2.1. MEDICINAL PLANTS

Discovery of curative powers in plants is an ancient plan. People on all continents have extensive practical poultices and imbibed infusions of hundreds, if not thousands, of indigenous plants, dating back to prehistory. Our ancient literature can also be tapped for information on medicinal plants. No authentic record of any kind except a few archaeological sculptures of Mohenjo-Daro is available from the premedical period in this country. But, Rig-Veda and Atharvaveda, which date back to 2000 to 1000 B.C. which are our oldest Vedic literature resources, contain valuable information regarding medicinal plants of that period.

These plant lives are now broadly used in ethno medicine approximately all over the world. In history, therapeutic results have been mixed; quite often cures or symptom relief resulted. Poisonings occurred at a high rate, also. At present, one-quarter to one-half of all pharmaceuticals dispensed in the United States have higher-plant origins, and very little are planned for use as antimicrobials, since we have relied on bacterial and fungal sources for these activities. Since the start of antibiotics in the 1950s, the use of plant derivatives as antimicrobials has been nearly nonexistent.

It is approximate that there are 250,000 to 500,000 species of plants on Earth (Borris, 1996). Relatively small percentages (1 to 10%) of these are used as foods by both humans and other animal species. It is probable that yet more are used for medicinal purposes (Moerman, 1996). Hippocrates (in the late fifth century B.C.) mentioned 300 to 400 medicinal plants (Schultes, 1978). In the first century A.D., Dioscorides wrote *De Materia Medica*, a medicinal plant catalog which became the prototype for current pharmacopoeias. The Bible offers images of approximately 30 healing plants. Indeed, frankincense and myrrh probably enjoyed their status of great worth due to their medicinal properties. Reported to have antiseptic properties, they were even used as mouthwashes. The fall of earliest civilizations forestalled Western advances in the understanding of medicinal plants, with much of the certification of plant pharmaceuticals being damaged or lost (Stockwell, 1988). During the Dark Ages, the Arab world sustained to excavate their own older works and to build upon them. Of course, Asian cultures were also demanding compiling their own pharmacopoeia. In the West, the Renaissance years saw a revitalization of ancient medicine, which was built mostly on plant medicinal.

2.2. MEDICINAL PLANTS EXTRACT

Extraction, as the term is used pharmaceutically, involves the separation of medicinally active portions of plant or animal tissues from the inactive or inert components
by using selective solvents in standard extraction procedures. The products so obtained from plants are relatively impure liquids, semisolids or powders intended only for oral or external use. These include classes of preparations known as decoctions, infusions, fluid extracts, tinctures, pilular (semisolid) extracts and powdered extracts. Such preparations popularly have been called galenicals, named after Galen, the second century Greek physician.

It was decided that extracts would be used fresh and not stored, as there is a possibility of loss of activity of certain extracts after cold storage. This is apparently due to chemical modification of active components or to their precipitation over time (Eloff, 1999). Discussions with a local traditional healer (Tucker, 2002-2004), confirmed this decision, and it was also suggested the plants be used fresh as opposed to dry, as many of the traditional healers in general prefer the fresh plant and much of the activity is lost if dried. Various methods have been used in studies to determine the antibacterial activity of plant extracts (Caceres, et al., 1993, Cos, et al., 2002, Somchit, et al., 2003 and Vlietinck, et al., 1995). These give information on the activity of extracts and have been used to isolate biologically active components or to evaluate whether the ethno botanical use of plants is justified (Eloff, 2000). The agar diffusion method expresses the results as the width of the inhibition zone produced by the plant extract (Eloff, 1999). Discs impregnated with the plant extract may be used (disk-diffusion) or a borer may be used to make a hole in the agar into which the plant extract will be placed (hole-plate method). It has been shown that these two methods give similar results (Obi, et al., 2002).

2.3. MICROORGANISMS

Scientific microbiologists have two reasons in relation to antimicrobial plant extracts. Primarily, it is very likely that these phytochemicals will discover their way into the store of antimicrobial drugs agreed by physicians; several are previously being tested in humans. It is reported that, on average, two or three antibiotics derived from microorganisms are launched each year (Clark, 1996). After a recession in that pace in current decades, the pace is once more quickening as scientists realize that the efficient life span of any antibiotic is limited. Worldwide expenses on discovery new anti-infective agents (including vaccines) are expected to increase 60% from the expenditure levels in 1993 (Alper, 1998). New sources, especially plant sources, are also being investigated. Secondly, the community is becoming more and more aware of problems with the over prescription and mistreatment of traditional antibiotics. In totalling, numerous people are involved in having more self-sufficiency over their medical
care. A massive amount of plant compounds (often of variable purity) readily exists over-the-counter from herbal suppliers and natural-food stores, and self-medication with these substances is commonplace. The exercise of plant extracts, as well as other alternative forms of medical treatments, has enjoyed vast attractiveness in the late 1990s. In the coming decade, just about one-third of people surveyed in the United States used at least one "unconventional" therapy during the previous year (Eisenberg, et al., 1993). It was surveyed that in 1996, sales of botanical medicines were greater than before 37% over 1995 (Klink, 1997).

A broad sheet of microbial pathogens linked with a diversity of skin infections has been built-in in the showing: the Gram-positive Staphylococcae and Streptococcae are causing wound infections, furuncles, carbuncles, abscesses, impetigo and erysipelas (Kohler, et al., 2001 and Madigan, et al., 2003). The Gram-negative Enterobacteria are fraction of the physiological intestinal flora. On the other hand, they may cause wound infections and sepsis on the exterior intestine (Kohler, et al., 2001 and Madigan, et al., 2003). Pseudomonas, one more Gram-negative rod, is a common pathogen of wound infections. Anaerobic Gram-negative rods may cause skin infections below certain conditions, i.e. in immunocompromised subjects (Kohler, et al., 2001 and Madigan, et al., 2003). The Gram-positive Corynebacteria and Propionibacteria are part of the physiological skin flora. However, Corynebacteria may cause opportunistic skin infections in immunosuppressed patients. Propioni bacterium acnes play an important role as causative agent in acne vulgaris (Kohler, et al., 2001). The yeasts *C. albicans* and *C. krusei* may occur in low frequency on skin and mucous membranes without causing symptoms. As opportunistic pathogens they may overgrow the normal skin flora and cause skin diseases like intertrigo and candidiasis in diabetics, adipose and immunodeficient subjects. The dimorphic yeast *Malassezia furfur* that is growing in skin areas rich in sebaceous glands is associated with the pathogenesis of seborrhoic eczema and dundruff (Faergemann, 2004 and Grigoriu, et al., 1984).

Mainstream medicine is ever more receptive to the use of antimicrobial and other drugs derived from plants, as conventional antibiotics (products of microorganisms or their synthesized derivatives) develop into ineffective, and as new, particularly viral, diseases remain obstinate to this type of drug. One heavier factor for the renewed interest in plant antimicrobials in the past 20 years has been the fast rate of (plant) species extinction (Lewis
and Elvin-Lewis, 1995). There is a sentiment among natural-products chemists and microbiologists alike that the multitude of potentially useful phyto-chemical structures which could be synthesized chemically is at risk of creature lost irretrievably (Borris, 1996). There is a technical discipline known as Ethno botany (Ethno pharmacology), whose goal is to exploit the impressive array of knowledge assembled by indigenous peoples about the plant and animal products they have used to retain health (Georges and Pandelai, 1949, Rojas, et al., 1992, Silva, et al., 1996 and Vanden Berghe, et al., 1986). Lastly, the ascendancy of the human immunodeficiency virus (HIV) has spurred intensive investigation into the plant derivatives which may be effective, especially for use in underdeveloped nations with little right to use to expensive Western medicines (For a comprehensive review of the search for new anti-HIV agents. (De Clercq, 1995)

Recently the minimum inhibitory concentration (MIC) of extracts has been determined by means of serial dilution methods (Fabry, et al., 1998). According to Eloff, (2000), many scientists did not determine the MIC values due to difficulties when the method was applied to plant extracts, mainly owing to the colour of the extract or the precipitation of compounds. Most of these difficulties have been overcome in a new micro-dilution method using 96-well microtitre plates. Tetrazolium salts are frequently used to indicate biological activity because the colourless compound acts as an electron acceptor and is reduced to a coloured compound by a biologically active organism (Eloff, 1998). With the use of INT (p-iodonitrotetrazolium violet) in the microtitre plate method, bacterial growth is indicated by red colour when the INT is reduced to formazan (Eloff, 2000).

This review describes the present state of plant antimicrobials, ranging from extracts commonly in use, largely by the lay community, to substances being prospected and tested by researchers and clinicians. These compounds potentially are effective in treating of skin infections, which are being caused by environmental pollution. An attempt is also made to summarize the current state of knowledge of relatively undefined herbal products, since clinicians in this country will encounter their use among patients.

2.4. **GYMNEMA SYLVESTRE** R. Br.

2.4.1. **Chemical constituents**

The preliminary phyto-chemical screening of the leaves of the plant revealed the presence of acidic compounds, flavonoids, phenols, saponins, tannins and triterpenoids (Rachh, et al., 2009). Malik, et al., 2008, reported the presence of steroids, triterpenoids and
saponin glycosides in the pet-ether extract of the leaves of the plant. Tannins and saponins are chief chemical constituents present in the plant (Kokate, 1999). The major bioactive constituent of the plant includes oleanane type triterpenoid saponins known as gymnemic acid (Nadakarni, 1976, Sinshheimer and Subbarao, 1970, 1971). It also contains flavones, anthraquinones, pentatriacontane, hentriacontanem resins, d-quercitol, tartaric acid, formic acid, butyric acid, lupeol, β-amyrin and its related glycosides and stigmasterol (Dateo and Long, 1986). The leaves of the plant contain triterpene classes of oleanane saponins (gymnemic acids, gymnemasapinons) and dammarene saponins (gymnemasides) (Liu, et al., 1992 and Yoshikawa, et al., 1992). The leaves also contain resins, albumin, chlorophyll, carbohydrates, tartaric acid, formic acid, butyric acid, anthraquinone derivatives, inositol alkaloids, organic acid, parabin, calcium oxalate, lignin and cellulose.

The major bioactive component, gymnemic acid contains several acylated (tigloyl, methylbutyroyl etc.) derivatives of deacylgymnemic acid (DAGA) which is the 3-O-β-glucuronide of gymnemagenin (3ß, 16ß, 21ß, 22α, 23, 28-h-hexahydroxy-olean-12-ene). The presence gymnemic acids, (+) quercitol, lupeol, (-) amyrin, stigma sterol have been reported from the plant. A new flavonol glycoside namely kaempferol 3-O-βD-glucopyranosyl-(1→4)-α-L-rhamnopyranosyl-(1→6)-β-D-galactopyranoside has also been reported in the aerial parts of the plant (Liu et al., 2004). Three new oleanane type triterpene glycosides i.e. β-O-benzoysltakisogenin 3-O-β-glucopyranosyl (1→3)-β-D-glucuronopyranoside, the potassium salt of longiospinogenin 3-O-β-D-glucopyranosyl (1→3)-β-D-glucopyranoside along with sodium salt of alternoside II were isolated from an ethanol extract of the leaves of the plant (Yew et al., 2001). Four new triterpenoid saponins, gymnemasins A, B, C and D isolated from the leaves of the plant, have been identified as 3-O-[β-D-glucopyranosyl (1→3)-β-D-glucopyranosyl]-22-O-tigloyl-gymnemanol, 3-O-[β-D-glucopyranosyl (1→3)β-D-glucopyranosyl]-gymnemanol, 3-O-β-D-glucuronopyranosyl-22-O-tigloyl-gymnemanol and 3-O-β-D-glucopyranosyl-gymnemanol respectively. The aglycone, gymnemanol, a new compound has been characterized as 3ß-16ß-22α-23, 28-pentahydroxyolean-12ene (Sahu, et al., 1996). Gymnestrogenin, a new penta hydroxytriterene from the leaves of the plant has been reported (Stocklin, 1968). Gurmarin isolated from the leaves of the plant acts as snit-sweetner in humans (Maeda, et al., 1989).

2.4.2. Pharmacological Activities

The ethanolic extract of the plant leaves demonstrated antimicrobial activity against B.subtilis, P.aeruginosa and S.aureus and inactivity against P.vulgaris and E.coli (Satdive, et.
In vitro antibacterial studies were carried out with the aqueous extract of the plant leaf powder and gymnemagenin on six human pathogenic bacterial strains. Results revealed that the extracts showed good inhibitory activity against all the tested pathogens. Leaf powder was found better in activity that gymnemagenin extract at the tested concentrations. The inhibitory activities were found dose dependent (Ahalya, et al., 2011). Khanna and Kannabiran, 2008, evaluated the saponin fractions from the leaves of the plant against pathogenic bacteria and fungi in in vitro conditions. The pure saponin fractions were found to be more effective against tested bacterial pathogens when compared to crude saponin fraction.

Ohmori, et al., 2005, assessed the antioxidant activity of the aqueous extract of different plants, including G. sylvestre, against 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radicals and LDL oxidation and observed a moderate activity of the plant. Kang, et al., 2012, examined the ethanol extract of the leaf of the plant, both in vitro and in vivo, and observed strong activity in the assays, including TBA, SOD-like and ABTS. Rachh, et al., 2009, studied the antioxidant activity of the alcoholic leaf extract in some in vitro antioxidant models like DPPH radical scavenging activity, superoxide radical scavenging activity, ferric reducing power and hydrogen peroxide scavenging activity. The extract showed a high antioxidant potential in all the assays. The plant extracts exhibited significant activity against DPPH scavenging assays, superoxide radical scavenging assay, inhibition of in vitro lipid per oxidation assays and protein carbonyl formation assay. The antioxidant activity shown by 55% v/v alcoholic extract of the plant may be due to the presence of flavonoids, phenols, tannins and triterpenoids found in the preliminary screening. In vivo studies have shown that upon treatment with the plant extract, the radiation (8 Gy)-induced augmentation in the levels of lipid per oxidation and depletion in glutathione and protein levels in mice brain have enhanced significantly. This radio protective efficacy of the plant may be due to its antioxidant properties. Some poly-herbal ayurvedic formulations like hyponid and dihar containing the plant extracts have shown antioxidant activity by increasing superoxide dismutase (SOD), glutathione (GSH) and catalyse levels in rats.

In the Ayurvedic system of medicine, the plant is referred to as “mesasrngi” and both the dried leaf and dried root are used therapeutically. The plant is acrid, anti-inflammatory, liver tonic, emetic, diuretic, stomachic, refrigerant and astringent. It is also used in hepatosplenomegaly, dyspepsia, constipation, jaundice, helmithiasis and amenorrhea.
The different pharmacological activities, carried out on this plant, include hypoglycemic activity (Srivastava, et al., 1986), adreno-hypophasial activity inhibition in rats (Gupta and Variyar, 1999), leishmanicidal activity of saponins isolated from the leaves (Khanna, et al., 2009), anti-inflammatory activity in rats (Malik, et al., 2008), hypolipidemic and anti-atherosclerotic activity (Bishayee and Chatterjee, 2006).

The leaves of the plant are used as antiviral, diuretic, antiallergic, hypoglycemic, hypolipidemic, for the treatment of obesity and dental caries (The Ayurvedic Pharmacopoeia of India, 2006). It is also used as antibiotic, in stomach pain, as a blood purifier and in rheumatism (Evans, 2002).

2.5. **ADIANTUM LUNULATUM** Burm. f.

2.5.1. Chemical constituents

In ‘*Ayurvedic Pharmacopoeia of India*’, 2006, out of hundred drugs, only one is of the fern (*A. lunulatum*). Ghosh, et al., 2009, estimated the total phenolic content of the ethanolic extract of the plant and also reported the presence of gallic acid. The plant is reported to contain the compounds, fern-9(11)-ene, fer-9(11)-en-25-oic acid, adiantone and new triterpenoid, 22, 29xi-epoxy-30-norhopane-13ß-ol (Reddy et al., 2001). Chlorophyll degradation products, carotenoids (Bohara et al., 1979), 22.29ψ-epoxy-30-norhopane-13ß-ol, fern-9(11)-en-6α-ol, fern-9(11)-en-28-ol, filicenol-B, adiantone and oxidation product of fern-9(11)-en-6α-ol obtained as 6-oxofern-9(11)-ene, 3ßacetoxy-6α-hydroxy-hop-15,17(21)-diene (Mukherjee, et al., 2003), flavonoids (Agarwal, et al., 1989), 6a-acetoxy-16b,22-dihydroxy-3-ketoisohopane. Atsragalin (kaempferol-3-glucoside), pruning ans isoquercetin is isolated from the plant. Mixture of esters, ketone, a diol, a nortriterpene-adiantone, a triterpene epoxide-adiantoxide isolated and characterized as 3α, 4α-epoxyflicane, astragalin, isoquercitrin, nicoiflorin, kaempferol-3-glucuronide, rutin and quercitrone is also isolated. Adaiantine, traces of 3-filicene and a new ketol-21-hydroxy-30-norhopane-22-one was isolated along with a triterpenoid keto-alcohol, α-carotene monoepoxide, leucopelargonidin, kaempferol and quercetin glucosides (Singh and Panda., 2005), isohopane-type triterpenoid (Kirtikar and Basu, 1989). Hopane-type triterpenoids, mollugogenol (Brahmachari and Chatterjee, 2002) was isolated from the plant. Isohopane-type terpenoid, 3ß-acetoxy-21αH-hop-22(29)-ene, was also isolated from the plant (Mukherjee, et al., 2001).
Isofernene (8-fernene), fernene, 7-fernene, 3-flicene, adiantone, a nortriterpenoid hemiktal-adipedatol, and filicenal has been isolated from leaves. Mithraja, et al., 2012, extracted the leaves of the plant with pet ether, ethyl acetate, methanol, chloroform, acetone, benzene and water, and it was observed the presence of phenols, saponins, tannins, xanthoproteins, and carboxylic acidcarbohydrates. Compounds such as, alkaloids, flavonoids, proteins, quinines, steroids and coumarins were found absent in all the leaf extracts of the plant.

2.5.2. Pharmacological Activities

Reddy, et al., 2001, evaluated the antibacterial activity of the plant and observed significant activity. The plant is reported to act as febrifuge (Nadkarni, 1976) and reduces burning sensation (Chopra, et al., 1985). The decoction of the whole plant is applied externally on the affected places to get relief from body pain. It is a good tonic (Khare, 2004) and is beneficial in wasting disease, atrophy (Karthik, et al., 2011), cachexy (Anis, et al., 2000) inflammatory diseases. It is said to possess antiseptic activity, hence beneficial in septic conditions (Karthik, et al., 2011). It is a well known remedy in bronchitis and asthma (The Wealth of India, 1982, Rahmatullah, et al., 2010 and Reddy, et al., 2006). It provides relief in whooping cough (Karthik, et al., 2011). It is used to cure typhoid. The decoction being drunk helps those who are troubled with shortness of breath (Anis, et al., 2000). The whole plant is pungent and used as antidysentric (Chatterjee and Pakrashi, 1994). The plant is well known remedy for elephantiasis (Anis, et al., 2000 and Kirtikar and Basu, 1989). The plant was reported for antidysentric, ulcer healing, antidiarrhoeal, antifungal (Rai, 1988), hypotensive (Sharma, et al., 1978), antibacterial (Reddy, et al., 2001) and abortifacient (Hosagoudar and Henry, 1993) activities. Antifungal and antibacterial activities of the plant pheolics are well established (Reddy, et al., 2006). Plant was also reported for its contraceptive properties (Kumar, 1998). Ethanolic extract of the plant showed strong antioxidant activity by inhibiting DPPH, hydroxyl, hydrogen peroxide and nitric oxide radicals and reducing power activities when compared with standard ascorbic acid. The result of this study shows that the ethanolic extract of the plant can be used; it is easily accessible source of natural antioxidant (Sawant, et al., 2009). Alcohol extract of the plant are found effective against E.coli, S.typhi (Pan, et al., 2011) and S. aureus (Pradeep and Leena, 2010). Plant paste is given to women to help them to conceive (Reddy, et al., 2001). It is found useful in cold inposhumes (purulent swellings or abscess) of the uterus (Reddy, et al., 2006). The whole plant is ground into paste with turmeric and applied over the affected places to
treat burns, infected wounds (Rout, et al., 2009) and sores (Karthik, et al., 2011). Juice of the fresh plant is applied to abscess and wounds for quick healing (Kumari, et al., 2011). Paste of the plant is applied over boils to burst (Yusuf, et al., 2007). It is a good emollient (Karthik, et al., 2011) and is also chewed for the treatment of mouth blisters (Khare, 2004). The herb, boiled in oil of chamomile, dissolves knots, allays swellings and dries up moisture from ulcers (Karthik, et al., 2011). It is used in bleeding diseases (Chopra, et al., 1985). It is used in bladdness and hairfall (Karthik, et al., 2011). The plant is one of the ingredients of the classical drug *Manasamitra vataka* prescribed for mental disorders (Khare, 2004). It is also used in convulsions (Reddy, et al., 2006) and epileptic fits (Chopra, et al., 1985). It is used as an antidote in snake bites (Anand and Srivastava, 1994 and Chatterjee and Pakrashi, 1994, Kaushik and Dhiman, 1995) and also as an antidote for rabid dog’s bite (Anis, et al., 2000).

The seeds are prescribed externally in suppurations due to poisonous bites (Karthik, et al., 2011). With *Asparagus racemosus* it is used in gonorrhoea (Anis, et al., 2000).

The fronds are used against cough and cold. It is a good expectorant (Anand and Srivastava, 1994) the decoction of the rhizome is given in throat affections and also used for febrile conditions in children (Anis, et al., 2000, The Wealth of India, 1982). Leaf and root decoction is used for the treatment of chest ache (Karthik, et al., 2011) and other chest complaints (Rout, et al., 2009). Leaves, ground with cow’s milk, are given to children for diarrhoea due to indigestion. It is a good carminative and is used in bilious complaints (Rout, et al., 2009). The fern is boiled in wine and drunk in cases of affections of spleen, liver and other viscera. It is also beneficial in yellow jaundice, diseases of spleen and stops fluxes in the stomach (Karthik, et al., 2011). It is also said to be a good demulcent (Anand and Srivastava, 1994). It is used in muscle pain, sprain and rheumatic conditions. It is used to treat bone fractures (Karthik, et al., 2011). The fronds made into plaster are applied to chronic gouty and other swellings and also in chronic tumours (Joshi, 2008). Fresh leaf decoction is given to cure irregular menstrual cycle. Fruits and leaves are beneficial in leprosy and erysipelas (Chopra, et al., 1985 and Nadkarni and Nadkarni, 1976). Leaf juice is given in ulcers and burning sensation (Kumari, et al., 2011). The frond extract mixed with honey is used as an eye ointment (Anand and Srivastava, 1994).

The nasal drops prepared by boiling the root in oil, are installed in nose as a decongestant in hoarseness of voice. The rhizome of the plant is used to treat strangury (Anis, et al., 2000 and Chopra, et al., 1985). Roots are considered diuretic and are used in dysurea...
and help exceedingly to break the stone in the kidneys (Karthik, et al., 2011). Rhizome is used to reduce glandular swellings (Reddy, et al., 2006).

2.6. **BRYonia laciniosa l.**

2.6.1. Chemical constituents

The plant is known to contain cucurbitacins (Sivakumar, et. al., 2005). Phytochemical studies have resulted in the isolation of compounds honiothalamin, bryonin, punicic acid and lipids from the plant (Mosaddik, et al., 2000 and Singh, et al., 2006).

The whole plant extract exhibited the presence of goniothalamin, punicic acid and lipids (Gupta, et al., 2003).

2.6.2. Pharmacological Activities

Antimicrobial activity of ethanolic extract of leaf, stem, seed and fruit of the plant was tested against different pathogenic microorganisms. Leaf and stem extracts exhibited antimicrobial activity against different gram positive and negative bacteria, which was comparable to the standard antibiotics (Ehsan, et al., 2009).

In India the plant is commonly used as an aperients medicine and tonic. Whole plant is used to treat adenopathy, ague, asthma, bronchitis, carbuncles, cholera, colic, constipation, convulsions, cough, delirium, fertility, headache, megalospleney, paralysis, phthisis, snake bite. The chloroform extract of the plant has exhibited significant anti-inflammatory activity (Gupta, et al., 2003). Analgesic and antipyretic activity of methanol extract of the plant also has been shown in standard animal models (Sivakumar, et al., 2004).

The plant in particular is used for the treatment of cancer among tribal populations of south India (Sivakumar, et al., 2005). Recent investigations on the plant have shown good activity of pet ether, chloroform and ethyl acetate extracts against growth and multiplication of brine shrimp (Mosaddik, et al., 2000). The goniothalamin isolated from the whole plant has shown substantial antimicrobial and an antifungal activity against a wide range of Gram negative bacteria and fungi (Mosaddik, et al., 2003). Significant anti-inflammatory activity of chloroform extract of the plant has also been reported in experimental animal models of acute and chronic inflammation by Gupta, et al., 2003.

Traditional healers use the leaves and the seeds of the plant for treatment of fevers. It is also taken in impotency and used as a tonic. Antioxidant and antitumor role of methanol
extract of the leaves have been demonstrated in animal models (Sivakumar, et al., 2005). An analgesic and antipyretic activity in animal models has also been exhibited by methanol extract of its leaves (Sivakumar, et al., 2004). Reddy, et al., 2010, studied the plant to ascertain the anti-asthmatic, analgesic and anti-convulsant activities. The anti-asthmatic activity was estimated by mesenteric mast cell count by atopic allergy method. Eddy’s hot plate and analgesiometer tests were used to assess the analgesic activity. Anticonvulsant activity was evaluated by maximum electroshock-antiasmatic activity, analgesic activity and also anticonvulsant activity. The plant a significant activity against all the tests performed. The plant has been reported for its anti-inflammatory activity (Gupta, et al., 2003). Suruse, et al., 2009, tested the plant extracts on albino rabbit skin for deducing the anti-inflammatory activity of the plant and observed significant activity.

2.7.  **TECTONA GRANDIS** L. f.

2.7.1.  Chemical constituents

The phytochemical analysis of the leaves of the plant has been reported to contain tectoquinone, lapachol, deoxylapachol and its isomer tectoleafoquinone, anthraquinone – naphthaquinone pigment. The analysis of the steroidal compounds exhibited the presence of aqualene, polyisoprene-α-tolyl methyl ether, betulinic acid, tecto grandone, monoterpene and apocartotenoids. Also, tectoionol-A and tectoionol-b were found. Furthermore, the presence of anthraquinone glycosides was reported. The major phenolic acids reported in the leaves were tannic acid, gallic acid, ferulic acid, caffeic acid and ellagic acid. Rutin and quercetin were the major flavonoids observed in the leaves. The leaves of the plant have also been reported to contain carbohydrates, alkaloids, tannins, sterols, saponins, proteins, calcium, phosphorus, crude fibre and dye (yellowish-brown or reddish) (The Ayurvedic Pharmacopoeia of India, 2006, Goswami, 2009, Krishnan, 2006, Majumdar, et al., 2007 and Nayeem and Karvekar, 2010). Nayeem and Karvekar, 2010, extracted the leaves of the plant with methanol and observed the presence of gallic acid, ellagic acid, rutin and quercetin.

Roots of the plant have been reported to contain lapachol, tectol, tectoquinone, β-sitosterol and a diterpene, tectograndinol (Atkinson, et al., 2001).

Goswami, et al., 2010, extracted the bark of the plant with a number of different solvents viz, pet ether, ethyl acetate, ethanol and distilled water for studying the phytochemistry of the plant. Carbohydrates, proteins, amino acids, steroids, glycosides, saponins, flavonoids, alkaloids and tannins were observed in the various extracts. Karnik, et
al., 1970, analysed the barks of a number of different plants, including *T.grandis*, for the presence of tannins, ash, cold- and hot-water soluble, ether extract, alcohol/benzene extract, pentosans, lignin and chlorite holocellulose on an oven-dry basis.

A new compound was isolated from the plant, abeograndinioc acid and its structure showed that this compound has an unusual carbon skeleton. A further 21 known terpenoids – including four sesquiterpenoids, 8 diterpenes and 9 triterpenes – were also isolated (Macias, *et al*., 2010).

### 2.7.2. Pharmacological Activities

Methanol extract of the plant was found inhibitory to *L.monocyogenes* and methicillin resistant *S.auresu* (MRSA) by means of disc diffusion method. The inhibitory compound was identified as 5-hydroxy-1, 4-maphthalenedione (juglone) (Neamatallah, *et al*., 2005). The antifungal activity of the methanolic crude extract of a number of plants, including *T.grandis*, was evaluated against *Alternaria cajani*, *Curvularia lunata*, *Fusarium sp.*, *Bipolaris sp.* and *Helminthosporium sp.* The plant exhibited a moderate activity among the selected plants, against all the microorganisms tested (Srivastava, 2009).

Antibacterial activities of all extracts from the plant were checked against *S.paratyhi* and *P.mirabilis* by disc diffusion assay. Chloroform extract of the leaf showed inhibition to the growth of *S.aureus* and *K.pneumoniae* (Krishna and Nair, 2010).

The wood of the plant is used traditionally as sedative, anthelmintic. It is used for curing piles, in the treatment of gravid uterus, leucoderma, dysentery, headache, burning pain over liver region, anti-inflammatory, anodyne, vermifuge, ophthalmic, deurative, laxative, vitiated conditions of pitta and kapha, neuralgia, arthritis, dyspepsia, flatulence, cough, skin diseases, leprosy, hyperacidity, menorrhagia, leucorrhoea, abortion, hemorrhoids, antibilious and lipid disorders. Paste made from the wood is used as diuretic, stimulant, hepatic, astringent, relief from tooth ache. Wood ash is applied to the swollen eyelids to strength the eye sight. Oily product obtained from the wood chips is applied to eczema. Roots of the plant are used in the treatment of anuria and urine retention.

The extract of leaves of the plant is widely used in the folklore for the treatment of various kinds of wound, especially burn wound (Sumthong, *et al*., 2006). Leaves of the plant have been used in the treatment of thatching, haemostatic, depurative, anti-inflammatory,
vulnerity, leprosy, skin diseases, puritus, stomatities, indolent ulcers, hemorrhages, Haemoptysis, vitiated conditions of pitta. Further it was reported that the methanolic extract of the leaves showed significant wound healing, analgesic and anti-inflammatory activity (Majumdar, et al., 2007, Nayeem and Karvekar, 2010).

Seeds of the plant are used as diuretic, emollient, demulcent, skin diseases, prurities and in vitiated conditions of vata. Oil obtained from the seeds of the plant promotes growth of hair and is useful in eczema, ringworm and to check scabies.

Bark of the plant is used in the treatment of bronchitis, constipation, anthelmentic, depurative, hyperacidity, dysentery, verminosis, burning sensation, diabetes, leprosy, skin diseases, leucoderma, headache, piles, laxatives, expectorant, anti-inflammatory, indigestion; it expels worms from the body in vitiated conditions of pitta.

The flowers of the plant are used in the treatment of bronchitis, biliousness, urinary discharge, diuretic, depurative, anti-inflammatory, burning sensation, dipsia, leprosy, skin diseases, strangury diabetes and vitiated conditions of pitta and kapha. Oil obtained from the flowers promotes growth of hair and useful in scabies, eczema. Infusion of flowers is taken in congestion of liver.

Fruits of the plant are used in the treatment of diuretic, demulcent, strangury, vesicle calculi, pruritus, stomatitis. All parts of the plant, seeds, slowers, fruits, wood, bark, root and leaves are useful either alone or along with other plants for many applications (Khare, 2007, Kirtikar and Basu, 2006, Krishnan, 2006, Nadkarni and Nadkarni, 1908 and Longman, 1996).

Extracts from various parts of the plant show expectorant, anti-inflammatory, anthelminthic properties, and are also used against bronchitis, biliousness, hyperacidity, dysentery, diabetes, leprosy, astringent, anthelmintic and dysentery. In traditional medicine, a wood powder paste has been used against bilious headache and swellings. They are also used for treating inflammatory swelling (Varier, 2007, Khare, 2007). According to Ayurveda, the wood of the plant is acrid, cooling laxative sedative to gravid uterus and useful in treatment of piles, leucoderma and dysentery. It allays thirst and possesses anthelmintic and expectorant properties (Singh, et al., 1996). The plant has been reported to be used in the treatment of urinary discharge, bronchitis, common cold and headache, as a laxative, sedative, diuretic and in scabies.
2.8. **VIOLA ODORATA L.**

2.8.1. **Chemical constituents**


Karioti, *et al.*, 2011, developed a method based on liquid chromatography with diode array detection coupled to an electro spray ionization interface for the determination of the constituents in the aqueous preparations of the plant flowering tops. The characteristic constituent of the flowering tops was found to be anthocyanins. Presence of complex flavones glycosides was observed. The essential oil composition of the flowers of the plant was investigated by GC/MS and presence of phenyl butanone, linalool, benzyl alcohol, α-cadinol, globulol and viridiflorol was reported (Hammami, *et al.*, 2011). Toiu, *et al.*, 2008, analysed the tinctures of air-dried flowering aerial parts of the plant and reported the presence of flavonoids, polyphenol carboxylic acids and salicylic acid. The flowers of the plant contain the odorous principle, blue coloring matter and sugar, a glucoside. *Viola*-quercetin is found throughout the plant. Salicylic acid (natural aspirin) has also been obtained from this plant (Jackson and Bergeron, 2005). Flowers of the plant are reported to contain anthocyanins, flavonols, mucilage and ash (Lamaison, *et al.*, 1991).

Elemental analysis showed the presence of C, O, Na, Mg, Al, Si, Cl, K, Ca, and Fe in different parts of the plants. Excepting Al in leaves, Fe in petiole and leaves, all the remaining parts have all the analysed minerals in varying concentrations. Na was found to be present only in roots (Samra, *et al.*, 2006). Essential oil composition of the leaves of the plant was determined after extracting by hydro-distillation-solvent extraction method. The analysis
revealed the presence of 25 identified compounds, with butyl-2-ethylhexylphthalate and 5, 6, 7, 7a-tetrahydro-4, 4a-trimethyl-2(4H)-benzofuranone being the 2 main components (Akhbari, et al., 2012).

Ireland, et al., 2006, determined the cyclotide content in the roots and aerial parts of the plant. 30 different cyclotides were identified, of which 13 were novel.

2.8.2. Pharmacological activities

Tea made from the entire plant is used to treat digestive disorders and research has detected the presence of glycoside of salicylic acid (natural aspirin) which substantiates its use for centuries as a medicinal remedy for headache, body pains and as a sedative (Hammami, et al., 2011). The aerial parts of the plant are used in traditional medicine for their anti-inflammatory, expectorant and diuretic properties, for treating skin conditions, bronchitis, cystitis, rheumatism (O’Neill, et al., 1997, Eden, et al., 1996, Yourman and Jeffers, 1999, Mekki, et al., 2006 and Li, et al., 2004). The anti-inflammatory activity is related to depurative and anti-allergic effects because some of the skin conditions can be caused by inflammation. Anti-inflammatory properties are ascribed to salicylic derivatives, rutin and can be enhanced by saponins (Kim, et al., 2007). The whole aerial part of the plant including stem, flowers and leaves are used in bronchitis, cancer, cough, fever, urinary infections, rheumatism, sneezing and kidney and liver disorders (Karnick, 1996 and Kloss, 2001). Usual form of the preparation is syrup made from the petals of the flower. An infusion is given as a cooling mixture in fever (Nadkarni, 1976). The plant was investigated for cytotoxicity and reported as pharmacological tool to antitumor agents (Lindholm, et al., 2002). Furthermore, it is demonstrated that the plant showed a significant oral antipyretic activity in rabbits (Khattak, et al., 1985). Antil, et al., 2011, evaluated the analgesic effects of the hexane, butanolic, methanolic and aqueous extract of the plant. The results showed that only the aqueous and methanolic extract of the plant had significant analgesic effect on the central nervous system. The cyclotide cycloviolacin O₂ isolated from the plant exhibited high efficiency in inhibiting the growth of *S.enterica*, *E.coli*, *K.pneumoniae* and *P.aeruginosa*. In contrast, no activity was observed against *S.aureus* (Pranting, et al., 2010). The aqueous extract of the plant inhibited the growth of *E.coli* (Khatibi, et al., 1989). The plant is traditionally believed to relieve the pain due to cancer (Kapoor, 1990). In traditional system, it has been used in anxiety (Keville, 1991), insomnia and lowing the blood pressure (Duke, 2002).
Medicinal and edible, the flowers and leaves of the plant are made into a syrup used in alternative medicine mainly for respiratory ailments associated with congestion, coughing and sore throat (Hammami, et al., 2011). The essential oil and the methanol extract of the flower of the plant were tested for antifungal activity against *Botrytis cinerea*. The oil showed strong antifungal activity against the pathogen (Hammami, et al., 2011). A decoction made from the root (dry herb) is used as laxative (Hammami, et al., 2011).

Antioxidant and antibacterial activities of the oil of the leaves of the plant and also the methanol and chloroform extracts of the leaves were evaluated by Akhbari, et al., 2012. They observed a significant activity of the plant.

2.9. **DASHMOOL**

2.9.1. **Chemical constituents**


2.9.2. **Pharmacological activities**

In the Ayurvedic system of medicine the preparation is used as analgesic, antiarthritic, against cough, rheumatism (Anonymous, 1992). Khan, et al., 2004, studied the bioactivity of the aqueous extracts of the individual components of dashmularishta. *A. marmelos* exhibited severe toxicity against brine shrimp assay, wheat rootlet growth inhibition bioassay and lettuce seed germination (LSG) bioassay, but no activity revealed against PPR and Reo virus in vitro cell line. *O. indicum* exhibited moderate toxicity against brine shrimp (BST) and wheat rootlet growth (WRG), but it showed no activity against LSG and didn’t inhibit PPR and Reo viral growth. *S. suaveolens* exhibited severe toxicity to the BST and LSG, but it is not to WRG. Although it inhibited the growth of Reo virus, but no effect of was observed on PPR virus. *P. integrifolia* showed severe toxicity to BST, but not toward WRG and LSG. Besides PPR and Reo virus were also not sensitive towards it. The *G. arborea* exhibited severe toxicity to the BST and WRG, but not against LSG. It exhibited no inhibition to the growth of PPR and Reo virus. *S. xanthocarpum* was mildly toxic against BST, WRG, LSG and Reo virus. *S. indicum* was inactive against BST, WRG and LSG, but was found active against PPR virus. *D. gangeticum* showed no toxicity to BST, but was observed moderately active against WRG, LSG and PPR virus. *U. lagopoides* showed no toxicity to BST, WRG, LSG and Reo virus. *T. terrestris* was found inactive against BST, but was moderately active against WRG, LSG and PPR and Reo virus.
2.10. **SOLANUM XANTHOCARPUM** SCHRAC&WENDLE

2.10.1. Chemical constituents

Poongothai, *et al.*, 2011, reported the presence of chlorophyll, carotenoids, sugars, proteins, amino acids and minerals in the methanolic extract of the leaves of the plant. Chemical examinations of berries of the plant were initially done by Saiyed and Kanga, 1936, which led to the isolation of glycoalkaloid, solasonine. From the non-alkaloidal portion, a glycoside of β-sitosterol with galactose as a sugar moiety was obtained along with two phenolic substances, which could be identified as methyl caffeate and caffeic acid (Siddiqui, *et al.*, 1983). The fruits were reported to contain several alkaloids like solanacarpine (Gupta and Dutt, 1938) and solamargine (Siddiqui, *et al.*, 1983). Other constituents like caffeic acid coumarins like aesculetin and aesculin (Tupkari, *et al.*, 1972), steroids carpesterol, diosgenin, campesterol, daucosterol ad triterpenes like cycloartenol and cycloartenol were reported from the fruits (Sato and Latham, 1953). The fruit of the plant contain saponins which could extract in alcohol and had a heart-stimulating function (Josekutty, 1998). The detailed study on this plant resulted in the isolation of solaasonine and solasodine (Saiyed and Kanga, 1936), β-sitosterol (Sato and Latham, 1953) and carpesterol (Heble, *et al.*, 1968). The fruits contained 20.71% of dry seeds, 4.62% of pericarp and 74.67% of moisture. The powdered seeds were extracted with benzene and yielded 19% of greenish-yellow oil which did not contain nitrogen and sulphur. The composition of the oil was calculated as oleic acid, linoleic acid, palmitic acid, steric acid, arachidic acid and unsaponifiable matter (Gupta and Dutt, 1938). The plant has a high concentration of solasodine alkaloid, a spiroketal alkaloid sapogenin with a heterocyclic nitrogen atom, which is the starting material for the manufacture of cortisone and sex hormones (Bector and Puri, 1971). The berries are the main source of solasodine and diosgenin. Solasodine is N-analogue of diosgenin and used as a steroidal precursor in the steroid drug industry. It is present in the form of a glycoside and the glycoalkaloids are variously known as solasonine, solamargine, etc. with the common spiro aminoketa alkaloid or a glycon namely solasodine. The solasodine content of the berries of the plant is reported to vary from 1.1% to 4.6% (Asolkar and Chadha, 1979) depending on climatic and soil conditions. It has been observed that berries collected in autumn yielded only solasonine and solamargine without any traces of solasurine which was obtained from the material collected in summer. Solasodine does not have a conjugated double bond in it structure (Trivedi and Pundarikakshudu, 2007).

2.10.2. Pharmacological Activities
Antimicrobial activity of the aqueous and organic extracts (ethanol, benzene, acetone and methanol) of different parts of the plant viz. roots, stems, leaves and fruits, of the plant was tested against gram-positive and gram-negative bacteria and fungi. Except aqueous extract of different parts of the plant, all the extracts prepared in organic solvents and showed antimicrobial activity against all the test organisms. A strong inhibition of *P. aeruginosa* was caused by the ethanolic and methanolic extracts of the plant (Salar and Suchitra, 2009). Antibacterial activity of various parts (stem, leaf and fruit) of the plant extracted with various solvents (pet-ether, alcohol and acetone) tested against *E. coli*, *K. pneumoniae*, *S. xanthocarpum* and *B. cereus*. The extracts of the plant showed high sensitivity to *K. pneumoniae* and *S. typhi*, moderate sensitivity to *E. coli* and less sensitivity and resistant of *B. cereus* (Udaykumar, et al., 2003).

The efficacy of leaf extracts (aqueous and ether-water extracts) of a number of different plants, including *S. xanthocarpum*, was evaluated against four different bacteria, *S. aureus*, *K. pneumoniae*, *E. coli* and *B. subtilis* and major seed-borne fungi, *A. awamori*, *A. niger* was studied *in vitro* and *in vivo*. The plant extract showed a moderate activity among the selected plants against the test microorganisms (Patel, et al., 2007).

A pilot study on the clinical efficacy of the plant and *S. trilobatum* in bronchial asthma was undertaken to prove the significant use of herbs in treatment of asthma (Mohan, et al., 2007). Vadnere, et al., 2008, evaluated the therapeutic effect of ethanolic extracts of the plant i.e. asthma relieving or antihistaminic, antiallergic property. They also studied the effects of the plant extract on some of the parameters like smooth muscle relaxation and antagonism of asthma mediators such as histamine, eosinophils and protection against mast cell degranulation which seemed to be prominent in pathophysiology of asthma (Vadnere, et al., 2008). Further they showed that ethanol extract of the plant shown a significant antihistaminic activity in histamine induced contraction in goat tracheal chain preparation. Thus, the significant inhibition of histamine induced contractions produced by ethanol extract of the flower of the plant on isolated goat tracheal chain preparation indicates that the plant flower has antihistaminic action.

The plant is widely used by practitioners of the Siddha system of medicine in southern India to treat respiratory diseases (Nadkarni, 1954). The powder of the whole dried plant or a decoction is used for this purpose. Govindan, et al., 1999, showed that treatment with the plant improved the pulmonary functions to a significant level in patients suffering from mild
to moderate asthma. Subjective relief from asthmatic symptoms was reported by the patients an hour after administration of the plant powder. The effect lasted for about 6–8 hour. However, responses observed were apparently less when compared to that of deriphilline or salbutamol. A decrease in forced expiration volume and peak expiration flow rates were indicative of both large and small airway obstruction and muscle power (Davies, 1990). The dose of the plant was well tolerated and no untoward effects were reported. The plant is a safe medicine in the traditional system and has been used by mankind over centuries. It was suggested that relief from symptoms of bronchial asthma by the plant may be due to its bronchodilator effect, reduction on the bronchial mucosal edema or reduction in the secretions within the airway lumen.

The Kondh tribes of Dhenkanal district of Orissa, India use the hot aqueous extract of the matured fruits as a traditional medicine for the treatment of diabetes mellitus. The aqueous extracts showed hypoglycemic effect in both normal and streptozotocin induced diabetic rats. The activity showed by the aqueous extract was comparable to that of the standard oral hypoglycemic agent, glibenclamide. The experimental results indicated that it exhibited a potent blood glucose lowering property both in normal and streptozotocin induced diabetic rats. The LD$_{50}$ of the extract was found to be high indicating high margin of safety (Gupta, et al., 2005). Jigrine is a polypharmaceutical herbal formulation containing aqueous extracts of 14 medicinal plants including *S. xanthocarpum* and is used for liver ailments. Najmi, et al., 2005, investigated the DPPH-free radical scavenging activity, hepatoprotective and antioxidant activity of Jigrine against galactosamine induced hepatotoxicity in rats. Pasnani, 1988, reported that Abana, a polyherbal formulation containing the plant causes a direct sensitization of the atrium through an increase in permeability to Ca$^{2+}$ and an effect similar to withdrawal of chronic ISO administration, i.e. down regulation of ß-adrenoceptors.

2.11. *WITHANIA COAGULANS* (STOCKS) DUNAL

2.11.1. Chemical constituents


Root cultures of the plant were obtained from in vitro germinated sterile plantlets. The root cultures synthesized with anolides of which withaferin A was the major compound.
2.11.2. Pharmacological Activities

Antifungal and antibacterial properties have been demonstrated in the with anolides isolated from ethanolic extract of the whole plant and leaves (Choudhary, et al., 1995).

The volatile oil obtained from the fruits of the plant had antibacterial activity against *S.aureus* and *Vibrio cholera* (Gaind and Budhiraja, 1967). Mughal, 2009, tested the antibacterial activity of a number of different plants, including *W.coagulans*, against *S.aureus*, *E.coli*, *P.aeruginosa*, *S.pneumoniae*, *B.subtilis* and *H.stirgosum*. The methaolic extract of *W.coagulans* exhibited the strongest activity against all the tested microorganisms. Khan, et al., 1993, evaluated the antibacterial activity of the plant on a several different bacteria and observed significant results.

The plant is used in chronic complaints of liver. The plant extracts are also used in dyspepsia, flatulent colic and other intestinal infections. In some parts of the Pak-Indian sub-continent, the berries were used as a blood purifier. The twigs were chewed for cleaning of teeth and the smoke of the plant was inhaled for relief in toothache (Dymock, et al., 1972). The stock of the plant was used to treat nervous exhaustion, debility, insomnia, wasting diseases, failure to thrive in children, impotence. The plant is reported to be toxic (Purohit and Vyas, 2004). Antimicrobial, anti-inflammatory, antitumor, hepatoprotective, anti-hyperglycemic, cardiovascular, immunosuppressive, free radical scavenging and central nervous system depressant activities of the plant have been reported (Rakesh, et al., 2010).

The phytoconstituents quantified in one study exhibited great deal of medicinal importance like phenolic compounds as a good antioxidant (Ruch, et al., 1989), tannins having protein precipitating property (Haslam, et al., 1989), whereas flavonoides and flavones possessed good anti-inflammatory (Gabor, 1979 and Havsteen, 1983) and antioxidant activities (Crespy, et al., 2002). Hypoglycemic activity of the plant was confirmed in streptozotocin induced diabetic rats by Hemalatha, et al., 2004. Aqueous extract of the plant was tested in swiss albino mice which confirmed the hypolipidemic activity in it (Hemalatha, et al., 2004).

The alcoholic extract and total alkaloids of the plant showed significant anti-inflammatory effect in acute inflammation induced with formalin and granulation tissue formation by cotton-pellet method (Budhiraja, et al., 1977). The effects of crude methanolic extract of the plant were found effective against possible calcium channel blocking activities in rabbit’s jejunum preparations at different doses (Alam, et al., 2009). The aqueous extract of the plant also exhibited free radical scavenging activity in an in vitro using DPPH also
showed hypolipidemic activity (Khan, et al., 1993). Cardiovascular effects of with anolides isolated from the plant have been reported (Budhiraja, et al., 1983). The extract has hypertensive, respiratory stimulant and smooth muscle relaxant activity in experimental animals (Siddiqui, et al., 1963). The aqueous extracts of the plant possess a demonstrable and potent diuretic potential. The presence of steroidal lactones in addition to glycemic minerals in aqueous extract of the plant were found effective against STZ induced SD rats therefore it suggests it will be helpful for type II diabetic patients in controlling their blood glucose level (Jaiswal, et al., 2009).

The fruits of the plant are used for liver complaints, asthma and biliousness. Oral administration of the aqueous extract of the fruit of the plant was reported to lower the blood sugar, serum cholesterol, serum LPO and hepatic LPO levels in normal as well as streptozotocin induced diabetic rats (Hemalatha, et al., 2006). The aqueous extract and 3-ß-hydroxy and 2, 3-dihydrowithanolide-F of the fruits of the plant has been shown to exert hepatoprotective activity against CCl₄ induced hepatotoxicity in adult albino rats (Budhiraja, et al., 1986). The volatile oil obtained from fruits of the plant was observed to have anthelminthic activity (Gaind and Budhiraja, 1967). Coagulonolie along with four known withanolides form the plant fruits showed significant inhibitor in postprandial rise in hyperglycemia, post sucrose load in normoglycemic rats (Maurya and Akansha, 2010).

Flowers of the plant are used in the treatment of diabetes (Bown, 1995). The root is harvested in autumn and dried for later use (Chevallier, 1996). Antifungal and antibacterial properties have also been demonstrated in the withanolides isolated from the ethanolic extract of the leaves of the plant (Choudhary, et al., 1995).