respect to its ethnomedicinal importance. It is widely used in traditional health care system. So this importance builds a pressure on the plant regarding its use. So there is a need to conserve this plant family which is under threat according to the listing of IUCN (International Union for Conservation of Nature). So practical steps are needed for its conservation which include *ex situ* and *in situ* conservation. Much more work should be done on studies phytochemistry and essential oils. The structures and composition of different chemical components present in it should be determined for recognizing its further activities. This type of information is required for drug production from this plant for treating various diseases.

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