4. PLANT PROFILE

4.1. Piper betle

- **Vernacular Names**[122, 123]

  Sanskrit: Nagavallari, Nagini, Nagavallika,Tambool, Saptashira

  Malaysia: Sirih, Sirih melayu, Sirih cina

  English: Betel, Betel pepper, Betel-vine

  Tamil: Vetrilai

  Telugu: Nagballi, Tamalpaku

  Hindi: Pan

  Gujurati: Nagarbael

  Marathi: Nagbael

  Bengali: Pan

Figure 4.1 Piper betle Leaf

- **Classification**[124]

  Kingdom: Plantae

  Division: Magnoliphyta

  Class: Magnolipsida

  Order: Piperales

  Family: Piperaceae

  Genus: Piper

  Species: *betle*

  Binomial name*: Piper betle* L.

- **Morphological description**[124]

  Dimensions: Length of leaf: 8-16 cm and Width of leaf: 6-12 cm

  Color and condition: Green to dark green and fresh leaves

  Lamina Composition and venation: Simple and reticulate

  Margin and apex: Entire and acuminate

  Base: Broadly cordate leaves with rounded base

  Surface and texture: Thick lamina with smooth and glabrous surface

  Petiole: Long petiole 1.5 to 4.5 cm long

  Leaf base: Stipulate leaves

Phyllotaxis: Alternately arranged leaves

Taste: Aromatic

Odor : Characteristic and pleasant

- **Cultivation[125]**

  It is cultivated in soil, which is black, friable, clay loam resembling tank earth, contains huge portion of organic materials. The plant grown from sea level to 1000 meter, rainfall of more than 179 cm is required. The plant type in partially controlled cultivation is modified to suit the prevailing conditions. Such weather conditions with adequate sunshine (photo synthetically active radiations 1200-1800µ mole m^{-2} S^{-1}) are scarcely favorable to good growth. With the advancement in greenhouse/glasshouse construction technology, now it is quite easy to shift plants from their natural habitat and grow them under controlled conditions by regulating precisely the humidity incident of light and temperature.

- **Chemical Constituents[124]**

  Chavibetol, Allypyrocatechol, Chavibetol acetate, Eugenol, Piperitol, Quercetin, Luteolin, ß- sitosterol, Hydroxychavicol, a-terpineol, D- limonene, Myrcene, Cavacrol, Terpinolene, Gallic acid, Arecoline, Piperine, Piperbetol, Piperol-B, Piperol-A, Ellagic acid etc.

- **Pharmacological activities**

  1. ***Hepato-protective activity***

     The antihepatotoxic effect of betel leaf extract was evaluated on ethanol and carbon tetrachloride (CCl_4) induced liver injury in a rat model.[126] The histological examination showed that the betel leaf extract protected liver from the damage induced by CCl_4 by decreasing alpha smooth muscle actin (alpha-sma) expression, inducing active matrix metalloproteinase-2 (MMP2) expression through the Ras/Erk pathway, and inhibiting TIMP2 level that consequently attenuated the fibrosis of liver. These findings support a chemo preventive potential of betel leaf against liver fibrosis.[127]

  2. ***Nuropharmacological activity[128]***

     Hydro alcoholic extract of betel leaves demonstrated improvement in the discrimination index, potentiating the haloperidol induced catalepsy, reduction

in basal as well as amphetamine induced increased locomotors activity and delay in sodium nitrite induced respiratory arrest.

3. ***Cardiovascular or platelet inhibition activity***

   The heart shape of betel leaf makes it a suitable candidate for heart-related curative properties. Leaf is considered to provide strength to the heart (cardio tonic) and regulates irregular heart beat and blood pressure. Platelet hyperactivity is important in the pathogenesis of cardiovascular diseases due to intravascular thrombosis. Piperbetol, ethylpiperbetol, piperol A and piperol B isolated from leaves, selectively inhibited platelet aggregation induced by platelet activating factor (PAF) in a concentration dependent manner.[129]

4. ***Antidiabetic activity***

   The aqueous extract of betel leaves have discernible hypoglycaemic activity when tested in fasted normoglycaemic rat.[130] The ability of lowering blood glucose level of Streptozocin induced diabetic rat gives a suggestion that the extract have the insulinomimetic activity.

5. ***Anti cancer activity***

   Supplementation of *betle* leaf extract in drinking water significantly reduced the benzo (a) pyrene-induced forestomach neoplasia in a concentration dependent manner in mice. Thus, the leaf extracts of *Piper betle* have anti proliferative and chemo preventive potential and can be used for the treatment of various ailments including human lung cancer.[131]

6. ***Anti-allergic activity***

   Piper betle may offer a new therapeutic approach for the control of allergic diseases through inhibition of production of allergic mediators. The goal of an antiseptic was to eliminated or reduced the number of microorganisms in the surgical field at the time of the surgery.[132]

7. ***Anti-dengue Activity***

   The ethanol plant extract of *P. sarmentosum* possessed larvicidal effect on larvae of dengue mosquitoes of *Aedes aegypti* (LC50 of 4.06 ppm). Concurrently, the extract was also found to exert adulticidal activity (LC50 of 0.14 µg) when tested against female *A. aegypti* mosquitoes.[133]

4.2. Rubia Cordifolia

Figure 4.2 Rubia cordifolia Root

- **Vernacular Names**[134]

  Sanskrit: Aruna, Bhandi, Bhandiralatik

  Assamme: Mandar, Majathi

  Bengali: Manjistha

  English: Indian Madder

  Malayalum: Manjithi

  Marathi : Manjestha

  Hindi: Majit, Manjit

- **Classification**[135]

  Kingdom: Plantae

  Class: Dicotyledoneae

  Subclass : Sympetalae

  Order : Rubiales

  Family: Rubiaceae

  Genus: Rubia

  Species*:* Cordifolia

- **Morphological description**[135]

  Plant: Perennial herbaceous climber

  Roots: Long, cylindrical, flexuous with a thin red bark

  Stems: Very long, rough, grooved and woody base

  Branches: Scandent, quadrangular, glabrous and shining

  Leaves: Arranged in four whorls, ovate

  Fruits: 4-6 mm in diameter, globose, purplish black when ripe

  Flowers: Small, greenish, terminal panicle-cymes

- **Cultivation**[136]

  The species is found throughout the hilly subtropical to sub-temperate regions of India, between 300 m and 2000 m altitudes. Rubia cordifolia occurs mostly in loamy soil rich in humus. The rainfall is high in the regions in which this plant grows. The plant is a climber and requires support for growth. Crop maturity and harvesting R. cordifolia starts flowering after one year in August and seeds

mature in October–November. Roots can be harvested after two years at preflowering stage in October or late fruiting Rubia cordifolia – dry root stage by the end of November or even in early December when seed is required for next crop. The crop can, however, be allowed to stand in the field for three years.

- **Chemical Constituents**[135]

  The Roots contain Quinones like glycosides including rubiadin, rubiprasin A, B, C, mangistin, alizarin, garancin, mollugin and anthraquinone like munjistin, purpurin, and psudopurpurin. The dried roots contain furomollugin, eugenol and anethole as chief component in the essential oil and eugenol, geraniol and geranyl acetate were the most aroma compounds.

- **Pharmacological activities**

  1. ***Anti-arthritic activity***

     The anthraquinones rich fraction of ethanolic extract of R. cordifolia has imperative anti-arthritic potential and showed paw edema inhibition in FCA induced arthritic model, which is similar to a standard NSAID, aspirin.[137]

  2. ***Anti-cancer activity***

     The crude aqueous extracts demonstrated growth inhibitory activity on selected cancer cell lines as well as on normal human mammary epithelial cells.[138] The quinones and RC-18 exhibited significant anticancer activity against P388 leukemia, L1210, L5178Y, B16 melanoma.[139] Mollugin may have potential as a chemotherapeutic agent for human oral squamous cell carcinoma cells via the upregulation of the HO-1 and Nrf2 pathways and the down regulation of NF-κB.[140]

  3. ***Anti-diabitic activity***

     Alcoholic extract of root and leaf extracts were found to have shows potential antidiabetic activity against animal models. The extract of roots reduced the blood sugar level in alloxan treated diabetic rats, shows that the extract has an extra pancreatic effect.[141] Methanolic root extract inhibited glycated and fructated guanosine and ROS-modification of glycated and fructated guanosine, which demonstrates its antiglycation, antioxidant and anti-diabetic activities.[142]

4. ***Anti-inflammatory activity***

   Rubia cordifolia root extract has been used as anti-inflammatory agent because of the presence of rubimallin. It also inhibited the lipoxygenase enzyme pathway, which catalyses the production of various inflammatory mediators such as leukotrienes that are involved in asthma, arthritis, and other inflammatory disorders, and the production of cumene hydroperoxides.[143]

5. ***Anti-oxidant activity***

   Rubia cordifolia contains a wide variety of antioxidants like alizarin, hydroxyl anthraquinones and rubiadin which have been using in various medicaments. Extracts can protect peroxidation and reduced glutathione content in rat liver homogenate compared with vitamin E and parabenzoquinone.[144]

6. ***Hepatoprotective activity***

   The quinone derivatives from Rubia cordifolia reported to have hepatoprotective effect on animal systems. Animal model studies proved that the methanolic extract protects the liver thioacetamide-induced hepatotoxicity. The aqueous-methanol extract is active against acetaminophen and CCl_4-induced hepatic damage in rats.[145]

7. ***Nuroprotective activity***[146]

   Rubia cordifolia has been reported to contain a wide variety of antioxidants and exhibited strong free radical scavenging properties against reactive oxygen and nitrogen species. The herb attenuate oxidative stress mediated cell injury during oxygen glucose deprivation and exert the above effects at both the cytosolic as well as at gene expression level and may be an effective therapeutic tool against ischemic brain damage. The alcoholic extract administration reduced the β-amyloid induced cognitive and memory dysfunction in rats.