

1. INTRODUCTION

Nature has been a tremendous source of therapeutic significance material for thousands of years (Cragg and Newman, 2000). Plants are the richest bioresource of drug developing material for all the pharmaceuticals across the globe (Calixto, 2000). Ethnobotanical knowledge on herbal plants and their usages are helpful in drug development. The authentic information of the usage of herbal plants were passed from one generation to another after refining and addition of indigenous traditional knowledge (Haq *et al.*, 2011; Ajaib *et al.*, 2016).

Researches around the world has proved that, medicinal properties of the plants lies in their secondary metabolites which produces certain health benefiting actions on human body. Phytochemicals are naturally occurring in plants. Phytochemicals are classified into primary and secondary compounds. Primary compounds include chlorophyll, protein and common sugars. Secondary compounds include alkaloid, terpenoid and phenolic compounds (Krishnaiah *et al.*, 2007). More than 4000 phytochemicals have been reported and are classified based on their protective role, physical and chemical properties out of which 150 phytochemicals have been evaluated in detail (Meagher and Thomson, 1999).

Isolation of bioactive compounds act as starting materials for production of drugs (Aziz *et al.*, 2003). There are about 12,000 phytochemical compounds isolated from herbs that are frequently available to mankind and have been explored for their therapeutic properties (Hill, 1952; Cowan, 1999; Okwu, 1999; Okwu, 2001). These phytochemical molecules are novel and complex structure which can be extensively used in their original form. They can also be compounds to develop derivatives with accurate specificity and less side effects (Koehn and carter, 2005).

Hence, screening of phytochemical is needed to evaluate the pharmacological profile of plant based therapeutic action (Akinmoladun *et al.*, 2007). Herbal drugs used by the traditional local people are obtained from natural wild resources (Handa, 2004). Numerous plant species have been used in folkloric medicine to cure various health ailments (Sah and Verma, 2012). According to the World Health Organization (WHO), more than 80% of world's population rely on indigenous traditional medicinal plants for their primary healthcare system and it was also reported that since 1980, around 50% of

the medicines have been derived from the natural products. Also it has been estimated that approximately 25% of the recently used modern medicines are developed from plants (Fabricant and Farnsworth, 2001; Newman and Cragg, 2007; Veerapur *et al.*, 2009).

Nowadays, traditional medicine have been replaced by conventional medicine (Winslow and Kroll, 1998). Ayurveda, Siddha, Homeopathy, Naturopathy, Unani and Chinese are the ancient traditional medicine system that are producing some important plant based drugs which are still in use (Ghanekar, 1981). Department of Ayush constitutes the Ayurvedic Pharmacopoeia Committee which has revealed certain quality parameters. Classical protocol of powder microscopy is still a valuable technique used in identification of species and can also be employed in the authentication of the drug material (Malati and Pillai, 2004).

Pharmacognostic study has given a valuable knowledge regarding the macroscopic, microscopic and physicochemical characteristic of crude plant drug (Bairwa *et al.*, 2010; Mapunya, 2010; Nassar *et al.*, 2010). About 35,000 plant species have therapeutic properties due to the presence of bioactive compounds. Recently around 80% of the immuno suppressive, cardio vascular, antimicrobial and antitumour drugs were derived from herbal plants (Lahlou, 2013; Pan *et al.*, 2013; Ahmed and Azam, 2014; Atanasov *et al.*, 2015; Singh *et al.*, 2017). Medicines have been discovered by the scientists after evaluating the chemical compounds of herbal plants that are traditionally used by tribal and village people (Jain *et al.*, 2014). The plant kingdom is a rich source in synthesising a wide range of natural antioxidants (Antolovich *et al.*, 2000; Matkowski, 2006; Sarikurkcu *et al.*, 2009).

In recent days, diseases were associated with the shift in balance of pro-oxidant and antioxidant homeostasis in the human body. Reactive Oxygen Species (ROS) is a class of compounds which include superoxide, hydroxyl, hydrogen peroxide, hydroperoxyl, peroxide and alkoxy radicals causing extensive cell and tissue damage also cause oxidative damage to cellular molecules like protein, lipid and DNA which leads to many chronic diseases such as heart disease, carcinogenesis and diabetes (Adelman *et al.*, 1988; Aiyegoro and Okoh, 2010). Antioxidants are the molecules (or) compounds which prevent oxidative stress and the damage induced by free radicals (Velioglu *et al.*, 1998; Gulcin *et al.*, 2003; Gulcin, 2006). Antioxidants reduce oxidative stress which could affect and

damage biological molecules (Farhat *et al.*, 2013). Enormous number of plants with antioxidant property is attracting the research teams, for its extraordinary role in fighting against ailments such as cancer, athero sclerosis, cardiovascular events, diabetes, hypertension and alzheimer's disease (Liu and Ng, 2000; Devasagayam *et al.*, 2004).

Natural antioxidants have the ability to protect human body from free radicals and inhibit the progress of chronic diseases like cancer, heart disease and stroke (Gulcin *et al.*, 2003; Dave, 2009). Eventhough, number of synthetic antioxidants like Butylated hydroxyanisole, Butylated hydroxytoluene and Ascorbic acid are easily available in the market, they are quite toxic and unsafe to human body (Patel *et al.*, 2010). Scientific research revealed that the long term and high dosage of these synthetic antioxidant compounds can create toxic symptoms and tumours in human. Therefore, people are moving forward to alternative natural antioxidant (Kumar *et al.*, 2013).

Nilgiri Biosphere Nature Park (NBNP) is situated at Thuvaipathy Village, Anaikatti, Coimbatore, Tamilnadu, India. It has an aquarium, few insects, other small animals, medicinal garden and butterfly species. The staffs of NBNP usually take the visitors for trekking where they can enjoy and the different eco zone of the park. NBNP is a hill area. Normally hill area contain various diversity of plants, vegetation, geographical and climatic conditions. In this area 180 plant species have been reported in 61 families and 151 genera. These plant species are used to cure diseases. Trees dominate here than the climbers, herbs and shrubs (Marimuthu and Walker, 2010; Hemila and Krishnaveni, 2019).

Oleaceae is a major family of flowering plants including dicotyledon trees, shrubs and woody climbers. It comprise about 25 genera and around 600 species. The family contain several tribes that are Fontanesieae, Forsythieae, Jasmineae, Myxopyreae and Oleaeae. These tribes occur native of all the continents except Antarctic. Many of the genera such as *Chionanthus*, *Menodora* and *Fraxinus* species were cultivated for timber and *Forsythia*, *Jasminum*, *Syringa* and *Ligustrum* are grown for ornamental purpose (Grohmann, 1974; Cronquist and Takhtadzhian, 1981; Bianco, 1990; Wagstaff and Olmstead, 1997; Flowering, 1998; Wallander and Albert, 2000; Bartolini and Petruccelli, 2002; USDA, 2009).

Oleaceae plant species and their extracts were used in traditional system of medicine throughout the world and has potential application in medicinal, pharmaceutical, cosmetic and food fields (Sheth, 2005; Erbay and Icier, 2010; Lockyer *et al.*, 2012; Harasym and Oledzki, 2014; Redrigues *et al.*, 2015). It is characterized by their presence of numerous phytochemicals iridoid glucosides and phenylethanoid derivatives in the form of esters and glycosides of tyrosol (p-hydroxy phenyl-ethanol) especially connected with dopaol (3,4-dihydroxyphenyl-ethanol). Coumarins and lignan glucosides are basically common in the family Oleaceae (Hegnauer, 1969). The family also consists of secoiridoid oleuropein, neo-nuzhenife and 20 hydroxyoleuropein (Obied *et al.*, 2008).

The genus *Chionanthus* consist of 80-100 species majorly distributed in tropical area. In recent years, 20 species of *Chionanthus* were discovered from Mesoamerica and South America (Lombardi, 2006; Davidse, 2009; Cornejo *et al.*, 2011). According to the herbarium collection of Colombia, three new species of *Chionanthus* were also identified (Fernandez-Alonso and Cogollo–Pacheco, 2016). *Chionanthus* is familiarly known in the southern region of India as old mans beard. *Chionanthus* is derived from the Greek word. “Chion” (Snow) and “anthus” represents flower. There flowers are white in colour. It has no poisonous qualities. In pharmaceutical preparation, *Chionanthus* powder was solubilized with alkaline solution, alcohol, glycerin and water. It is the most valuable therapeutic agent in Materia medica.

Chionanthus is an extraordinary and powerful remedy against liver related disease such as jaundice, hepatic congestion, cirrhosis of the liver, hepatic inflammation (acute and chronic), irritable condition of the liver, chronic hepatitis, congestion of liver and acute catarrhal condition of liver. It discharges the biliary calculi. It also cures various health ailments such as infantile dyspepsia, rheumatic affection, chronic kidney lesions, diabetes mellitus, poultices in ulcer, wounds, open sores, febrifuge (chronic fever), chronic splentitis, nephritis, pancreatic disease, uterine and ovarion congestion, treatment of obesity, malaria, diuretic, purgative, chronic asthma, spasmodic asthma, syphilitic, nausea, vomiting and blood formation. It cures the digestive issues such as chronic stomachic, intestinal disease and diarrhoea. Small quantity of this plant powder drug mixed with gin and daily uptaking of a tablespoon of this mixture before each meal will improve the appetite chronic catarrh of the uterus (Goss, 1994).

Chionanthus virginicus is one of the well known species of *Chionanthus* genera. It is also called as old mans beard tree, a native of North America. It contains saponins, lignans, glycosides and secoiridoids. It is one of the traditional medicine of North America. It is a large shrub or small tree up to 10 m in height with bright green leaves and clusters of small slender white flowers and having blue berries. It contained in the form of decoction, infusion and extract of root bark.

In case of infusion preparation, a cup of boiling water is poured over 1-2 teaspoons of chopped root bark and left to steep for 10-15 minutes. This infusion has to be drunk three times a day. While tincture preparation, an equivalent amount about 1-2 ml, is taken three times a day (Van Wyk and wink, 2018). In recent days, root bark is used in homeopathy for hepatitis and icterus (Guermonprez *et al.*, 1997). In folk medicine, it is used for cholagogue, diuretic and hepatic disorders (Duke and Wain, 1981). It is also used to cure jaundice, gall stone, hepatitis, liver tonic, bitter tonic, febrifuge, anti ametic, laxative, minor wounds, sores, bruises, inflammation with infected wounds and other disease associated with poor liver function. In homeopathic medicine, it is used for migraine, head ache and symptom of depression. American Indians use this plant to cure malaria (Singh and Somaday, 2005).

It also improves the skin health of elderly people due to its antioxidant property and having cosmetic application. Hence, it is used in pharmaceutical industries. Stem and root bark having lignin and phillyrin (Steinegger and Jacober, 1959). Root bark contains pinoresinol- β -D-glucoside and pinoresinol di- β -D-glucoside that is potential as an oxidant agent (Gulcin *et al.*, 2007). Leaves, have flavonoids such as rutin, kaempferol-3-glucoside, kaempferol-3-rutinoside, quercetin tri glycosides, triterpenoid compound in the form of ursolic acid (Harborne and Green, 1980). Flowers of *C. virginicus* were used for alpha glucosidase inhibitory activity, anti-inflammatory, anti-wrinkle and whitening activities. It is also used for managing health related issues and cosmetic concern of the aging population (Lee and Cho, 2018).

Chionanthus mala-elengi (Dennst.) P.S. Green is an endemic tree species of Peninsular India, Western Ghats belongs to the family Oleaceae. Local name of the species is 'kallidala' and 'mala-elengi'. It is an occasionally near threatened species. Based on the literature survey, it was revealed that the plant *Chionanthus mala-elengi* is used as an

indigenous folk herbal medicine by the local physicians of Malabar area (Kerala). The Flowering period is from December to April. In India, it is distributed in evergreen forest of Karnataka, Kerala and Tamilnadu at an altitude between 150-800 meters (Pius *et al.*, 2015; Narayanan *et al.*, 2018). Leaves, bark and kernel of the fruit is used for giddiness, liver affection, epilepsy and similar affection of the brain. The whole plant paste is used for wound healing (Manilal and Remesh, 2010; Deepa *et al.*, 2016; Kumar *et al.*, 2016). As far as our literature survey could ascertain, no scientific research study was available on this plant. This is the first effort to find out the phytochemical, pharmacognostic and pharmacological profile of the endemic plant *Chionanthus mala-elengi*.

The major objective of the present study is to focus on the evaluation of the the pharmacognostic, phytochemical and pharmacological properties of *Chionanthus mala-elengi* based on the following studies.

1. Morphological and Microscopical characteristics
2. Physicochemical and Fluorescence studies of *C. mala-elengi*
3. Qualitative and Quantitative phytochemical evaluation of *C. mala-elengi*
4. *In vitro* studies to assess the secondary metabolites for their
 - Antioxidant activity
 - Antimicrobial activity
5. To evaluate the chemical compounds and functional groups of the crude drugs by
 - FT-IR analysis
 - GC-MS analysis
6. *In vitro* antidiabetic property to assess
 - α -amylase assay
 - α -glucosidase assay
7. *In vitro* cytotoxicity assay to determine anticancer property by MTT assay
8. *In vivo* pharmacological properties to assess
 - Acute toxicity
 - Wound healing activity
 - Hepatoprotective activity
 - Histopathological studies