Chapter 1

General Introduction
Science is a way of thinking much more than it is a body of knowledge

-Carl Sagan

Plants continue to be an important therapeutic aid for alleviating ailments of human mankind. Search for eternal health, longevity of life, remedy to relieve pain and discomfort prompted the early man to search for therapeutic agents. Medicinal plants since times immemorial have been used in virtually all cultures as a rich source of medicine for various ailments. The World Health Organization estimated that more than 80 percent of the population in developing countries relies on traditional medicine, mostly herbal medicines, for their primary health care needs due to their availability, accessibility and affordability. With the scarcity of doctors, paucity of hospitals and clinics, the large populations in developing countries have to rely on sources other than allopathic medicine for their health care (Petrovska, 2012).

Traditional and folklore medicine bequeathed from generation to generation is rich in domestic recipes and communal practice. Encompassing concepts and methods for the protection and restoration of health, traditional medicine has served as a fount of alternative medicine, new pharmaceuticals, and healthcare products. The best known examples of traditional medicine, differing in concept and protocol, are well-developed systems such as acupuncture and ayurvedic medicine that have been widely used to conserve human health in China and India.
India has 15 Agro climatic zones, 47,000 different plant species and 15,000 medicinal plants. The Indian Systems of medicine have identified 1500 medicinal plants, of which 500 species are widely used in the preparation of drugs for the treatment of various diseases. The medicinal plants contribute to cater 80% of the raw materials used in the preparation of drugs. The effectiveness of these drugs mainly depends upon the proper use and sustained availability of genuine raw materials. It is greatly to the credit of the people of India that they were acquainted with a far larger number of medicinal plants than the natives of any other country on the faces of the earth. Most of the plants used today were known to the people of ancient cultures throughout the world and were highly considered as their preservative and medicinal powers.

Herbs are staging a comeback and herbal ‘renaissance’ is happening all over the globe. The herbal products today symbolize safety in contrast to the synthetics that are regarded as unsafe to human. Although herbs had been priced for their medicinal, flavoring and aromatic qualities for centuries, the synthetic products of the modern age surpassed their importance, for a while. However, the synthetics have been fallen out of use and phytotherapy is continued with hope of safety and security. Natural products have played a significant role in drug discovery and development, especially for agents targeted against cancer and infectious diseases. Ethno-traditional use of plant-derived natural products has been a major source for discovery of potential medicinal agents (Gonzales and Valerio, 2006).
The Indian indigenous drugs have great importance both from the professional and economic point of view. Although Indian traditional systems of medicine are based on humoral pathology, each has got certain characteristic and distinct feature of its own. Plants possessing anti-inflammatory and/or anti arthritic activity are being used in Ayurveda, Siddha and Unani systems of medicine (Satakopan, 1994). The Ayurvedic system of medicine uses about 700 species, Unani 700, Siddha 600, Amchi 600 and modern medicine around 30 plant species. These drugs are derived either from the whole plant or from different parts like leaves, stem, bark, root, flower, seed, etc. Some drugs are prepared from excretory plant products such as gum, resins and latex. Even the allopathic system of medicine has adopted a number of plant-derived drugs which form an important segment of the modern pharmacopoeia.

Plants have the ability to synthesize a wide array of chemical compounds that protect them against the attack from a wide variety of predators such as microbes, insects, and herbivorous mammals. Some of these compounds, while being toxic to plant predators, turn out to have beneficial effects, when used to treat human diseases. Such secondary metabolites are highly varied in structure; many are aromatic substances, most of which are phenols or their oxygen-substituted derivatives. Chemical compounds in plants mediate their pharmacological as well as beneficial effects on the human body by binding to receptor molecules present in the cells. Most of the herbs and spices used by human yield useful medicinal compounds.
However, similar to prescription drugs, a number of herbs are thought to be likely to cause adverse effects due to "adulteration, inappropriate formulation, or lack of understanding of interactions have led to adverse reactions that are sometimes life threatening or lethal.

Several medicinal plants have been used as dietary adjunct and in the treatment of numerous diseases without proper knowledge of their contents and function. Although phytotherapy continues to be used in several countries, most of the traditional medicinal plants have not received scientific or medical scrutiny. One such traditionally important medicinal plant, which lacks scientific evidence for its folklore use is *Pithecellobium dulce* Bentham(1875).

*The Leguminosae* is one of the largest families of flowering plants with 12000 species classified into around 600 genera. The family is usually divided in to three sub families: Papilionoidae, caesalpinioideae and mimosoideae, which are known to contain, around 377,40 and 133 genera respectively (Trease and Evans, 1985). *Pithecellobium* is one of 100-200 species in this genus under the subfamily of *mimosoideae* and distributed in the tropics, chiefly in Asia and America. About 10 species, *P. clypearia*, *P. dulce*, *P. monadelphum*, *P. globosum*, *P. unguiscati*, *P. arboreum*, *P.flexicaule*, *P. jiringa*, *P. parviflorum* and *P. mart* etc commonly occur in India.
*Pithecellobium dulce* Bentham (1875) is one of the familiar species among them, commonly referred as manila tamarind, as its sour taste resembles tamarind. The generic name is derived from the Greek word ‘pithekos’ meaning an ape and lobos referring to a pod and the species name ‘dulce’ in Latin means sweet in allusion to the edible pulp of the pod. Because of the close resemblance of the fruits to the Indian sweet jalebi, the plant also earns the name jungli jalebi. The vernacular name of this plant known as in Hindi: vilayati babul; Tamil: Kodukkapuli; Kannada: Kottampuli, Seemae Hunase; Bengali: Dekhani Babul; Marathi: Vilayati hinch; Telugu: Simachinta; Malayalam: Korukkapuli etc (Nandkarni 1982).

*Pithecellobium dulce*

*Pithecellobium dulce* Benth. (*Leguminosae*) is a small to medium sized, evergreen, spiny tree up to 18 m height, native of tropical America and cultivated throughout the plains of India and in the Andamans.

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PLANT DESCRIPTION

_Pithecellobium dulce_ is a well known Indian medicinal plant. The species has become naturalized where planted and is now widely distributed throughout the plains in India, Srilanka, Pakistan and Andamans. The tree usually stands up to 25m in height. They are broad-spreading with irregular branches. The bark is grey, becoming rough, furrowed and then peeling. Leaves are bipinnate, and leaflets oblong to 4 cm in length. The spines are in pairs at the base of leaves, and rang from 2 to 15 mm in length. The flowers are small in size with white heads of about 1 cm in diameter. Each flower has a hairy corolla and calyx surrounding about 50 thin stamens united in a tube at the base. Flowering begins in 3-4 years and is seasonal (January to March) and the fruits ripen from April to July. The pods are curved or twisted, constricted, pinkish, 1-1.5 cm wide, about 12 cm long, and become spiral as they mature.

Seeds are about 10 per pod, black and shiny, hanging on a reddish thread from the pod. Seeds can be easily separated from the mature fruits and they remain viable for about six months. Seeds can be used for direct sowing. However, propagation by stem cuttings is often preferred. The seeds germinate 1 to 2 days after sowing without any pretreatment. The seed oil is suitable for edible purposes and for soap manufacture. Seedlings reach a good out planting height of 40cm about in three months after sowing. The pod splits along both margins. Bark smooth, grey with yellowish white lenticles. Pod pulps are consumed as food in many parts of India because of their sweet
taste and medicinal properties. Back in a few decades ago, the old folk used to colour their silk and other garments by using the colour of the pod pulps.

The photographs of *Pithecellobium dulce* fruits, Seeds, Pod pulp are presented in Plate 1 and Plate 2.

**ECOLOGY**

*P. dulce* grows well at low and medium altitudes in both wet and dry areas under full sunlight. It is a strong light demander, but can stand a considerable shade. Generally found in the plains, it can also survive in undulating terrain. *P. dulce* can grow on poor soils, on wastelands and even with its roots in brackish water. It is a drought resistant species but susceptible to frost, coming up well in areas of low rainfall due to its extensive root system. *P. dulce* is noted for their tolerance of heat, drought, salinity and impoverished soils.

**ETHANO MEDICAL USES**

Leaves can be used as a plaster to allay pain even from veneral sores, and can relieve convulsions. The leaves together with salt can cure indigestion. The fruits are sold by the street vendor during the seasons at a very low cost. In Mexico, the aril is widely used in the preparation of a beverage similar to lemonade. The saline extract of the seeds showed a haemolytic agglutinating reaction with human blood. The bark of the root is good for dysentery, and as a febrifuge in Guiana. The decoction is given as an
enema. The bark extract reported to be a folk remedy for ear ache, leprosy, peptic ulcer and tooth ache. It also acts as emollient, anodyne and larvicide in folk medicine. Infusions of different parts have been used traditionally to treat diseases, such as skin of the stem for dysentery, leaves for intestinal disorders, and seeds for ulcer, among others (Nandkarni, 1982; Chopra, 1992; Sivakumar and Murugesan, 2005; Rajasab and Mahamad Isaq, 2004; Aguilar et al., 1996; Fall et al., 1998; Rzedowski 1985).

PRODUCTS

**Food**: Pods contain a pulp that is variably sweet and acid, commonly white but also red. The pulp is made into a sweet drink similar to lemonade and also eaten roasted or fresh in India. In Mexico, Cuba and Thailand, the pods are harvested and are customary sold on roadside stands.

**Fodder**: The pods and leaves gathered from hedge clippings are devoured by all livestock; horses, goats, camels, cattle and sheep. The presscake residue from seed oil extraction may be used as stock feed.

**Apiculture**: Flowers are visited by bees and yield good quality honey.

**Fuel**: Fast-growing and coppices vigorously but due to its smokiness and low calorific value (5 177-5 600 kcal/kg), *P. dulce* wood is not of very high quality. In parts of India, it is planted and harvested to fuel brick kilns.

**Timber**: Sapwood is yellowish, and heartwood yellowish or reddish-brown. The wood of *P. dulce* is strong and durable yet soft and flexible. It is
moderately hard and usually straight grained. It weighs about 590 kg/m³, is easy to saw and finishes to a smooth surface. In south India, it is used to make drums, while in China, it is said to be used for matches. It can be used in construction and for posts. However, the short spines and irregular, crooked growth make it less attractive for wood uses.

**Gum or resin:** The wounded bark exudes a mucilaginous reddish-brown gum somewhat like gum arabic.

**Tannin or dyestuff:** Tannin, used to soften leather, can be extracted from the bark (about 25%), seeds and leaves; the bark is also used to dye fishnets a yellow colour.

**Lipids:** Seeds contain greenish oil (20%), which, after refining and bleaching, can be used for food and can substitute kapok and ground nut seed oils.

**SERVICES**

**Shade or shelter:** The tree is extensively planted for its dense shade.

**Reclamation:** Since it can grow on waste and denuded lands, *P. dulce* can afforest and conserve poor soils.

**Nitrogen fixing:** *P. dulce* forms root nodules with Rhizobium bacteria. Nodulation is common in all types of soil, but quantitative data on fixation has not been reported.
**Ornamental:** Very popular as an ornamental and is used in topiary (plant sculpturing). Trees with variegated leaflets are available as ornamental pot plants in Hawaii.

**Boundary or barrier or support:** With regular trimming, *P. dulce* makes a dense, almost impenetrable thorny hedge that keeps out livestock and forms useful shelter belts; for hedges, seeds may be sown in 2 rows of 15 x 30 cm

The bark of the plant is reported to be used as astringent in dysentery, febrifuge and it is also useful in dermatitis and eye inflammation. The leaves have been reported to possess astringent, emollient, abortifacient and antidiabetic properties. A steroid saponin, tannins, glycosides, glycolipids and polysaccharides have been reported in the seeds (Bhargava et al., 1970; Misra et al., 1979) . The fruits of *P. dulce* have been consumed as a dietary supplement for its high nutritive and medicinal value. The edible fruit has been widely used traditionally to combat gastric problems and found to be non-toxic in nature (Megala and Geetha, 2012). The fruit extract was found to be rich in phenolic compounds and revealed the presence of flavonoids – quercitrin, rutin, kaempferol, naringin and daidzein (Megala and Geetha, 2010).

According to ethanobotanical data, the fruit or pods possesses an antidiabetic effect which has never been experimentally demonstrated. Survey of Literature shows that antidiabetic activity of fruit pods of *P. dulce* have
not been carried out in the past. In the light of the above folklore uses, the present study was carried out to scientifically validate the hypoglycemic, hypolipidemic, antioxidant and of *P. dulce* pod pulp (edible part of the fruits) on streptozotocin induced experimental diabetes in rats. Also, the antimicrobial properties against clinically important bacterial and fungal strains were evaluated.