

Pharmacognostical and phytochemical screening of an *Ayurvedic* Medicinal Plant '*Karunthakali*' (*Solanum rubrum* Mill)

Research article

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Abstract

The presence of phytochemicals and the medicinal value of the *Ayurvedic* medicinal plant *Karunthakali* or *Karimthakali* (*Solanum rubrum* Mill) is investigated in detail for the first time, both quantitatively and qualitatively. Phytochemical compounds are identified from the samples extracted from the leaf, root and seed of the plant, using standard methods. The ash values of the plant leaf are obtained. Alkaloids, flavanoids, anthronol glycosides, terpenes, carbohydrates, saponins and proteins are found present in this plant parts. Tanins, Free amino acids, Free Anthroquinone and Cartenoids are absent in this plant. Presence of high mineral content is the unique identification observed in this plant. The preliminary investigation of phytochemical study of this plant confirms qualitatively its antimicrobial, antiviral, antidiarrhoeal, anthelmintic and anticancer activity.

Keywords: Medicinal plants, *Solanum rubrum*, Phytochemicals, Extraction, pharmacology

Introduction

The ancient healing systems of India, *Ayurveda* and *Sidha*, are practiced even today worldwide. *Ayurveda*, which is based on the classical texts, *Charaka Samhita* and *Sushruta Samhita* were written around 1000BC. *Ayurvedic* drugs are used in crude forms like expressed juice, decoction, emulsion, apozems, liniments, electroactive and powdered. Medicinal herbs are the major ingredient in the formulation of *Ayurvedic* drugs prepared and used by ancient healers and which had remarkable advancement in leading a healthy life and even curing

diseases.

Due to the rich complement of phytochemicals and secondary metabolites, plants have been used as sources of medicament against various ailments since very early days. In rural areas where access to modern health facilities is limited by the level of development, plants remain the mainstay of the health care system.

The availability of modern scientific technologies made the medicinal plants having application in pharmaceutical, cosmetic, agricultural and food industry(1,2) and are considered to be chemical factory as they contain multitude of chemical compounds like alkaloids, glycosides, saponins, resins, sesquiterpene lactones and oils. Belewu(3) in agreement with Ijeh et al,(4) noted the growing interest on the medicinal properties of a number of common plants. With the onset of research, it was concluded that plants contain active principles, which are

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responsible for curative actions of the herbs.

Besides the roles played in human and animal nutrition, knowledge of proximate, phytochemical and micronutrient composition are fundamental to the understanding of modes of action of medicinal plants in general.

We therefore in this preliminary study, qualitatively and quantitatively analysed the phytochemical constituents of an *Ayurvedic* medicinal plant *Solanum rubrum* Mill, which is not yet studied, even though it has potential application in traditional practice of medicine.

The plant *Solanum rubrum* Mill, was identified in literature as a synonym for *Solanum nigrum*. In fact, *Ayurvedic* system pronounces these two plants differently, such as *Solanum nigrum* as 'Manathakkali' and *Solanum rubrum* as 'Karunthakali' or *Karimthakali*. Its phytochemical analysis yielded different results than other plants in the same family '*Solanaceae*'. A photograph of the plant is given in Fig.1., for identification.

Fig.1: *Solanum rubrum* Mill



It is a shrub, and which may be classified as a poisonous plant on the basis of traditional practice and use. It is available in Western Ghats of Peninsular

India which has much ecological significance and grows upto one feet to one meter height with dark green coloured leaves and the fruits are red or yellow in colour. Commonly, this plant is not in use nowadays for any purpose. In old palm leaves and manuscripts of *Ayurvedic* system it is mentioned that this plant can be used for skin diseases, and paralysis disease. With the structure and taste of the leaf, similar to ancient traditional identification of medicinal plants, we suspect that this plant has some more valuable medicinal characters. Hence for the first time, the phytochemical constituents of this plant are presented in this paper. The antioxidant activity of this plant parts were reported recently(6).

Aim and Objective

Ayurvedic drug forms such as *Kashaya*, *Gulika*, *Ghrita*, *Arista*, *Churna*, etc. are having their own bioactive nature depending upon the presence of active compounds in the respective plant parts used. In pharmaceutical industries the pharmaceutical aids like binding agent, flavouring agent, sweetening agents, and colouring agents are commonly used in *Ayurvedic* drug formulation. The scientific understanding of the influence of medicinal plants in curing ailment can be possible through the identification of presence of chemical compounds and hence the phytochemical analysis of medicinal plants became important.

Materials and Methods

Collection of plant and character identification:

Fresh plants are collected from Kanyakumari district, the southernmost part of India (8.29302Latitude & 77.21828 Longitude) during the month of August i.e., the fruiting season of the plant. The collected plants are washed well in fresh water and shadow dried. The leaves and root are separated and made into fine powder using mortar and pestle. The fruits

were collected from live plants and the seeds are separated and shadow dried. The shadow dried leaf powder was kept in a closed conical flask with solvents(1:10),(7,8), acetone, benzene, chloroform, ethanol, water, butanol, and ethyl acetate, separately and shook well for 10 min and kept at room temperature for 3 days. After 3 days the extract is filtered, and the filtrate was then dried under room temperature. The same procedure was followed for root and seeds. The ethnomedical information about the plant

is searched for and we couldn't trace any literature.

The physical character and the colour analysis of the plant parts are tabulated in Table 1&2. The powdered leaf samples are added with different reagents for behavioral analysis and the possible different chemicals present are identified (Table 3). The extraction values of solvents such as Water, ethanol, chloroform, ether, acetone, ethyl acetate, butanol and benzene are tabulated in Table 4.

Table 1: Characteristics of plant powder

Character	Leaf	Root	Seed
Colour	Dark Green	Pale Yellow	Brown
Taste	Characteristic	Characteristic	Characteristic
Odour	Characteristic	Characteristic	Characteristic

Table 2: Colour analysis of plant parts

Nature of Extraction	Colour perception under normal light			Consistency
	Leaves	Root	Seed	
Powder as such	Light green	Yellow	Brown	-
Water	Brown	Yellowish green	Yellow	Sticky
Ethanol	Dark green	Light Yellow	V.light Yellow	Sticky
Chloroform	Yellowish green	Yellowish orange	Yellowish orange	Resinous
Ether	Green	Pink	Light pink	Sticky
Acetone	Green	Light Yellow	V. light Yellow	Sticky
Ethyl acetate	Dark green	Light Yellow	V.light Yellow	Sticky
Butanol	Brownish green	Transperant Yellow	Transperant Yellow	Viscous
Benzene	Green	Yellow	colourless	resinous

Table 3: Behavior of the leaf powder of *S. rubrum* Mill with different chemical reagents:

Reagent	Colour/ precipitate	constituent
Picric acid	Yellow	Alkaloids present
Conc. H ₂ SO ₄	Dark yellow	Steroids/Triterpenes present
Aq.FeCl ₃	No change	Tannin absent
Ammonia solution	No change	Anthraquinone absent
Aq.AgNO ₃	Yellow ppt	Protein present
Aq.NaOH	Dark yellow	Flavonoids present

Aq. Lead acetate	No change	Tannin absent
Aniline+H ₂ SO ₄	yellow	Lignin
Aq. KOH	No change	Anthraquinone absent
Spot test	No stain	Fixed oil absent
Water shaken	Foam	Saponin present
Mg/HCl	Magenta	Flavonoids present
Mayer's reagent	yellow	Alkaloid present

Table 4: Extraction value of solvents

Type of solvent	Leaves %w/w	Root %w/w	Seeds %w/w
water	9.81	8.21	7.02
Ethanol	3.83	2.92	2.05
Chloroform	1.11	1.51	1.30
Ether	2.21	2.45	2.76
Actone	2.04	2.29	2.52
Ethyl acetate	1.70	1.51	2.48
Butanol	2.31	2.10	1.89
Benzene	1.54	2.07	1.38

Powder analysis

Total ash value:

5 gm powder was ignited in an electric furnace at 500- 550°C in silica crucible until the sample reaches a constant weight.

Water soluble ash value:

The water insoluble matter was collected in an ashless filter paper and ignited in an electric furnace at 450°C in silica crucible until it reached a constant value. The weight of water soluble ash was calculated by subtracting the weight of insoluble matter from the weight of the total ash.

Acid insoluble ash value:

Total ash obtained was heated with addition of 25 ml of dilute HCl for 10min. It was filtered in an ash less filter paper (Whatman No.41) and the residue was ignited in the furnace to get a constant weight.

Preliminary phytochemical screening of *S. rubrum* Mill.

Phytochemical screening were carried out for the extracts namely Water, Ethanol, Chloroform, Ether, Acetone, Ethyl acetate,

Butanol and Benzene and the powder as such, as per the standard methods(9-15).

Detection of alkaloids

Extracts were dissolved individually in dilute hydrochloric acid and filtered.

- A. *Mayer's test*: Filtrates were treated with Mayer's reagent (Pottassium Mercuric iodide). Yellow coloured precipitate was formed and which indicates the presence of alkaloids.
- B. *Wagner's test*: Filtrates were treated with Wagner's reagent (Iodine in potassium iodide). Brown precipitate formed indicates the presence of alkaloids.
- C. *Dragendroffs test*: Filtrates were treated with Dragendroffs reagent (solution of potassium bismuth iodide). Red precipitate formed indicates the presence of alkaloids.
- D. *Hager's test*: Filtrates were treated with Hager's reagent (saturated picric acid solution). Formation of yellow coloured precipitate confirmed the presence of alkaloids.

Detection of carbohydrates

Extracts were dissolved individually in 5ml distilled water and filtered. The filtrates were used to test the presence of carbohydrates.

A. *Molisch's test*: Filtrates were treated with 2 drops of alcoholic α - naphthol solution in a test tube. A violet ring was formed at the junction and which indicates the presence of carbohydrates.

B. *Benedict's test* : Filtrates were treated with Benedict's reagent and heated gently. Orange red precipitate formed indicates the presence of reducing sugars.

C. *Fehling's test*: Filtrates were hydrolyzed with dil.HCl, neutralized with alkali and heated with Fehling's A & B solutions. Formation of red precipitate indicated the presence of reducing sugars.

Detection of tannins

1gm of powdered sample was separately boiled with 20 ml water for five minutes in a water bath and was filtered while hot. 1 ml of cool filtrate was distilled to 5ml with distilled water and three drops of 10% ferric chloride. A brownish- green precipitate formed indicated the presence of tannins.

Detection of flavonoids

A. *Alkaline reagent test*: Extracts were treated with few drops of NaOH solution. Formation of intense yellow colour, which becomes colourless on addition of dilute HCl acid, indicated the presence of flavonoids.

B. *Lead acetate test*: Extracts were treated with few drops of lead acetate solution. A yellow colour precipitate was formed and which indicates the presence of flavonoids.

Detection of Saponins

A. *Froth test*: Extracts were diluted with distilled water to 20ml and which was shaken in a graduated cylinder for 15 minutes. A layer of foam of about 1cm was formed, which indicates the presence of saponins.

B. *Foam test*: 0.5 gm of extract was shaken with 2ml of water. The foam

produced persisted for ten minutes and it indicates the presence of saponins.

Detection of phytosterols

A. *Salkowski's test*: Extracts were treated with chloroform and filtrates were treated with few drops of conc. Sulphuric acid, shaken and allowed to stand. A golden yellow colour was appeared and it indicates the presence of triterpenes.

B. *Liebermann Burchard's test*: Extracts were treated with chloroform and filtered. The filtrate were treated with few drops of acetic anhydride, boiled and cooled. Then conc. Sulphuric acid was added. Formation of brown ring at the junction indicated the presence of pytosterols.

Detection of protein and amino acids

A. *Xanthoproteic test*: The extracts were treated with few drops of conc. Nitric acid. Formation of yellow colour indicated the presence of proteins.

B. *Ninhydrin test*: To the extract, 0.25% w/v Ninhydrin reagent was added and boiled for few minutes. Formation of blue colour indicated the presence of amino acid.

Detection of phenol

A. *Ferric chloride test* : Extracts were treated with 3-4 drops of ferric chloride solution. Formation of bluish black colour indicated the presence of phenol.

Detection of Diterpenes

A. *Copper acetate test*: Extracts were dissolved in water and treated with 3-4 drops of copper acetate solution. Formation of emerald green colour indicated the presence of diterpenes.

Detection of glycosides

Extracts were hydrolyzed with dil. HCl, and then subjected to test for glycosides.

A. *Modified Borntrager's test*: Extracts were treated with ferric chloride solution and immersed in boiling water for about 5 minutes. The mixture was cooled and extracted with equal volumes of

benzene. The benzene layer was separated and treated with ammonia solution. Formation of rose-pink colour in the ammonical layer indicated the presence of anthranol glycosides.

B. *Cardiac glycosides*: 5 ml of extract was treated with 2 ml of glacial acetic acid containing one drop of ferric chloride solution. This was underplayed with 1 ml of concentrated sulphuric acid. A brown ring at the interface indicated the deoxysugar characteristics of cardenolides. A violet ring appeared below the ring while in the acetic acid layer, a greenish ring was formed.

Detection of phlobatannins

Deposition of a red precipitate when an aqueous extract of the plant sample was boiled with 1 % aqueous hydrochloric acid was taken as evidence for the phlobatannins.

Detection of combined anthraquinones

1 gm of powdered sample of the specimen was boiled with 2 ml of 10% hydrochloric acid for 5 mins. The mixture was filtered while hot and filtrate was allowed to cool. The cooled filtrate was partitioned against equal volume of chloroform and the chloroform layer was transferred into a clean dry test tube using a clean pipette. Equal volume of 10% ammonia solution was added into the chloroform layer, shaken and allowed to separate. The separated aqueous layer was observed for any colour change. Delicate rose pink colour showed the presence of an anthraquinone.

Detection of free anthraquinones

5 ml of chloroform was added to 0.5 gm of the powder. The resulting mixture was shaken for 5 minutes after which it was filtered. The filtrate was then shaken with equal volume of 10% ammonia solution. The appearance of a bright pink colour in the aqueous layer indicated the presence of free anthraquinones.

Detection of carotenoids

1 g of each specimen sample was extracted with 10 ml of chloroform in a test tube with vigorous shaking. The resulting mixture was filtered and 85% sulphuric acid was added. A blue colour observed at the interface showed the presence of carotenoids.

Detection of fixed oils and fats

A. *Spot test*: A small quantity of extract was pressed between two filter papers. The observed oil stain on the paper shows the presence of fixed oil.

Detection of gums and mucilages

Extract was mixed with 10 ml distilled water and 25 ml of alcohol with constant stirring. A White precipitate formed indicates the presence of gums and mucilages.

Result

Plant material is composed of primary metabolism such as water, minerals, organic compound, protein lipid and carbohydrates, and secondary metabolism such as phenol, tannins, flavonoids, vitamin C & E. In order to establish the identity, purity, safety and quality of the plant, standardization is an important tool for the herbal drugs. In order to standardize a drug, various macroscopic, physiochemical and phytochemical analysis are to be performed.

As per the analysis performed on the *Solanum rubrum*, the physical contents such as total ash, acid soluble and water insoluble ash values give a specific identification to this plant since these values are much high compared to many other plants. The total ash of *Solanum rubrum* at 500-550°C is 24% which is very high and the acid soluble ash is 40%; the water insoluble ash is 78%, (with Loss on heat: 2%), which are the special characters as far as medicinal plants are concerned.

The phytochemical screening of leaf, root and seed of the plant revealed the presence of protein, carbohydrate,

reducing sugar, phenol, flavonoids, saponins and alkaloids (Table 5). The presence of these secondary metabolites suggests that the plant might be medicinal importance (16). It is found that the presence of Alkaloids, Flavanoids and Anthranol glycosides are high in the plant leaf, followed by Diterpene, Triterpene, Carbohydrates, Saponins and Protein (Table 6). (Depending upon the appearance of the darkness of the colour, the concentration of phytochemicals are identified as high, moderate and low). Flavanoids are phenolic compounds act as primary antioxidant or free radical

scavenger. Terpinoids act as regulators of metabolism and play a protective role as antioxidant. Saponins are glycosides of both triterpene and steroids having hypotensive and cardiodepressant properties. Tannins, free amino acid, free anthraquinone and Carotenoids are not identified. Whereas in root, only Alkaloids, Carbohydrates and Anthranol glycosides are present more than saponins and Diterpene (Table 7). The experiment on the seed shows only the presence of Alkaloids, Carbohydrates, Anthranol glycosides and phenolic compounds (Table 8).

Table 5: Preliminary phytochemical screening of *S. rubrum* Mill

Test	Reagent	Leaves	Root	Stem	Constituent
Alkaloids	Dragendroff test	+ve	+ve	+ve	Alkaloids present
	Mayer's test	+ve	+ve	+ve	
	Hager's test	+ve	+ve	+ve	
	Wagner's test	+ve	+ve	+ve	
Carbohydrates	Molish test	+ve	+ve	-ve	Carbohydrate present
	Felbling's test	+ve	+ve	-ve	Reducing sugar present
	Benedict's test	+ve	+ve	+ve	
Tannin	Aq. FeCl ₃ test	-ve	-ve	-ve	Tannin absent
	Alc. FeCl ₃ test	-ve	-ve	-ve	
Flavonoids	Lead acetate test	+ve	-ve	-ve	Flavonoids present
	Aq. NaOH	+ve	-ve	-ve	
Saponin	Foam test	+ve	+ve	+ve	Saponin present
	Froth test	+ve	+ve	+ve	
Phytosterols	Salowaski test	+ve	+ve	+ve	Triterpene present
	Libberman Brochad	-ve	-ve	-ve	Sterol present
Protein & Amino acid	Xanthoprotic test	+ve	+ve	-ve	Protein present
	Ninhydrine test	-ve	-ve	-ve	Free amino acid absent
Phenolic cpd	FeCl ₃	-ve	-ve	+ve	Phenol present
Diterpenes	Cuppr acetate	+ve	-ve	+ve	Diterpene present
Glycosides	Modified Borntrager's test	+ve	+ve	+ve	Glycosides present
	Legal's test	+ve	-ve	-ve	Cardiac glycosides absent
Phlobatanin		-ve	-ve	-ve	Phlobotannin absent
Combined & Free anthraquinon		-ve	-ve	-ve	Combined & Free anthraquinon absent
Carotenoides		-ve	-ve	-ve	Carotenoid absent

Gums & Mucilage	&	Water Alcohol	&	-ve	-ve	-ve	Gum & Mucilage absent
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Table 6: Detailed Phytochemical analysis of *S. rubrum* Mill. (Leaf)

Test	Water	Ethanol	Chloroform	Ether	Acetone	Et. Acetate	Butanol	Benzene
Alkaloids	+++	+++	+++	+++	+++	+++	+++	+++
Carbohydrate	+++	+	+++	+	+	-	++	-
Tannins	-	-	-	-	-	-	-	-
Flavonoids	+++	+++	+++	+++	+++	+++	+++	+++
Saponin	+++	+	+++	++	-	+	-	++
Phyto sterols	-	+	+	+	+	+	+	+
Protein	+++	+++	+	-	++	+++	-	+
Free amino acid	-	-	-	-	-	-	-	-
Phenolic cpd	-	++	-	-	-	-	+	+
Diterpene	+++	+++	-	+	+++	++	++	-
Anthranol glycosides	+++	+++	+++	+++	+++	+++	+++	+++
Free anthraquinone	-	-	-	-	-	-	-	-
Carotenoids	-	-	-	-	-	-	-	-
Gums & Mucillages	-	-	-	-	-	-	-	-
Triterpenoids	+++	-	++	+	+++	++	++	+++
Cardioic glycosides	-	-	-	-	-	-	-	-

+++ = high concentration; ++ = moderate concentration; + = low concentration; - = absent

Table 7: Detailed Phytochemical analysis of *S. rubrum* Mill. (Root)

Test	Water	Ethanol	Chloroform	Ether	Acetone	Et. Acetate	Butanol	Benzene
Alkaloids	+++	+++	+++	+++	+++	+++	+++	+++
Carbohydrate	+++	+++	+++	+++	-	+++	++	+++
Tannins	-	-	-	-	-	-	-	-

Flavonoids	-	-	-	-	-	-	-	-
Saponin	+++	+	++	-	++	+	-	+++
Phyto sterols	-	-	-	-	-	+	-	-
Protein	++	-	-	-	+	-	-	-
Free amino acid	-	-	-	-	-	-	-	-
Phenolic cpd	-	-	-	-	-	-	-	-
Diterpene	-	-	+++	-	-	-	-	-
Anthranol glycosides	+++	+++	+++	+++	+++	+++	+++	+++
Free anthraquinone	-	-	-	-	-	-	-	-
Carotenoids	-	-	-	-	-	-	-	-
Gums & Mucillages	-	-	-	-	-	-	-	-
Triterpenoids	+	+	+	+	+	+	+++	-
Cardiac glycosides	-	-	-	-	-	-	-	-

+++ = high concentration; ++ = moderate concentration; + = low concentration; - = absent

Table 8: Detailed Phytochemical analysis of *S. rubrum* Mill. (Seed)

Test	Water	Ethanol	Chloroform	Ether	Acetone	Et. Acetate	Butanol	Benzene
Alkaloids	+++	+++	+++	+++	+++	+++	+++	+++
Carbohydrate	+	+++	+++	+++	+++	+++	+++	+++
Tannin	-	-	-	-	-	-	-	-
Flavonoids	-	+	-	-	-	-	-	-
Saponins	+++	-	+	-	-	+	++	-
Phyto sterols	+	-	-	-	-	-	-	-
Protein	-	-	+	-	-	-	-	-
Free amino acid	-	-	-	-	-	-	-	-
Phenolic cpd	+++	+++	+++	-	-	-	-	-
Diterpene	-	-	+++	-	-	-	-	-
Anthranol	+++	+++	+++	+++	+++	+++	+++	+++

glycosides								
Free anthraquinone	-	-	-	-	-	-	-	-
Carotenoids	-	-	-	-	-	-	-	-
Gums & Mucillages	-	-	-	-	-	-	-	-
Triterpenoids	++	-	+	+	+	+	+	+++
Cardiac glycosides	-	-	-	-	-	-	-	-

+++ = high concentration; ++ = moderate concentration; + = low concentration; - = absent

Alkaloids, carbohydrates, anthranol glycosides are common in leaf, root and seed of the plant studied and tannin, free amino acid, free anthraquinone and Cardiac glycosides are absent in this plant parts. The activity and mechanism of action of the phytochemicals present in this plant are tabulated in Table 11, and the phytomedicinal value of the compounds found in this plant are discussed in the next section.

Table 9: Mechanism of action of Phytochemicals present in *Solanum rubrum*(17-25).

Phytochemicals	Activity	Mechanism of action
Flavonoids	Antimicrobial Antidiarrhoeal	Complex with cell wall, binds to adhesins, Inhibits release of autacoids and prostaglandins, Inhibits contractions caused by spasmogens, Stimulates normalization of the deranged water transport across the mucosal cells, Inhibits GI release of acetylcholine
Terpenoids	Antimicrobial Antidiarrhoeal	Membrane disruption, Inhibits release of autacoids and prostaglandins
Alkaloids	Antimicrobial Antidiarrhoeal Anthelmintic	Intercalates into cell wall and DNA parasites Inhibits release of autacoids and prostaglandins, Possess anti-oxidation effects, thus reduces nitrate generation which is useful for protein synthesis, suppresses transfer of sucrose from stomach to small intestine, diminishing the support of glucose to the helminthes, acts on CNS causing paralysis.
Polypeptides	Antiviral	Blocks viral fusion or adsorption, forms disulfide bridges
Sapponins	Antidiarrhoeal, Anticancer, Anthelmintic	Inhibits histamine release in vitro Possesses membrane permeabilizing properties Leads to vacuolization and disintegration of teguments.
Steroids	Antidiarrhoeal	Enhance intestinal absorption of Na ⁺ and water.

Discussion

The physio-chemical evaluation of drugs is an important parameter in detecting adulteration or improper handling of drugs. It can serve as a

valuable source of information and provide appropriate standards to establish the quality of the plant material in future study or application. Plant extract containing alkaloids, flavanoids, phenolic and /or

terpenes showing active trypanocidal activity(26). These compounds are potent bioactive compounds that could be used for therapeutic purpose or which are precursors for the synthesis of useful drugs(27).

Alkaloids are known to play some metabolic roles and control development in living system(28). These have protective role in human and animal and it is used in medicine especially the steroidal alkaloids which constitutes most of the valuable drugs. Though one of their biological property is cytotoxicity(29), alkaloids have analgesic(30,31), antispasmodic and antibacterial(32,33) properties.

Flavanoids are found to be useful in disease resistance(34). They are hydroxylated phenolic and they have been found to be antimicrobial substances against wide array of microorganisms in vitro. Their activity is probably due to their ability to complex with extracellular and soluble proteins and to complex with bacterial cell wall (35). They also are effective antioxidant and show strong anticancer activities(36-38).

The phenolic compounds are one of the largest and most ubiquitous groups of plant metabolites(39). They possess biological properties such as antiapoptosis, antiaging, anticarcinogen, antiinflammation, antiatherosclerosis, cardiovascular protection and improvement of endothelial function, as well as inhibition of angiogenesis and cell proliferation activities (40). The phenols are reported to inhibit alpha-amylase, sucrose, as well as the action of sodium glucose-transporter 1 (SGLUT-1) of the intestinal brush border. The polyphenol compound has antimicrobial and antifungal effect and has been used in disinfections.

Steroids have been reported to have antibacterial properties(41) and are important especially due to their relationship with compounds such as sex

hormones(42). Plant sterols could act as a natural preventive dietary product(43). It helps in the lowering plasma cholesterol and LDB cholesterol. Hence, it will assist in reducing drastically the morbidity and mortality caused by cardiovascular disease.

Saponins, which are known to produce inhibitory effect on inflammation(44) and has the property of precipitating and coagulating red blood cells. Crude saponins are having inhibition of glucose transport. Glycosides are known to lower the blood pressure (45).

The major parts of the medicinal plants used for various treatments are leaf, root and seed and to some extent flower and fruits. The pharmaceutical industry first extract the active ingredients before being used in the manufacturing of drugs, hence, discovering the evolution of drugs in the medicinal plants may highly useful for synthesis of new drugs.

The physico-chemical and phytochemical studies of *Solanum rubrum* yielded a set of qualitative and quantitative pharmaco-botanical parameters or standards that can serve as an important source of information to ascertain the identity and to determine the quality and purity of the plant material in future studies. However, in designing specific drugs, it is essential to isolate the bioactive fractions from these major groups.

Conclusion

For the first time, the phytochemical constituents of *Solanum rubrum* are identified qualitatively as a preliminary study. The presence of triterpenoids, saponin, steroids, flavanoids, carbohydrates and phenols show the high medicinal value of this plant as antimicrobial, antiviral, antidiarrhoeal, anthelmintic, and anticancer. The high ash value (both acid and water soluble) of this plant is a unique character identified, which suggest the higher availability of minerals in the plant leaves, and also

provides high probability of medicinal value.

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