

PHYTOCHEMICAL SCREENING IN THE STEM AND LEAF OF *MYXOPYRUM SERRATULUM* A. W. HILL. (OLEACEAE)

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Abstract: This study aimed to evaluate the pharmacological importance of *Myxopyrum serratum* A. W. Hill. (Oleaceae) through the screening of phytochemical constituents. Preliminary phytochemical screening for alkaloids, phenols, coumarins, flavonoids, quinones, tannins, steroids, glycosides, saponins and triterpenoids was carried out in different solvent extracts of the stem and leaf of *M. serratum* by following standard procedures. Qualitative analysis on phytochemical constituents of the different solvent (benzene, ethanol, ethyl acetate, methanol and petroleum ether) extracts of the stem and leaf of *M. serratum* reveals the presence and also of absence of aforesaid phytochemical constituents which cause definite pharmacological actions on the human body.

Keywords - *M. serratum*, Traditional Medicine, Phytochemical Constituents, Screening of Phytochemical Constituents.

I. INTRODUCTION

There has been man's unending desire for good and healthy living since the time immemorial which has led to his curiosity to examine all aspects of his environment by trial and error (Dalziel, 1961). This gave rise to the traditional medicine practice which was the only way of saving life in the olden days before the advent of modern medicine as the earliest humans used various plants to treat illness (Ajiwe *et al.*, 2008). The World Health Organization (WHO) defines traditional medicine: "Traditional medicine is the sum total of the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness". The WHO notes, however that "inappropriate use of traditional medicines or practices can have negative or dangerous effects" and that "further research is needed to ascertain the efficacy and safety" of several of the practices and medicinal plants used by the traditional medicine systems (WHO, 2008). Traditional medicine that has been adopted by other populations (outside its indigenous culture) is often termed complementary or alternative medicine (CAM) (Gurib-Fakim, 2006).

Traditional medicine which is widespread throughout the world has been recognized by World Health Organization (WHO) as an essential building block of primary healthcare (Bannerman, 1982). World Health Organization has stated that 80% of the world's population depends on traditional medicine for its primary healthcare and has become indispensable for its survival (Hiremath and Taranath, 2013). Today, these traditional medicines are increasingly popular as cost effective alternative to, or complementary to, orthodox medicine (Tang and Haliwel, 2010). Nowadays, traditional medicinal practices form an integral part of complementary or alternative medicine (Park and Pezzutto, 2002).

Traditional medicine is widely used and accounts for about 40% of all healthcare delivered (WHO, 2002-2005). The use of traditional medicine is widespread and plants still present a large source of novel biological active compounds with different activities, including anti-inflammatory, anti-cancer, anti-viral, anti-bacterial and cardioprotective activities (Yan *et al.*, 2002). About 85% of traditional medicines are plant derived (Fransworth, 1988), and about 80% of population in developing countries still use plant based traditional medicine for their healthcare (Silva, 1997).

World Health Organization (WHO) (1976) describes a medicinal plant as any plant in which one or more of its organs contains substances that can be used for therapeutic purposes or which are precursors for

the synthesis of useful drugs. Medicinal plants are the richest bio-resource of traditional systems of medicine, modern medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drugs (Ncube *et al.*, 2008). Medicinal plants are now more focused than ever because they have the capability of producing many benefits to society indeed to mankind, especially in the line of medicine and pharmacological. The medicinal power of these plants lies in phytochemical constituents that cause definite pharmacological actions on the human body (Akinmoladun *et al.*, 2007). Phytochemicals, are non-nutritive plant chemicals that have either defensive or disease protective properties. They are nonessential nutrients and mainly produced by plants to provide them protection. They have tremendous impact on the healthcare system and may provide medical health benefits including the prevention and/or treatment of diseases and physiological disorders. Phytochemicals are divided into two groups, which are primary and secondary constituents; according to their functions in plant metabolism. Primary constituents comprise common sugars, aminoacids, proteins and chlorophyll while secondary constituents consists of alkaloids, terpenoids and phenolic compounds and many more such as flavonoids and tannins etc. Phytochemicals are naturally occurring in the medicinal plants, leaves, vegetables and roots that have defense mechanism and protect from various diseases (Krishnaiah *et al.*, 2007).

Phytochemicals are known to possess antioxidant (Wong *et al.*, 2009), antibacterial (Nair *et al.*, 2005), antifungal (Khan and Wassilew, 1987), anti-diabetic (Singh and Gupta, 2007; Kumar *et al.*, 2008a), anti-inflammatory (Kumar *et al.*, 2008b), and radioprotective activity (Jagetia *et al.*, 2005), and due to these properties they are largely used for medicinal purpose. The medicinal plants are useful for healing as well as for curing of human diseases because of the presence of phytochemical constituents (Nostro *et al.*, 2000). The medicinal value of plant lies in the bioactive phytochemical constituents of the plant which show various physiological effects on human body. So through phytochemical screening one could detect the various important compounds which could be used as the base of modern drugs for curing various diseases (Sheikh *et al.*, 2013). Plants contain many active compounds such as alkaloids, steroids, tannins, glycosides, volatile oils, fixed oils, resins, phenols and flavonoids which are deposited in their specific parts such as leaves, flowers, bark, seeds, fruits, roots, etc. The beneficial medicinal effects of plant materials typically result from the combination of these secondary products (Tonhubthimthong *et al.*, 2001).

During the last century, the practice of herbalism became popular throughout the world. In spite of the great advances achieved in contemporary medicine, plants still make a significant contribution to healthcare (Pour and Sasidharan, 2011). With the increasing recognition of herbal medicine as an alternative form of healthcare, the screening of medicinal plants for active compounds has become very significant (Meurer-Grimes *et al.*, 1996; Koduru *et al.*, 2006).

II. MATERIALS AND METHODS

2.1. Collection of Plant Specimen/Parts

Myxopyrum serratum A. W. Hill. (Oleaceae) commonly known as 'Chaturmallai' in Tamil is a twining woody climbing shrub mostly found in the evergreen forests of the Western Ghats. It is traditionally claimed to treat headache, asthma, cough, fever, nerves, otitis, rheumatism and wounds. In order to ensure the use of genuine and authentic material in the preparation of herbal formulations. pharmacognostical and phytochemical methods of standardization of the plant are necessary.

M. serratum was collected from Pechiparai panchayat (forest area) in Kalkulam taluk of Kanyakumari district in Tamil Nadu, India. The collected voucher specimen was identified taxonomically by referring to regional floras and authenticated by the Botanical Survey of India, Southern Circle, Coimbatore, Tamil Nadu, India. A voucher specimen of the collected plant was deposited in the Research Department of Botany, V. O. Chidambaram College, Thoothukudi, Tamil Nadu, India.

2.2. Preliminary Phytochemical Screening

2.2.1. Preparation of Extracts

Phytochemical screening was carried out to know about the qualitative existence of various phytochemical constituents (secondary metabolites) in the stem and leaf of *Myxopyrum serratulum*. The stem and leaf of *M. serratulum* were cut into small fragments and shade dried. The shade dried organs were powdered separately by using a blender and sieved to get uniform particles by using sieve No. 60. The powders of stem and leaf are extracted successively with 250 ml of various solvents such as benzene, ethanol, ethyl acetate, methanol and petroleum ether in a Soxhlet apparatus for 24h. All extracts were filtered through Whatman No. 41 filter paper separately. Five different solvent extracts were subjected to qualitative tests for the detection of (to check the presence or absence of) various phytochemical constituents as per the standard qualitative methods followed by Brinda *et al.* (1981). Screening for alkaloids, phenols, coumarins, flavonoids, quinones, tannins, steroids, glycosides, saponins and triterpenoids was carried out for the present study.

2.3. Qualitative Analysis of/Tests for Phytochemical Constituents

Test for Alkaloids

One ml of extract was treated with dilute hydrochloric acid and Mayer's reagent and observed for the formation of white precipitate.

Test for Phenols

To 1ml of extract, few drops of ferric chloride solution was added and observed for the formation of blue, green or purple colour.

Test for Coumarins

To 1ml of extract, few drops of alcoholic sodium hydroxide was added and observed for the formation of yellow colour.

Test for Flavonoids (Shindo's test)

One ml of extract was boiled with few magnesium turnings and few drops of concentrated hydrochloric acid for five minutes and observed for the formation of red or orange red colour.

Test for Quinones

One ml of extract was treated with few drops of concentrated sulphuric acid and observed for the formation of yellow colour precipitate.

Test for Tannins

One ml of extract was treated with few drops of basic lead acetate solution and observed for the formation of the white precipitate.

Test for Steroids (Liebermann-Burchard Test)

One ml of extract was treated with few drops of chloroform, acetic anhydride and a drop of concentrated sulphuric acid and observed for the formation of a series of colors (as pink to blue to green).

Test for Glycosides

Few ml of extract was mixed with a little anthrone and a drop of concentrated sulphuric acid on a watch glass. The mixture was gently warmed and observed for the formation of dark green colour.

Test for Saponins

Few ml of extract was shaken with water and observed for the formation of soapy lather.

Test for Triterpenoids (Noller's Test)

One ml of extract was warmed with a piece of tin and few drops of thionyl chloride and observed the formation of pink color.

III. RESULTS AND DISCUSSION

In the present study screening for alkaloids, phenols, coumarins, flavonoids, quinones, tannins, steroids, glycosides, saponins and triterpenoids which are considered as active medicinal chemical constituents is carried out in five different solvent extracts of the stem and leaf of *M. serratum*. Qualitative analysis on phytochemical constituents of the different solvent (benzene, ethanol, ethyl acetate, methanol and petroleum ether) extracts of the stem and leaf of *M. serratum* reveals the presence and also of absence of aforesaid phytochemical constituents (Tables 1 & 2).

Qualitative phytochemical screening/analysis of five different solvent extracts of the stem and leaf of *M. serratum* reveals the presence of alkaloids, phenols, coumarins, flavonoids, steroids, glycosides and triterpenoids. Three different solvent (ethyl acetate, methanol and ethanol) extracts of the stem and leaf of *M. serratum* are found to show a positive result for the presence of quinones. Similarly, two different solvent (methanol and ethanol) extracts of the stem and leaf of *M. serratum* are found to show a positive result for the presence of tannins and triterpenoids.

Presence of aforesaid phytochemical constituents considered as active medicinal chemical constituents strongly concludes the great potential of the selected plant *M. serratum* as a source of phytochemicals. The other compounds not analyzed in the present study may also exert a therapeutic action.

Alkaloid-containing plants have been used by humans since ancient times for therapeutic and recreational purposes (Aniszewski and Tadeusz, 2007). Medical use of alkaloid-containing plants has a long history, and, thus, when the first alkaloids were isolated in the 19th century, they immediately found application in clinical practice (Hesse and Manfred, 2002). Alkaloids are known for decreasing blood pressure, balancing the nervous system in case of mental illness and antimalarial properties (Ronan *et al.*, 2009). They often have pharmacological effects and are used as medications, as recreational drugs, or in entheogenic rituals. Examples are the local anesthetic and stimulant cocaine; the psychedelic psilocin; the stimulant caffeine; nicotine; the analgesic morphine; the antibacterial berberine; the anticancer compound vincristine; the antihypertension agent reserpine; the cholinomimetic galatamine; the spasmolysis agent atropine; the vasodilator vincamine; the anti-arrhythmia compound quinidine; the anti-asthma therapeutic ephedrine; and the antimalarial drug quinine (Springbob and Kutchan, 2009).

The phenolics under consideration are secondary plant metabolites characterized by having one (monophenolic) or more (polyphenolic) aromatic rings with one or more hydroxyl groups attached. Over 8000 different plant phenolics have been identified and they are widely distributed throughout the plant kingdom (Goldberg, 2003; Liu, 2004; Vecchia, 2004; Agarwal and Shishodia, 2006; Colomer and Menendez, 2006; Duthie, 2007). Many phenolic compounds have been reported to possess potent antioxidant activity and to have anticancer or anticarcinogenic/antimutagenic, antiatherosclerotic, antibacterial, antiviral, and anti-inflammatory activities to a greater or lesser extent (Baidez *et al.*, 2007; Han *et al.*, 2007). A large number of reports have demonstrated that these compounds are of great value in preventing the onset and/or progression of many human diseases (Parshad *et al.*, 1998; Lee *et al.*, 2000). Natural phenols have both anticarcinogenic-proapoptotic effect and a carcinogenic, DNA damaging, mutagenic potential. Some polyphenols, particularly from the flavan-3-ol (catechin-type), have both anticarcinogenic-proapoptotic and mutagenic effects (Strick *et al.*, 2000). Some natural polyphenols share the properties of some anticancer drugs such as etoposide and doxorubicin while other polyphenols may induce DNA mutations in the MLL gene, which are common findings in neonatal acute leukemia (Linden *et al.*, 2012). Over the past few years, investigations for phenolic compounds in medicinal herbs have gained importance due to their high antioxidative activity (Zhu *et al.*, 2004). Recent studies intensively support the role of polyphenols in the prevention of degenerative diseases, like cardiovascular affections and cancers

(Scalbert *et al.*, 2005). Consuming dietary polyphenols may be associated with possible reduction in inflammation such as in coronary artery disease (Muldoon and Kritchevsky, 1996).

Coumarins have shown some evidence of biological activity, but they are approved for few medical uses as pharmaceuticals. The reported coumarin activity includes anti-HIV, antitumor, antihypertension, antiarrhythmic, antiinflammatory, antiosteoporosis, antiseptic, and analgesic and also used in the treatment of asthma and lymphedema (Farinola and Piller, 2005; Liu, 2011). Studies have proven that coumarins possess anti-aging, and cardioprotective function. Studies have also shown that they function as blood diluting agent and also exhibits anti-fungicidal property (Rohini and Srikumar, 2014). Many coumarins have been isolated from the plant parts and reported to possess many pharmacological activities like anti-inflammatory and antipyretics, antioxidant, brochodialator, vasodialator, antiamoebic, antibacterial and antifungal activities (Asif, 2015).

Recently there has been an upsurge of interest in the therapeutic potential of medicinal plants which might be due to their phenolic compounds, specifically to flavonoids (Pourmorad *et al.*, 2006; Kumar and Pandey, 2012). Flavonoids are polyphenols produced during the secondary metabolism of plants. Plants containing them have been utilized in traditional medicine for a long time, without knowing the origin of their attributed virtues (Yamanaka *et al.*, 1996; Jhonson, 1999). Flavonoids have been reported to possess certain biological properties such as antibacterial, antitoxic and anti-inflammatory activities and often function as strong antioxidants, free radical scavengers and metal chelators (Davies, 1991). Functional hydroxyl groups in flavonoids mediate their antioxidant effects by scavenging free radicals and/or by chelating metal ions (Kumar *et al.*, 2013; Kumar and Pandey, 2013). Flavonoids can affect the functions of cells linked to inflammatory processes, acting on enzymes and pathways involved in anti-inflammatory processes

(Middleton Jr. *et al.*, 2000) and they have been shown to have a wide range of biological and pharmacological activities in *in vitro* studies. Examples include anti-allergic, (Yamamoto and Gaynor, 2001) anti-inflammatory, (Yamamoto and Gaynor, 2001; Cazarolli *et al.*, 2008) antioxidant, (Cazarolli *et al.*, 2008) anti-microbial and antibacterial, (Cushnie and Lamb, 2011; Manner *et al.*, 2013) antifungal, (Cushnie and Lamb, 2005; Friedman, 2007) and antiviral (Cushnie and Lamb, 2005; Friedman, 2007), anti-cancer, (De Sousa *et al.*, 2007; Cazarolli *et al.*, 2008) and anti-diarrheal activities (Schuier *et al.*, 2005).

Quinones are important naturally occurring pigments which are widely distributed and known to exhibit a variety of physiological activities as antimicrobial and anticancer compounds (Koyama, 2006). Natural or synthetic quinones show a biological or pharmacological activity, and some of them show anti-tumoral activity. They embody some claims in herbal medicine. These applications include purgative (sennosides), antimicrobacterial (rhein- and saporthoquinone, atovaquone), anti-tumor (emodin and jugone), inhibition of PGE2 biosynthesis (arnebinone and arnebifuranone) and anti-cardiovascular disease (tanshinone) (Liu, 2011). Depending on their redox state, quinones can act as both pro and anti-oxidants and their action in the mitochondria is highly dependent on their concentration. For example, deficiencies in ubiquinone-10 have been associated with the pathology of a diverse number of diseases, including encephalopathy, myopathy, male infertility, and nephrotic syndrome (Balercia *et al.*, 2009; Quinzii and Hirano, 2010; Villalba *et al.*, 2010). Due to their anti-oxidant effects, quinones are also currently being investigated as part of the treatment of head trauma (Kalayci *et al.*, 2011) and neurological diseases like Parkinson disease (Rakoczi *et al.*, 2009; Kerr, 2010), Huntington disease, (Hyson *et al.*, 2010) and Alzheimer disease (Yang *et al.*, 2010). Quinones have a potential role in modulating the ageing process (Soares *et al.*, 2011). Quinones are still being investigated for their antimalarial effect (Jacquerioz and Croft, 2009; Qu *et al.*, 2010). Anthraquinone compounds are used as laxatives mainly from their glycosidic derivatives and also used in the treatment of fungal and skin diseases (Li *et al.*, 2004.).

Tannins comprise a large group of natural products widely distributed in the plant kingdom (Haslam, 1998). Tannins are polyphenols sometimes called plant polyphenols (Haslam, 1989), although originally the name tannin was given to the plant extracts exhibiting astringency, without knowing their chemical structures. Tannins were once classified into two groups: pyrogallol type tannins

and catechol type (or catechin type) tannins, according to the polyphenol groups in their molecules. Then, the developments in tannin chemistry led to the renaming of these two groups to hydrolyzable tannins and condensed tannins (Okuda, 2005).

Although both types of tannin have been used to treat diseases in traditional medicine, the hydrolyzable tannins are generally considered as officinal in Europe and North America. They have been included in many pharmacopoeias, in the older editions in particular, and are specifically referred to as “acidum tannicum” or tannic acid. Few accounts with respect to the use of condensed tannins originate from China, where plant extracts containing these tannins as their major constituents are also applied as medicinal agents for the treatment of burns (Halkes *et al.*, 2001). The condensed tannins provide a novel therapeutic option for the major factors in the induction of Ulcerative Colitis (UC). They can modulate inflammation caused by food allergens and pathogenic microflora in the Gastro Intestinal (GI) tract. They help to return the altered GI microflora to a state of balance. They help to decrease the inflammatory cytokines in the colon that are problematic for UC patients who have a defect in mucin or an increase in intestinal permeability in the GI tract. Intestinal permeability in the colonic inflammation of UC can be treated with the condensed tannins. The condensed tannins can mitigate the damage that Matrix Metallo Proteinases (MMPs) inflict on the GI mucosal immunity in UC. Several classes of MMPs are responsible for the colonic damage in UC, and the use of condensed tannins can help to reduce their presence and inflammatory effects in the GI tract. The condensed tannins can decrease the effect that food allergens have on GI inflammation in UC (Clinton, 2009). Some groups of tannins act on arachidonic acid metabolism in leucocytes with important roles in reversing inflammations (Okuda, 2005) and they are used in treatments fostering wound healing. *In vitro*, tannins showed antiviral, (Lü *et al.*, 2004) antibacterial (Akiyama *et al.*, 2001) and antiparasitic effects (Kolodziej and Kiderlen, 2005). Studies have shown that tannins possess antidiarrhoeal (Rani *et al.*, 1999; Panizzi *et al.*, 2002; Kamijo *et al.*, 2008; Mbagwu and Adeyemi, 2008; Amabeoku, 2009; Carretero *et al.*, 2009; Sá *et al.*, 2009; Tian *et al.*, 2009) and antimicrobial activities (Dall'Agnol *et al.*, 2003; Corrales *et al.*, 2009).

Plant steroids are known to be important for their cardio tonic activities, possess insecticidal and antimicrobial properties (Callow, 1936). Many plants store chemicals in the form of inactive glycosides. These can be activated by enzyme hydrolysis which causes the sugar part to be broken off, making the chemical available for use. Many such plant glycosides are used as medications (Brito-Arias, 2007). Cardiac glycosides are organic compounds containing a glycoside (sugar) that act on the contractile force of the cardiac muscle. Because of their potency in disrupting the function of the heart, most are extremely toxic. These glycosides are found as secondary metabolites in several plants (Singh and Rastogi, 1970). More than a hundred cardiac glycosides have been identified as secondary metabolites in plants, with most belonging to the angiosperms (Melero *et al.*, 2000). Cardiac glycosides, also known as cardiotoxic steroids, are natural products with a steroid-like structure and an unsaturated lactone ring. They usually contain sugar moieties in their structure and have cardiotoxic activity. Several cardiac glycosides are used in cardiology for the treatment of cardiac congestion and some types of cardiac arrhythmias (Rahimtoola and Tak, 1996; Xie and Askari, 2002; Schoner and Scheiner-Bobis, 2007). *In vitro* and *ex vivo* experiments have revealed that some cardiac glycosides (e.g. digitoxin) induce potent and selective anticancer effects (Haux, 1999; Sreenivasan *et al.*, 2006; Hallböök *et al.*, 2011) which may occur at concentrations commonly found in the plasma of patients treated with these drugs (López-Lázaro *et al.*, 2005).

The presence of saponins has been reported in more than 100 families of plants out of which at least 150 kinds of natural saponins have been found to possess significant anti-cancer properties (Man *et al.*, 2010). Because of heterogeneity in their chemical structures, saponins always display anti-carcinogenic effects through varieties of anti-cancer pathways (Awasure *et al.*, 2012). Saponins in combination with conventional tumor treatment strategies result in improved therapeutic success (Man *et al.*, 2010). Saponins are glycosides of both triterpenes and sterols and are used as expectorant and emulsifying agent (Edeoga *et al.*, 2006). Saponins have been reported to possess anti-carcinogenic properties, immune modulation activities and regulation of cell proliferation as well as health benefits such as inhibition of the growth of cancer cells and cholesterol lowering activity (Davies, 1991). The occurrence of steroidal saponins from

numerous studies showed their importance and interest in pharmacy due to relationship with such compounds as sex hormones mostly in the development of female contraceptive pills. Additionally, saponin is used in medicine and pharmaceutical industries because of its foaming ability with the production of frothy effect (Okwu, 2003). There is evidence of the presence of saponins in traditional medicine preparations (Xu *et al.*, 1996; Asl and Hosseinzadeh, 2008) where oral administrations might be expected to lead to hydrolysis of glycoside from terpenoid (and obviation of any toxicity associated with the intact molecule).

Terpenoids are contained in many herbal plants, and several terpenoids have been shown to be available for pharmaceutical applications, for example, artemisinin and taxol as malaria and cancer medicines respectively. Various terpenoids are contained in many plants for not only herbal medicine use but also dietary use (Mo and Elson, 1999). Terpenoids have been found to be useful in the prevention and therapy of several diseases, including cancer, and also to have antimicrobial, antifungal, antiparasitic, antiviral, anti-allergenic, antispasmodic, anti-hyperglycemic, anti-inflammatory, and immunomodulatory properties (Wagner and Elmadfa, 2003; Sultana and Ata, 2008; Rabi and Bishayee, 2009; Shah *et al.*, 2009).

IV. CONCLUSION

It is assumed that a plant could demonstrate several therapeutic activities without necessarily having the compounds focused on the present study. Further study is recommended on other compounds on a road map of development of phyto-pharmaceuticals for disease management. The selected plant *M. serratum* may be a rich source of several other phytochemical constituents which can be isolated and screened for different kinds of biological activities on their reported therapeutic uses. The present study could be of help to develop new drugs based on traditional medicine for effective remedy of different human ailments.

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Table 1: Preliminary Phytochemical Screening of the Stem Extract of *Myxopyrum serratum*

Bioactive Components	Solvent Extracts				
	Petroleum Ether	Benzene	Ethyl Acetate	Methanol	Ethanol
Alkaloids	+	+	+	+	+
Phenols	+	+	+	+	+
Coumarins	+	+	+	+	+
Flavonoids	+	+	+	+	+
Quinones	-	-	+	+	+
Tannins	-	-	-	+	+
Steroids	+	+	+	+	+
Glycosides	+	+	+	+	+
Saponins	+	+	+	+	+
Triterpenoids	-	-	-	+	+

+ Indicates the Presence

- Indicates the Absence

Table 2: Preliminary Phytochemical Screening of the Leaf Extract of *Myxopyrum serratum*

	Petroleum Ether	Benzene	Ethyl Acetate	Methanol	Ethanol
Alkaloids	+	+	+	+	+
Phenols	+	+	+	+	+
Coumarins	+	+	+	+	+
Flavonoids	+	+	+	+	+
Quinones	-	-	+	+	+
Tannins	-	-	-	+	+
Steroids	+	+	+	+	+
Glycosides	+	+	+	+	+
Saponins	+	+	+	+	+
Triterpenoids	-	-	-	+	+

+ Indicates the Presence

- Indicates the Absence