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REVIEW ARTICLE

A REVIEW ON MEDICINAL IMPORTANCE OF *ALLOPHYLUS SERRATTUS* AND *PREMNA TOMENTOSA*

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ABSTRACT

Medicinal plants produce different secondary metabolites which are used as medicines in different parts of the plant such as leaf, root, flower and seed. In recent years, the usage of different medicinal plants for the treatment of different ailments in traditional and modern medicines has been increasing. Generally, in India, it is estimated that over 6000 plants are in use in traditional and herbal medicine. *Allophylus serratus* and *Premna tomentosa* are medicinal plants, which have traditional uses against various diseases. The objective of this review is to compile medicinal values of *Allophylus serratus* and *Premna tomentosa*.

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INTRODUCTION

Medicinal plants are defined as plants with one or more of its part containing properties that can be used for therapeutic purposes or which can be used as precursors for the synthesis of various drugs (Sofowora, 1993). Medicinal plants contain numerous biologically active compounds such as carbohydrates, proteins, enzymes, vitamins, minerals, fats and oils, tannins, quinones, terpenoids, flavonoids, sterols, carotenoids, simple phenolic glycosides, alkaloids, saponins, polyphenols etc. Extracts from different medicinal plants represent a continuous effort to find new compound against pathogens. Approximately 20% of the plants found in the world have been submitted to pharmacological or biological test, and a substantial number of new antibiotics introduced on the market are obtained from natural or semi synthetic resources (Mothana and Linclequist, 2005). It is estimated that about 20,000 to 35,000 species of plants are used as source of pharmaceuticals, medicines, cosmetics and nutraceuticals by different people in the entire world (Trivedi, 2006).

Many modern medicines, approximately one quarter of prescribed drugs contain plant extracts or active ingredients obtained from plants. For example, aspirin, was originally derived from plant source. The most valuable anti-cancer agents are also derived solely from plant sources. Medicinal plants have been found useful in the treatment and management of various health problems. They are source of several pharmacologically active compounds, which are commonly used in traditional and modern medicines against multiple ailments (Biswas et al., 2002). Many natural products of plants origin are very important source of drugs and important resource for developing new drugs to treat various human diseases. Because of their traditional medicinal use and source of modern medicines, recently there has been an increasing interest by researchers in the use and study of medicinal plants in different parts of the world (Anandarajagopal et al., 2011; Giday et al., 2009; Daniyan and Muhammad, 2008).

There are large numbers of plant species existing all over the world which has been used for the treatment of different diseases and multi beneficial activities. *Allophylus serratus* and *Premna tomentosa* are among these medicinal plants used traditionally to treat different ailments. There are research reports on the traditional medicinal importance, chemical

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constituents and pharmacological activities of these plants. Therefore, the main aim of this review is to compile the medicinal importance of *Allophylus serratus* and *Premna tomentosa* with special attention towards their various traditional medicinal uses, chemical constituents and pharmacological properties.

Allophylus serratus

Scientific Classification

Kingdom: Plantae

Phylum: Magnoliophyta

Class: Magnoliatae

Order: Sapindales

Family: Sapindaceae

Genus: *Allophylus*

Species: *Allophylus serratus* Kurz

Synonyms for *A. serratus* were assigned by several researchers as *Allophylus cobbe* Ornitrophe *serrata* Roxb, *Schimidelia serrata* Wight and Arn., Wight, *Sapindus cobbe* graham, *Allophylus edulis* Radlk.

Botanical Description

Allophylus serratus (Roxb) Kurz, family Sapindaceae commonly known as Tippani in Hindi is an evergreen, low branching small tree or a large shrub about 3-6m tall. Trunk is straight with open canopy. Stem shows white branchlets and bark grayish or whitish. Leaves are compound with three leaflets (tri-foliolate), alternate, ovate or elliptic, serrate-dentate, crowded at the ends of branchlets and each leaflet is 5 to 12 cm in length and 3 to 5 cm in breadth; upper surface is green and lower surface is pale green in colour. Terminal leaflet, which is larger than the lateral ones, is elliptic or elliptic-lanceolate in shape whereas lateral leaflets and ovate-lanceolate in shape. Leaf margin is sparsely curled. The margin of leaflets varies from serrate to dentate. Flowers are small, white in fascicles, alternate born on rachis, on spicate axillary racemes, stamens 8, inserted on the receptacle inside the disc. Fruit is a small berry, round, fleshy, and red in colour when ripe (Vinay, et al., 2005).

Ecology

Allophylus serratus Kurz is found extensively all over India; it is found to be growing along the site of Andhra University, Andhra Pradesh, West Bengal, Arunachal Pradesh, Tripura, Orissa, Karnataka, Tamilnadu and Kerala, scrubby forest of Mahabaleshwar, scrubby forests of Kolhapur, Satara, Borbet, Barki, Manoli, Panhala, Patgaon of Kolhapur District, Sri Lanka and South East Asia. It is well adapted to grow in coarse and fine sandy and nutrient poor soil but prefers sandy loam with slightly high moisture content and it can grow well in shade too. The plant is tolerant to drought and high salinity (Selvam, 2007).

Ethanobotany

Allophylus serratus has strong ethnobotanical and ethanopharmacological background. The plant has a

distinction of being used in Indian system of medicine (Ayurveda) as an anti-inflammatory, as carminative drug, treatment of elephantiasis, oedema, fractured bones, in bone dislocations, wound, ulcer, several gastrointestinal disorders such as dyspepsia, anorexia and diarrhea (Gupta and Tandon, 2004). The fruits are sweet, edible and have cooling and nourishing tonic. The flesh of the berry is eaten raw to expel tapeworm. The leaves are crushed into juice and used to reduce fever, to relieve rashes, promote lactation, to treat colic. Leaves ground with quicklime is applied with heat to relieve stomach aches. Leaves and barks are used as a remedy for elephantiasis; antiulcer and reduce piles (Maurya and Srivastava, 2011; Devi et al., 2013). According to Binu and Rajendran, (2013), leaf paste with turmeric is applied for fracture and sprains. The roots of this plant contain tannin and are considered astringent; they are used for treating piles and nose bleeding and to check diarrhea and rheumatic pains (Maurya and Srivastava, 2011).

Bioactive component

Allophylus serratus contains different bioactive substances which are very important as medicines and other activities. It is rich in phenolic compounds, flavonoids, tanning substances, Steroids, Alkaloids and Saponins (Priya et al., 2012). Dharmani et al., (2006) screened Pharmacognosy and phytochemistry of *A. serratus* (Kurz) and they found the presence of various chemicals in different parts. The plant leaves contain β -sitosterol and phenacetamide, Ph-acetamide, alkaloids and Benzylamide. Fruits contain three cyanogenic glycosides (3-O- β -D-glucopyranosyloxy-4-methyl-2-(5H)-furanone, 4-O-D-glucopyranosyloxy-3-hydroxymethyl butyronitrile-2-ene and cardiospermin. (Rastogi and Mehrotra, 1995). There are also alkaloids and various fatty acids in leaves and β -sitosterol in stems (Priya et al., 2012; Rastogi and Mehrotra, 1995). There are reports which indicate that this plant also contains different compounds such as quercetin, pinitol, luteolin-7-O-d-glucopyranoside, rutin and apigenin-4-O-D-glucoside (Manmeet et al., 2010).

Pharmacological Properties

Anti ulcer

Allophylus serratus is a medicinal plant with a strong ethnopharmacological background of anti-ulcer activity. Pharmacognostic studies and phytochemical screening of *A. serratus* showed the presence of various chemical compounds in different parts of the plant which contain phenacetamide, betasitosterol and quercetin chemicals known for their antiulcer activity with very minimum side effects. Vinay et al., (2005) reported that the ethanolic leaf extract of the plant has anti-ulcerogenic property and the mechanism involved in antiulcer activity is cytoprotective mechanism, reduction in acid output and peptic as well as anti secretory (Dharmani et al., 2005).

Anti Osteoporotic Property

Manmeet et al. (2010) studied the osteoporotic property of the plant and confirmed that the plant possesses anti osteoporotic activity. The ethanolic extract of leaves of *Allophylus serratus* contain rutin (Boligon et al., 2009) which has significant

osteoporotic activity by causing osteoblast differentiation and mineralization (Manmeet *et al.*, 2010).

Antibacterial Activity

Gaikwad and Chavan, (2013) studied antibacterial activity of *A. serratus* and found that the aqueous and ethanolic extracts of young and mature leaves of the plant contains Saponins and Terpenoids which exhibit good antibacterial potential against *B. subtilis*. Thus, the extracts of leaves can be implicated to control the gram positive endospore forming bacterium such as *B. subtilis*.

Anti inflammatory Activity

The ethanolic extracts of the leaves were screened for anti-inflammatory activity and analgesic properties. The extracts showed both anti-inflammatory activity, analgesic, activity against Ranikhet virus disease properties, hypothermia and showed gross effects on central nervous system (Asolkar *et al.*, 1992).

Table 1. Medicinal uses of *Allophylus serratus*

Plant part	Medicinal use	References
Leaves	Anti inflammatory	Asolkar <i>et al.</i> , 1992
Leaves	Anti Ulcer	Dharmani <i>et al.</i> , 2005 and Vinay <i>et al.</i> , 2005
Leaves	Anti osteoporotic	Boligon <i>et al.</i> , 2009, Kumar <i>et al.</i> , 2010 and Manmeet <i>et al.</i> , 2010
Leaves	Anti bacterial	Gaikwad and Chavan, (2013)

Premna tomentosa

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Lamiales

Family: Verbenaceae

Genus: Premna

Species: *Premna tomentosa*

Botanical Description

Premna tomentosa Willd. belongs to the genus Premna (Verbenaceae) which distribute in tropical and subtropical areas of the world such as Asia, Africa, Pacific islands and Australia (Kadereit, 2004; Hymavathi *et al.*, 2009). It is a deciduous tree growing up to 50 feet, with fibrous bark, shredding off longitudinally in flakes. Its shoots, leaves and inflorescence densely covered with a tawny yellow stellate tomentum. The leaves are 10 to 15 cm. long, ovate, rounded or subcordate at base. The flowers are on very short pubescent pedicles (Devi *et al.*, 2004).

Ethanobotany

Premna tomentosa is a well known medicinal plant used extensively for the treatment of various ailments. Preparations from leaves, bark, and roots of *Premna tomentosa* have been used widely in traditional medicine for the treatment of various disorders like diarrhoea, hepatic disorders, stomach disorders, dog bites, anaemia and rheumatism (Devi *et al.*, 2004). The plant is also used as lipid lowering agent and as diuretic.

All parts of *this plant* have been in use in Indian traditional medicine for the treatment of various diseases. Aromatic oil obtained from the roots is used locally as a remedy for stomach disorders, its bark extract is claimed to have a lasting cure for hepatic disorders (Shanmugavelu, 1987) and root barks are used for rheumatic pains (Srinivasa Rao *et al.*, 2015). The water boiled with its leaf is used to treat human paralysis. It is also a good anti-rheumatic agent. The decoction of leaves is used to cure dropsy and stomach disorders and extract of inner bark is used to arrest diarrhea (Anonymous, 1969; Yoganarasimhan, 2000). Young leaves of this plant are used as food by tribal people of Andhra Pradesh, India (Bharath *et al.*, 2012). The wood of this plant is hard and heavy and is used for combs, house building, furniture, turnery, weaving shuttles, carving and fancy works.

Bioactive compounds

Suriyavathana *et al.*, (2010) studied the phytochemical screening of *Premna tomentosa* and found that the plant is rich in alkaloids, flavanoids, steroids, tannins and phenols which are popular phytochemical constituents. Another phytochemical investigations on this plant have resulted in the identification of different kinds of chemical compounds such as dl-limonene, b-caryophyllene, 5,30-dihydroxy-3,7,40,50-tetramethoxyflavone, myricetin-7,30,40-trimethyl ether, and a di-C-glycosyl flavone, vicenin 3 (Balakrishna *et al.*, 2003; Etti *et al.*, 2005; Jyotsna *et al.*, 1984).

There are also reports which established that the major compound present in the leaves (58%) is limonene which is a monocyclic terpene consumed by people mainly as an ingredient of traditional food. Other chemicals reported from this study are (17.2%) b-caryophyllene, (7.8%) cadalenetype sesquiterpene, (5.6%) sesquiterpene tertiary alcohol, (5.5%) aditerpene, 5,3-dihydroxy-3,7,4',5'-tetramethoxy flavone, myricetin-7,3',4'-trimethyl ether, di-C-glycosyl flavone, vicenin 3, three clerodane diterpenoids, premnones A-C, coniferaldehyde, syringaldehyde, lupeol, betulin, and 2-(4-methoxyphenyl)-2-butanone (Hymavathi *et al.*, 2009; Devi *et al.*, 2003; Chin *et al.*, 2006). The leaves of *Premna tomentosa* are also rich in flavonoids, tannins and steroids (Suriyavathana *et al.*, 2010). Hymavathi *et al.*, (2009) carried out a bioassay-guided fractionation and chemical investigation of the stem bark of *Premna tomentosa* and reported the presence of four icetexane diterpenes (icetexatriene-10,11,12,16-tetrol, 8,11,13 icetexatriene-10,11,16-triol, 8,11,13 icetexatriene-7,10,11,16-tetrol and 7,10-epoxy-8,11,13 icetexatriene-11,12,16-triol) and other known compounds such as coniferaldehyde, syringaldehyde, lupeol, betulin, and 2-(4-methoxyphenyl)-2-butanone.

Pharmacological Activities

Different studies have demonstrated that the leaf extracts of *P. tomentosa* possess diuretic, anti-inflammatory and a protective effect against acetaminophen-induced hepatotoxicity in the rat (Devi *et al.*, 2004). It has also hepatoprotective, and antioxidant (Devi, *et al.*, 1998), lipid-lowering (Devi *et al.*, 2004), cytoprotective, immunostimulant, anti-nociceptive and hypnotic effects (Devi *et al.*, 2003b) and protective against acetaminophen-induced mitochondrial dysfunction properties

(Devi *et al.*, 2005). The plant has also analgesic and sedative effects due to the presence of limonene and caryophyllene in the leaves (Devi *et al.*, 2003b).

Anti-inflammatory Property

The anti-inflammatory activity alcoholic extract of the leaves of *P. tomentosa* study by Alam *et al.* (1993), at a dose of 100 mg/kg body weight exhibited significant anti-inflammatory activity in albino rats. They also reported the extract caused reduction in the weight of spleen, thymus and adrenals and reduced cotton pellet granuloma by 32.21%. The serum biochemical parameters showed reduction in acid phosphatase, protein and transaminases.

Antimicrobial Activity

The antibacterial activity of hexane, chloroform, ethanol and water extracts of the leaves of *P. tomentosa* were studied against ten species of bacteria by well-diffusion assay method. The ethanolic and water extracts exhibited concentration dependent activity. The result showed that the extracts have activity against *Alkaligenes faecalis*, *Bacillus subtilis* and *Escherichia coli* (Anbazhakan and Balu, 2009) and *P. tomentosa* has antimicrobial activity (Mattrin *et al.*, 2006).

Antioxidant Activity

The ethanolic extracts of leaves *Premna tomentosa willd* were screened for their *in vitro* enzymatic and non enzymatic antioxidant activity and found to possess excellent antioxidant activity. The antioxidant activity may be attributed to the presence of flavanoids and phenolics present in the plant extract (Suriyavathana *et al.*, 2010). The major compound present in the leaves (58%) is limonene, which is a monocyclic terpene have also antioxidant property. Sridhar, (2013) studied the whole plant of *P. tomentosa* and found certain important phytochemicals to exhibit antioxidant and free radical scavenging activity in significant amount. They carried out bioassay-guided fractionation and chemical investigation of the whole plant of *P. tomentosa* which resulted in the isolation and characterization of compounds such as premnalin and acetoxy syringaldehyde which displayed potent α -glucosidase inhibition and free radical scavenging activities that can reduce oxidative stress.

Anti-nociceptive and hypnotic property

There are reports which established that methanolic extract of the leaf of *P. tomentosa* has anti-nociceptive and hypnotic effects (Devi, *et al.*, 2003a). They used experimental animals by acetic acid-induced writhing, tail flick and tail clip tests. When *P. tomentosa* extract was administered orally to at different doses (100, 200, 400 and 500 mg/kg) significant antinociceptive effects were observed. They also tested different doses of plant extract for hypnotic effects and found that the plant possesses hypnotic activities.

Antidiabetic Activity

In their study, Bharath *et al.* (2012), demonstrated *in vivo* anti-diabetic activity of an ethanolic extract of *P. tomentosa* in STZ-induced type-II diabetic rats. They carried their study with different doses (250mg/kg and 500mg/kg) of ethanolic extracts of root of the plant in rats. They found that the fasting blood glucose of the group treated with 500mg/kg body weight extract lowered the glucose level 60.77% ($P < 0.001$) and have significant reduction in serum creatinine 26.58% ($p < 0.001$), total cholesterol 41.82% ($p < 0.001$), triglycerides 46.07% ($p < 0.001$), SGPT 43.7% ($p < 0.001$) and SGOT 13.01% ($p < 0.001$) in STZ-induced diabetic rats. According to this report administration of ethanolic extract produced a significant reduction in serum glucose, total cholesterol, creatinine, triglycerides, SGPT and SGOT in STZ-induced diabetic rats and also highly effective in managing the complications associated with diabetes mellitus, such as hypercholesterolemia and impaired renal function.

Anti cancer Property

Hymavathi *et al.* (2009), reported that *P. tomentosa* stem-bark hexane extract showed cytotoxic activity against skin cancer (A-431), colon cancer (Colo-205), breast cancer (MCF-7), lung cancer (A-549) and liver cancer (Hep-G2), cell lines. The apparent antimutagenic and antioxidant activities of the plant further suggests their potential usefulness in cancer prevention.

Immunomodulatory Activities

Immunomodulatory effects of *P. tomentosa* extract against Chromium (VI) induced immunosuppression in splenic lymphocytes were investigated. Chromium (Cr) addition at a concentration of 5 μ g showed an increase in cytotoxicity, apoptosis and reactive oxygen species (ROS) and a decrease in lymphocyte proliferation and antioxidant levels, whereas pre-treatment of the cells with *P. tomentosa* extract (at 500 μ g concentration) resulted in decreased cytotoxicity and ROS levels.

Table 2. Medicinal uses of various parts of *Premna tomentosa*

No	Plant part	Medicinal use	Reference
1	Leaves	Anti-inflammatory	Alam <i>et al.</i> , 1993
2	Leaves	Anti-nociceptive and hypnotic	Devi, <i>et al.</i> , 2003a
3	Leaves	cytoprotective and immunomodulatory	Devi <i>et al.</i> , 2003b
4	Leaves	Hepatoprotective	Devi <i>et al.</i> , 2005
5	Leaves	Antimicrobial	Mattrin <i>et al.</i> , 2006
6	Stem-bark	Anti-ulcer (anti cancer)	Hymavathi <i>et al.</i> , 2009
7	Leaves	Antioxidant	Suriyavathana <i>et al.</i> , 2010
8	Root	Antidiabetic	Bharath <i>et al.</i> , 2012
9	Whole plant	Antioxidant	Sridhar, 2013

The drug treatment also maintained antioxidant levels and restored lymphocyte proliferation similar to that of control cells. The stimulation of both cell-mediated and humoral immunity along with antioxidant effect suggests the therapeutic usefulness of *P. tomentosa* extract in a variety of ailments where the immune system is suppressed (Devi *et al.*, 2003b).

Hepatoprotective Activity

Premna tomentosa is one of the medicinal plants used widely in Indian ayurvedic medicine for the treatment of liver disorders. Devi *et al.*, (2005) studied the effectiveness of *P. tomentosa* leaf extract in protecting the liver against mitochondrial damage induced by acetaminophen. Normal Wistar strain rats were pre-treated with *P. tomentosa* extract (750 mg/kg, orally) for 15 days and then intoxicated with acetaminophen (640 mg/kg, orally). Mitochondria were isolated from liver of experimental animals and assessed for the levels of lipid peroxide products, GSH and mitochondrial enzymes (isocitrate dehydrogenase, alpha-keto glutarate dehydrogenase, malate dehydrogenase, succinate dehydrogenase, cytochrome-C-oxidase and NADH dehydrogenase). The levels of Lipid peroxidation products were increased and the levels of the other assessed parameters were significantly decreased in hepatotoxicity induced animals. The result showed that, the extract has protective against damage of mitochondria and in pre-treated rats, the levels were brought back to normal. Presence of anti-oxidant compound D-limonene (58%) in *P. tomentosa* leaves, which is known to enhance conjugation of toxic metabolites by maintaining liver GSH concentrations may explain the hepatoprotective property of the extract (Devi *et al.*, 2005). The hepatoprotective effect may be also due to its ability to scavenge free radicals and inhibit lipid peroxidation by the antioxidant compound limonene which is present in the plant (Devi *et al.*, 2004).

Conclusion

It is quite evident from this review that *Allophylus serratus* and *Premna tomentosa* are traditionally used to treat various ailments and contains a number of phytoconstituents which reveals their uses for various therapeutic purposes. The whole plant or its individual parts of *Allophylus serratus* can be used for the treatment of various disorders in human being. It can be used as antiulcer, antibacterial, anti elephantiasis, anti Osteoporotic, anti-inflammatory, antioxidant and anti diabetics. *Premna tomentosa*, whole plant or its individual parts can be used as antioxidant, anti-inflammatory, antidiabetic, antimicrobial, anti-nociceptive and hypnotic, anticancer antidiabetic, immunomodulator, hepatoprotective and lipid lowering activities. Still, so much work is required with these plants to investigate other phytoconstituents and mechanism of actions with other therapeutic activities.

REFERENCES

- Alam, M., Joy, S., Susan, T. and Usman Ali S. 1993. Anti-inflammatory activity of *Premna tomentosa* willd. in albino rats. *Ancient Sciences of Life*, 13:185-188.
- Anandarajagopal, K., Sudhakar, D., Ajaykumar, T.V. and Muthukumaran, G. 2011. Evaluation of CNS Depressant Activity of Aerial Parts of *Basella alba* Linn. *IJPI'S Journal of Pharmacology and Toxicology*, 1:5.
- Anbazhakan, S. and Balu, S. 2009. Antibacterial activity of the leaf extracts of *Premna tomentosa* Willd. *Hamdard Medicus*. 52 (2):24-27.
- Anonymous, 1969. The Wealth of India-Raw materials. CSIR Publication, New Delhi. 8: 240-241.
- Asolkar, L.V., Kakkar, K.K. and Chakra, O.J. 1992. Second Supplement to Glossary of Indian Medicinal Plants with Active Principles Part-1 (A-K) 1965-1981. NISC, CSIR, New Delhi, India, pp: 265-266.
- Balakrishna, K., Sukumar, E., Vasanth, S. and Patra, A., 2003. Myricetin- 30,40,70-trimethyl ether from the leaves of *Premna tomentosa*. *J. Indian Chem. Soc.*, 80: 792.
- Bharath Reddy, T., Goverdhan, P. and Jagadeeshwar, K. 2012. Antidiabetic Activity of Ethanolic extract of *Premna Tomentosa* Root in Rat Model. *Journal of Scientific Research in Pharmacy*, 1(1): 23-28. www.jsrponline.com.
- Binu, T. and Rajendran, A. 2013. Less Known Ethnomedicinal Plants Used by *Kurichar* Tribe of Wayanad District, Southern Western Ghats Kerala, India. *Botany Research International*, 6 (2): 32-35.
- Biswas, K., Chatopadhyay, I., Banerjee, R. K. and Bandhopadhyay, U. 2002. Biological Activities and Medicinal Properties of Neem (*Azadirachta indica*), *Curr Sci.*, 82 : 1336.
- Boligon, A.A., Feltrin, A.C., Machado, M.M., Janovik, V. and Athayde, M.L. 2009. HPLC analysis and phytoconstituents isolated from ethyl acetate fraction of *Scutia buxifolia* Reiss. leaves. *Lat. Am. J. Pharm.*, 28:121-124.
- Chin, Y.W., William, P.J., Qiuwen, M. and Ismail R. 2006. Cytotoxic clerodane diterpenoids from the leaves of *Premna tomentosa*. *Phytochemistry*, 67: 1243-1248.
- Daniyan, S.Y. and Muhammad, H.B. 2008. Evaluation of the antimicrobial activities and phytochemical properties of extracts of *Tamaridus indica* against some diseases causing bacteria. *African Journal of Biotechnology*, 7(14): 2451-2453.
- Devi, A. G., Shyma, T. B. and Raghavendra, M. P. 2013. Plants used by the tribes for the treatment of digestive system disorders in Wayanad district, Kerala. *Journal of Applied Pharmaceutical Science*, 3 (08): 171-175.
- Devi, K.P., Anandan, R., Devaki, T., Apparantham, T. and Balakrishna, K. 1998. Effect of *Premna tomentosa* on rat liver antioxidant defense system in acetaminophen-intoxicated rats. *Biomed Res.*, 19:339-42.
- Devi, K.P., Sairam, M., Sreepriya, M., Ilavazhagan, G. and Devaki, T. 2003b. Immunomodulatory effects of *Premna tomentosa* extract against Cr (VI) induced toxicity in splenic lymphocytes – an *in-vitro* study. *Biomedicine and Pharmacotherapy*, 57: 105-108.
- Devi, K.P., Sreepriya, M., Balakrishna, K. and Devaki, T. 2004. Protective effect of *Premna tomentosa* extract (*Verbenaceae*) on membrane-bound phosphatases and inorganic cations transport in acetaminophen-induced hepatotoxicity rats. *Journal of Ethnopharmacology*, 93: 371-375.
- Devi, K.P., Sreepriya, M., Devaki, T. and Balakrishna, K. 2003a. Antinociceptive and hypnotic effects of *Premna tomentosa* L. (*Verbenaceae*) in experimental animals. *Pharmacology, Biochemistry and Behaviour*. 75: 261-264.

- Devi, K.P., Sreepriya, M., Balakrishna, K. and Devaki, T. 2005. Protective effect of *Premna tomentosa* extract (L. verbanaceae) on acetaminophen-induced mitochondrial dysfunction in rats. *Mol Cell Biochem.*, 272(1-2):171-7.
- Dharmani, P., Pushpesh Kumar, M., Rakesh, M., Vinay Singh, C. and Gautam, P. 2005. *Allophylus serratus*: a plant with potential anti-ulcerogenic activity. *Journal of Ethnopharmacology.*, 99 : 361–366.
- Etti, S., Shanmugam, G., Ponnuswamy, M.N., Balakrishna, K. and Vasanth, S. 2005. 5,30-Dihydroxy-3,7,40,50-tetramethoxyflavone. *Acta Crystallogr.*, 61: 846–848.
- Gaikwad, D.K. and Chavan, R.B. 2013. Antibacterial Activity of Medicinally Important Two Species of *Allophylus-Allophylus cobbe* (L.) Raeusch. & *Allophylus serratus* (Roxb.) Kurz. *Journal of Pharmacognosy and Phytochemistry.*, 2(1):1-7
- Giday, M., Asfaw, Z., Woldu, Z. and Teklehaymanot, T. 2009. Medicinal plant knowledge of the Bench ethnic group of Ethiopia: an ethnobotanical investigation. *Journal of Ethnobiology and Ethnomedicine*, 5:34.
- Gupta, A. K.; Tandon, N. 2004. *Reviews on Indian Medicinal Plants*. Indian Council of Medical Research, New Delhi. 2:90-92.
- Hymavathi, A., Suresh babu, K., Naidu, V.G.M., Ramakrishna, S., Prakash, V.D. and Madhusudana Rao, J. 2009. Bioactivity-guided isolation of cytotoxic constituents from stem-bark of *Premna tomentosa*. *Bioorganic and Medicinal Chemistry Letters*. 19: 5727-5731.
- Jyotsna, D., Sarma, P.N., Srimannarayana, G. and Rao, A.V.S. 1984. Di-Cglycosyl flavone from *Premna tomentosa*. *Curr. Sci*. 53: 573–576.
- Kadereit, J. W. 2004. *The Families and Genera of Vascular Plants*; Springer, Berlin. 7: 449.
- Kumar, M., P. Rawat, P. Dixit, D. Mishra, and A.K, Gautam 2010. Anti-osteoporotic constituents from Indian medicinal plants. *Phytomedicine*. 17: 993–999.
- Manmeet, K., Preeti, R., Preeti, D., Devendra, M., Abnish, K., Gautam, R. P., Divya, S., Naibedya, C. and Rakesh, M. 2010. Anti-osteoporotic constituents from Indian medicinal plants. *Phytomedicine*. 17: 993–999. www.elsevier.de/phymed
- Mattin Rathi, J. and Gopalakrishnan, S. 2006. *Premna tomentosa* willd. An Effective Insecticide. *Journal of Applied Zoological Research*, 17: 138-141.
- Maurya Umashanker and Srivastava Shruti, 2011. Traditional Indian herbal medicine used as antipyretic, antiulcer, anti-diabetic and anticancer: a review. *International Journal of Research in Pharmacy and Chemistry*, 1(4):
- Mothana, R. A. and Linclequist, V. 2005. Antimicrobial Activity of Some Medicinal Plants of the Island Soqotra. *Journal of Ethnopharmacology*, 96 (1-2):177-181. <http://dx.doi.org/10.1016/j.jep.2004.09.006>.
- Priya, E., Selvan, P. and Tamilselvan, R. 2012. Phytochemical Investigation of *Allophylus serratus* Kurz Leaves by UV and GC-MS Analysis. *Research Journal of Phytochemistry*, Vol. 6 Issue 1, p17-24.
- Rastogi, R. P. and Mehrotra, B. N. 1995. *Compendium of Indian Medicinal Plants*. Publication and Information Directorate, New Delhi. 4:151.
- Selvam, V. 2007. *Trees and Shrubs of Maldives*. 1st ed. FAO Regional Office for Asia and the Pacific. Thammada Press Co., Ltd., Bangkok.
- Shanmugavelu, M. 1987. *Sidhacure for Diseases*; Tamil Nadu Siddha Medical Board Publications: Chennai, India.
- Sofowora, A. 1993. *Medicinal Plants and traditional medicines in Africa*. 2nd Edn. Karthala Ibadan Nigeria.
- Sridhar Rao Ayinampudi 2013. a-Glucosidase enzyme inhibitory and free radical scavenging constituents from *Premna tomentosa*. *Journal of Pharmacy Research*, 6:893-896.
- Srinivasa Rao, D., Shanmukha Rao, V., Prayaga Murthy, P., Narasimha Rao, G. M. and Venkateswara Rao. Y. 2015. *J. Pharm. Sci. & Res.*, 7(4) : 210-218.
- Suriyavathana, M., Usha, V. and Shanthanayaki, M. 2010. Studies on phytochemical analysis and antioxidant activity of selected medicinal plants from kolli hills. *Journal of Pharmacy Research*, 3(2):260-262.
- Trivedi, P.C. 2006. *Herbal medicine: traditional practices* (Ed); Aavishkar Publishers, Jaipur. India :322.
- Vinay, S.C., Pushpesh, K.M., Rakesh, M., Dharmani, P. and Gautam, P. 2005. *Allophylus serratus*: a plant with potential anti-ulcerogenic activity. *Journal of Ethnopharmacology.*, 99:361–366.
- Yoganarasimhan, S.N. 2000. *Medicinal Plants of India*. Tamil Nadu, Govt. Siddha College, Palayamkottai. 2: 441-2000.
