CHAPTER – 1

Introduction

India has a rich tradition of plant-based knowledge on healthcare. A large number of plants/plant extracts/decoctions or pastes are equally used by tribal and folklore traditions in India for treatment of various diseases. Indigenous medicine is generally transmitted orally through a community, family and individuals until "collected". Within a given culture, elements of indigenous medicine knowledge may be diffusely known by many, or may be gathered and applied by those in a specific role of healer. Three factors legitimize the role of the healer - their own beliefs, the success of their actions and the beliefs of the community. The relationship between humans and plants goes back as far as human history itself. Humans have always relied upon the plant world as a source of food and medicine, sustenance and well being.

From prehistoric days, plants are used for shelter, food and medicine. The use of plants for medicinal purposes is as old as our civilization. The first known written record of curative plants was of Sumerian herbal of 2200 BC. In the 5th century BC, The Greek doctor Hippocrates list out some 400 herbs in common use. Dioscorides, in the 1st century AD, wrote an herbal by using 600 plants which ultimately became the base for many later works. Herbs have been used for uncounted time for various purposes like healing the sick and infirm. Most of the people still continue to use herbs to benefit their bodies. People thought that herbs keep the body in tune with nature as intended and maintain proper balance. Many scientific studies are still continued with modern research following the lead of old folklore and herbal uses to help finding new western medicine. Man has also been aware of the effects of herbs on the body, mind and emotion. For example - flowers were utilized to attract love, food and protection. Fragrant plants were
worn to heal the body and give a sense of well being. The most costly flowers are offered to gods and goddesses and the use of aromatic incense is recorded from the earliest of times.

Many herbs and minerals used in ayurveda were described by ancient Indian physicians such as charaka and sushruta. The sushruta samhita attributed to sushruta in the 6th century BC describes 700 medicinal plants. India's use of plants for health care also dates back close to 5000 years. About 8000 herbal remedies have been codified in the Ayurveda, which is still in use in many dispensaries today.[1]

For quite a long time, the only way to use plant medicines was either direct application or the use of crude plant extracts. With the development of organic chemistry at the beginning of this century, extraction and fractionation techniques improved significantly. It became possible to isolate and identify many of the active chemicals from plants. In the 1940s, advances in chemical synthesis enabled the synthesis of many plant components and their derivatives. It was thought that chemical synthesis of drugs would be more effective and economical than isolation from natural sources. Indeed, this is true in many cases. However, in many other cases, synthetic analogues are not as effective as their natural counterparts. In addition, some synthetic drugs cost many times more than natural ones. Inspired by these realizations, coupled with the fact that many drugs with complex structures may be totally impossible to synthesize, there is now a resurgent trend of returning to natural resources for drug development.

Traditional Herbal Medicine is a practice of protecting and restoring health that existed before the relatively recent arrival of modern medicine. Traditional Herbal Medicine often serves as one component of a comprehensive system of medicine that may involve the use of plant, animal and mineral based medicines,
and spiritual therapies, regulation of diet and exercise, and manual techniques to maintain health but also to prevent and treat illnesses.

In developing countries still rely primarily on Traditional Medicine for their healthcare. The use of Traditional Herbal Medicine in industrialized countries is also spreading rapidly, where Traditional Herbal Medicines are often referred to as alternative medicines or complementary medicines or even as herbal dietary supplements or natural health products.

Traditional medicine is the sum total of knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures that are used to maintain health, as well as to prevent, diagnose, improve or treat physical and mental illnesses.

Traditional medicine that has been adopted by other populations is often termed alternative or complementary medicine. Traditional medicine describes medical knowledge systems, which developed over centuries within various societies before the era of modern medicine. Practices known as traditional medicines include Ayurvedic, Unani, Ancient Iranian, Siddha, Islamic and traditional Chinese medicine, acupuncture, and other medical knowledge and practices all over the globe.

For thousands of years, humans have used herbs. Herbs have been used in the following ways - In cooking for flavoring foods, as perfumes, as disinfectants, to protect us against germs, as medicines to heal when we are sick. Herbal medicines include herbs, herbal materials, herbal preparations, and finished herbal products that contain parts of plants or other plant materials as active ingredients.
Herbs are generally defined as non-woody plants, which die after blooming. This definition has been expanded to any of the plants of which part or whole can be used in medicinal treatments, culinary preparations, nutritional supplementation, or used as a coloring or cosmetic agent. Fresh herbals and medicinal plants can be acquired by gathering them in wild conditions, growing them in your own personal garden, or buying them from other gardeners and health food stores.

Herbs are considered to be food rather than medicine because they are complete, all-natural and pure, as nature intended. When herbs are taken, the body starts to get cleansed, it gets purifying itself. Unlike chemically synthesized, highly concentrated drugs that may produce many side effects, herbs can effectively realign the body's defenses. Herbs do not produce instant cures, but rather offer a way to put the body in proper tune with nature.

With the realization that chemical medicines are not always "magic bullets" and may carry serious side effects, ancient medicines are making a comeback. Our challenge now is to ensure that valued botanicals should remain abundant for future generations.

There are several ways to prepare herbs for consumption and use in medicinal remedies. When herbs are prepared by steeping in boiling water to be drunk as a tea, they are known as an infusion. If these dried herbs get simmered in hot water, they are called as decoction. If gets incorporated in with other ingredients and made into cream, they are viewed as an herbal ointment. Sometimes used an Herbal compress where piece of cloth is soaked in an infusion or decoction and is wrapped and applied externally. If herbs are used to cleanse and heal externally, they are called herbal wash. Herbal infusions and decoctions can also be used as herbal bath for relaxation and healing. Always follow the
recommended dosages on your preparations and recipes because over-use of herbs can defeat the purpose for which you are using them. Some of the most beneficial herbs can prove to be toxic if over used.

The word drug itself comes from the Dutch word "drug" (via the French word Drogue), which means 'dried plant'. Some examples are inulin from the roots of dahlias, quinine from the cinchona, morphine and codeine from the poppy, and digoxin from the foxglove. The active ingredient in willow bark, once prescribed by Hippocrates, is salicin, which is converted in the body into salicylic acid. The discovery of salicylic acid would eventually lead to the development of the acetylated form acetylsalicylic acid, also known as "aspirin", when it was isolated from a plant known as meadowsweet. The word aspirin comes from an abbreviation of meadowsweet's Latin genus Spiraea, with an additional "A" at the beginning to acknowledge acetylation, and "in" was added at the end for easier pronunciation. "Aspirin" was originally a brand name, and is still a protected trademark in some countries.

The World Health Organization (WHO) defines traditional medicine as:

The health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illnesses or maintain well-being\(^2\).

In Asian countries like India up to 80% of the population relies on traditional medicine for their primary health care needs. When adopted outside of its traditional culture, traditional medicine is often called complimentary and alternative medicine. Herbal medicines can be very lucrative, generating billions
of dollars in sales, but adulteration or counterfeit herbs can also be a health hazard.\[2\]

WHO also notes, though, that "inappropriate use of traditional medicines or practices can have negative or dangerous effects" and that "further research is needed to ascertain the efficacy and safety" of several of the practices and medicinal plants used by traditional medicine systems.\[2\]

All plants produce chemical compounds as part of their normal metabolic activities. These include primary metabolites, such as sugars and fats, found in all plants, and secondary metabolites found in a smaller range of plants, some useful ones found only in a particular genus or species. Pigments harvest light, protect the organism from radiation and display colors to attract pollinators. Many common weeds have medicinal properties.

The functions of secondary metabolites are varied. For example, some secondary metabolites are toxins used to deter predation, and others are pheromones used to attract insects for pollination. Phytoalexins protect against bacterial and fungal attacks. Allelochemicals inhibit rival plants that are competing for soil and light.

Plants upregulate and downregulate their biochemical paths in response to the local mix of herbivores, pollinators and microorganisms\[3\]. The chemical profile of a single plant may vary over time as it reacts to changing conditions. It is the secondary metabolites and pigments that can have therapeutic actions in humans and which can be refined to produce drugs.

Proper double-blind clinical trials are needed to determine the safety and efficacy of each plant before they can be recommended for medical use.\[4\] In addition, many consumers believe that herbal medicines are safe because they are natural. Herbal medicines may interact with synthetic drugs causing toxicity to the
patient, herbal products may have contamination that is a safety consideration, and herbal medicines, without proven efficacy, may be used to replace medicines that have a proven efficacy.\[5\]

Herb drug interactions are a concern in consultation with a physician, usage of herbal remedies should be clarified, as some herbal remedies have the potential to cause adverse drug interactions when used in combination with various prescription and over-the-counter pharmaceuticals.

Many herbs have shown positive results in-vitro, animal model or small-scale clinical tests\[6\] but many studies on herbal treatments have also found negative results.\[7\] The quality of the trials on herbal remedies is highly variable and many trials of herbal treatments have been found to be of poor quality, with many trials lacking an intention to treat analysis or a comment on whether blinding was successful.\[8\]

Dosage is in general an outstanding issue for herbal treatments: while most medicines are heavily tested to determine the most effective and safest dosages, there are fewer varieties of dosages for various herbal treatments on the market. Furthermore, herbal medicines taken in whole form cannot generally guarantee a consistent dosage or drug quality, since certain samples may contain more or less of a given active ingredient.

Several methods of standardization may be applied to herbs. One is the ratio of raw materials to solvent. However different specimens of even the same plant species may vary in chemical content.
Although traditional medicine is widespread throughout the world, it is an integral part of each individual culture. Its practice is based mainly on traditional beliefs handed down from generation to generation for hundreds or even thousands of years. Unfortunately, much of this ancient knowledge and many valuable plants are being lost at an alarming rate. The scientific study of traditional medicines and the systematic preservation of medicinal plants are thus of great importance.

The scientific study of traditional plant medicines can be considered as a major part of ethnopharmacology. Ethnopharmacology can be defined as ‘the scientific study of materials used by ethnic and cultural groups as medicine’ and in most instances this is synonymous with the study of traditional medicines.

The isolation of some of the opium alkaloids in the early nineteenth century was a key event in the development of modern pharmacy. It showed that isolated compounds had much the same activity as the existing ethnopharmacological material and so paved the way for current orthodox Western medicine which uses pure compounds for treatment. Since then, a vast amount of money has been spent on the synthesis of novel compounds, but also on the isolation of molecules from natural sources and their development into medicines. The contribution of traditional plant medicines to this process has been significant.

It should also be remembered that the active molecules isolated from traditional medicinal plants might not only provide valuable drugs but are also valuable as ‘lead molecules’ which might be modified chemically, or serve as a template for the design of synthetic molecules incorporating the pharmacophore responsible for the activity.
The term ‘drug discovery’ is generally used to refer to the isolation of molecules with activity, it should also be remembered that there is increasing interest and recognition that a ‘drug treatment’ may consist of a mixture of compounds. This has always been the case for plant extracts which contain several ‘active ingredients’. It should be noted that such extracts, usually based introduced and increasingly used as a complementary therapeutic approach in the West.

Several recent surveys have shown that using ethnopharmacology as a basis of selecting species for screening results in a significant increase in the ‘hit rate’ for the discovery of novel active compounds compared with random collection of samples. With a very large number of living organisms still awaiting scientific investigation (about 90% of the estimated 250 000 species of flowering plants, probably the most studied part of the biosphere), ethnopharmacology appears to offer a reasonable selective strategy to be considered in deciding which organisms to study.

The discovery process is composed of several stages. The first stage must be the reported use of a naturally-occurring material for some purpose which can be related to a medical use. Consideration of the cultural practices associated with it is important in deciding possible bases of the reputed activity. If there is an indication of a genuine effect, then the material needs to be identified and characterized according to scientific nomenclature. It can then be collected for experimental studies, usually comprising some tests for relevant biological activity linked with isolation and structure determination of any chemicals present which might be responsible. The ‘active’ compounds are usually discovered by several cycles of fractionation of the extract linked with testing for activity of each fraction, until pure compounds are isolated from the active fractions, a process known as bioassay-guided fractionation. These compounds, once their activity is
proven and their molecular structure ascertained, serve as the leads for development of clinically-useful products.

The mostly reliable type of information arises from in-depth studies carried out by field workers, living in the particular community of a particular ethnic group, on the use of the local plants and other materials. Before such knowledge can be investigated scientifically, the information provided will often need clarification and translation into scientific terms.

The extract used for testing should approximate as closely as possible to that obtained by the traditional process used. Much research which has been published on the chemistry and activity of medicinal species is not very relevant to the traditional uses because it has concentrated on extracts made with non-polar solvents such as ether or chloroform whereas polar solvents are most commonly used. In many cases these will be simple extractions with hot water but a variety of other solvents may be used as well as various additives or treatment of the material before use. In most instances however, it is likely that fairly polar compounds will be extracted although the solubility of less polar substances may be elevated considerably due to solubilizing compounds e.g. saponins, also being present.

Ethanopharmacological research may, however, adopt a different approach when a particular biological effect of the traditional medicines or poison has been noted but the causes are not known. This is often the case when historical data are consulted and ailments are described in terms of their symptoms rather than underlying causes. The biological effect may be essentially toxicological.

The best type of test to verify a reputed activity (and any toxicity) is a well-designed clinical trial but this does not lend itself to bioassay-guided fractionation! It has been argued that long-term use of a material in traditional medicine is a
good indicator of therapeutic efficacy but many are cautious about making such claims, preferring the suggestion that a long history of use is more an indicator of lack of obvious toxicity. *In vivo* animal models of disease states are the next best approach but expense and ethical consideration preclude this type of experiment in many countries, particularly for a fractionation process.

Most test systems for biological activity therefore utilize *in vitro* animal tissue, cultured cells, and cloned receptors or enzymes systems. A large number of tests have been developed in recent years and they offer the opportunity to carry out large numbers of tests using small amounts of materials in a short time and are, therefore, well suited to bioassay-guided fractionation. To be of most value, a range of tests should be chosen which is closely related to the possible underlying causes of the disease, e.g. tests for the efficacy of a preparation for an inflammatory disease such as arthritis should encompass key mechanisms associated with the formation of the various mediators involved such as the lipoxygenases and cyclo-oxygenases involved in eicosanoid synthesis, histamine antagonists, secondary messenger systems such as the cytokine NFκ-B (nuclear factor kappa-light-chain-enhancer of activated B cells), as well as more general oxidation processes involving free radical damage.

The presence of common classes of naturally-occurring compounds can be screened by use of appropriate chromogenic reagents after separation using thin layer chromatography or by more sophisticated techniques such as gas chromatography or liquid chromatography linked with mass spectrometry. These techniques are also valuable in dereplication, the process by which known active compounds present in the extract, are detected, and so time is not wasted in a long bioassay-guided process which culminates in the ‘discovery’ of a well-known compound.
The present study thus attempts to evaluate the bark and leaf of traditional medicinal plant *Thespesia populnea* (fam: malvaceae) which includes:

- To perform a pharmacognostical study, this is useful to evaluate the quality, purity and standard of the plant material.
- To isolate a possible new phytoconstitutents, may verify their validity with their folklore claims.
- To characterize the phytoconstitutents and analyze by various instrumental methods.
- To elucidate the plant extract in to a newer pharmacological activity of greater interest to cure the common ailments and should be proved scientifically.
1.1 Ethanopharmacological information

*Thespesia populnea* is a reputed ever green tree belonging to the family Malvaceae; commonly known as Indian tulip tree. The plant is distributed tropical regions and coastal forest in India. It is well known and all the parts are used in traditional system of medicine.

The root is acrid; the fruit sour, acrid and sweet; difficult to digest; produce worms in the intestine and increase “kapha”; aphrodisiac; remove “vata” and “pitta”; and burning of the body; good for heart disease and throat troubles (Ayurveda).

In the central India, the root is taken as a tonic. In the Konkan, the flowers are employed in the cure of itch; and the leaves are employed as a local application to inflamed and swollen joints. The fruits yield a yellow, viscid juice, which forms a valuable local application in scabies and other cutaneous diseases. The affected parts of the body are daily washed with a decoction of the bark. A decoction of the bark is given internally as an alternative.

The bark is astringent and is prescribed in the Philippines for the treatment of dysentery in the form of a decoction. The fruit, leaves, and root are applied externally in scabies and other skin infections.

In Tahiti, the fresh capsules, bruised and applied to the forehead are said to cure migraine; the yellow sap exuding from the peduncles is considered a cure for the bites of insects, especially of the centipede; it is also useful in sprains, bruises, and all cutaneous infections. In Mauritius, the bark is described as depurative, as used in dysentery, hemorrhoids; the juice of the fruits being applied to warts. In Madagascar a decoction of the bark is commonly used in chronic dysentery and cutaneous diseases; the sap is applied externally for herpes. Rumphius speaks
highly of the value of the heartwood as a remedy for bilious attacks and colic, and in a kind of pleurodynia from which the Malayas often suffer.

Waring used the bark in scabies and other cutaneous diseases; in some cases, it exercised a favorable influence, but in the majority it was productive of little or no benefit.[9]

The leaves are ground into a paste and applied externally in children’s eczema; so also oil prepared by boiling the ground bark in coconut oil is applied externally in psoriasis and scabies. The contents of the fruit which is a capsule are applied externally to ringworm. A decoction of the bark is given internally in skin diseases. The ground leaves and contents of the capsules applied externally in eczema and ringworm respectively were found to be useful. A compound oil of the bark and capsules was given in cases of urethritis and gonorrhea with beneficial results.

The bark, leaves, flowers and fruits are reported to be useful in cutaneous affections, such as scabies, psoriasis, ringworm, guinea worm and eczema. The yellow juice of fruits is employed in treating certain herpetic diseases. A decoction of the bark is given internally in the disease of skin and that of the fruits as an antidote for poisoning. The fruit contains a principle which is active against both Gram-positive and Gram-negative bacteria; the principle is remarkably active against enterobacteria, and is promising for exploitation as a cure in intestinal disturbances. The seeds yield deep-red, thick fatty oil which is also used in cutaneous diseases. A compound oil of bark and capsules is useful in urethritis and gonorrhea. The astringent bark, roots and fruits are stated to be used in dysentery, cholera and hemorrhoids; the mashed bark is employed as a poultice or hot fermentation for wounds.
The young buds and leaves have a pleasant taste and along with the flowers are eaten either raw, cooked or fried in butter. The leaves are lopped for fodder and manure. They are reported to be employed as a local application to inflamed and swollen joints. The extracts of leaves are active against *Micrococcus pyogenes* var. *aureus* and *Escherichia coli*. The root is reported to be toxic. The seeds possess purgative properties. The plant has been shown to be effective in malaria. The pollen may also cause allergy\[^{10}\].

The heart-wood is used as a remedy in bilious attacks and colic, and in a kind of pleurodynia from which the Malays often suffer. The fruit abounds in a viscid yellow juice of the color of gamboge, which the natives use as an external application in psoriasis. The leaves are applied to inflamed and swollen joints. The tree is called in Sanskrit Pārisa and Gardhabhānda; it is noticed by Ainslie, who says that a decoction of the bark is given internally as an alterative to the extent of 3-4 ounces twice daily.\[^{11}\]
1.2 Plant profile

Vernacular names

- English: Portia Tree, Tulip tree, Umbrella tree
- Sanskrit: Gardha-bhanda
- Hindi: Parsipu, porush, paras-pipal, gajadanda
- Bengali: Dumba, parespipal, palaopipal, gojashuni
- Marathi: Parsacha-jhada, bhendi-ke-jhar
- Gujarati: Paarsapeepala
- Telugu: Gangaraavi, munigangaraavi, gangareenu
- Tamil: Poovarasam kallal, cheelanthi
- Kannada: Hoovarase, kandarola, adavi-bendi, jogiyarale
- Malayalam: Poovarasu
- Oriya: Gunjausto, porosopippoli
- Punjabi: Pararspipal
- French: Porcher
- Portuguese: Pau rosa
- Sinhalese: Gansurigaha, suriya
Botanical information

Kingdom : **Plantae** -- Planta, plantes, plants, Vegetal

Subkingdom : **Tracheobionta** -- vascular plants

Division : **Magnoliophyta** -- angiospermes, angiosperms, flowering plants, phanérogames, plantes à fleurs, plantes à fruits

Class : **Magnoliopsida** -- dicots, dicotylédones, dicotyledons

Subclass : **Dilleniidae**

Order : **Malvales**

Family : **Malvaceae** -- mallows, mauves

Genus : **Thespesia** Soland. ex Correa -- thespesia

Species : Thespesia populnea (L.) Soland. ex Correa.

Habit : A small tree upto 10 metre tall.

Leaves: 7.5-15 cm. Long, broadly ovate, cordate, acuminate, entire, smooth, finely reticulately veined, with 5-7 prominent nerves and often a glandular pore in one or more of the intercostal spaces beneath, sometimes with a few minute peltate scales on one or both surfaces; petioles 5-10 cm.

Flower: Solitary, yellow with purplish centre; Calyx truncate, entire. Petals are five, convolute. Staminal tube toothed at the top, clothed except at the swollen base with the free ends of the filaments. Ovary are five celled; ovules two-three in each cells, styles club-shaped; stigma clavate.
Fruit: Capsules globose, 2.5 cm. diam., covered with minute peltate scales, surrounded at the base by the persistent calyx. Seeds 1 cm. long, ovoid, channelled along the back, pubescent.

Distribution: Coast forest of India and Burma, largely grown as a roadside tree in tropical regions.[12,13]

It is a compact quick-growing, evergreen tree, 18 m. in height and 1.2 m. in girth, with 2.5m. Clear bole, commonly found on the coasts of India and the Andamans; also grown elsewhere in gardens for ornaments. Bark grey to brown, fissured often knobby, fibrous, c. 4.0mm. thick; leaves cordate-ovate, dark green, 7-15 cm. Long; flowers yellow with purple base, completely changing to purple when about to wither, 5.0-7.5 cm.; capsules brown, globose or oblong, 2.5 cm. × 4.0 cm., with persistent calyx; seeds pilose or powdery on the surface, flat, egg-shaped.

The tree is largely cultivated for ornament and shade, and its blooms throughout the year in the tropics. It can grow everywhere including saline soils, except in hilly areas, but prefers light and porous soils. It thrives in moist and warm situations, but can withstand temperatures as low as -4°C. It can easily be raised from the seed or cuttings, the former being preferable. The seed retains its viability even after a prolonged exposure to salt-water. The seed-raised trees are better and more erect than those from the cuttings; the timber from the seed-raised trees being knot-free, straight and even-grained and tough. The growth is rapid. This tree is much valued on account of the toughness of its timber, which is used for carriage building.
Fig: 1 *Thespisia populnea soland ex.correa*
1.3.1 Review of phytoconstituents

1) Eight new sesquiterpenoids, named populene A-H (1-8), were isolated from dichloromethane extracts of the wood and dark heartwood of *Thespesia populnea*, together with 11 known compounds (9-19). Their structures were determined on the basis of spectroscopic analyses.[14]

2) A rare flavonoid, quercetin-7-O-rhamnoglucoside, was isolated from this plant and its identity confirmed by spectral studies.[15]

3) The fruit yielded the following coloring principles: kaempferol-7-glucoside (populnin, 0.33%), Kaempferol (populnetin, 0.07%), herbacetin (mostly present as its glucoside, 0.03%), and a colorless flavonoid populneol (C$_{15}$H$_{14}$O$_{8}$; m.p. 109-100$^\circ$; 0.16%). Besides these, quercetin, gossypetin, kaempferol-3-monoglucoside and β-sistosterol have also been reported from the flowers.[16]

4) A dextro-rotatory gossypol (C$_{30}$H$_{30}$O$_{8}$; m.p. 184$^\circ$) has recently been isolated from the flowers, fruits and bark. This is significant since the gossypol occurring in the cotton-plant is optically inactive, whereas the gossypol from *T. populnea* has a high dextro-rotation, [α]$_D^{17}$ +475$^0$. [17]

5) It is also reported that the presence of thespesin (0.4%), and herbacetin has been reported from fruits (from Lucknow, Uttar Pradesh). Thespesin has, however, later been proved to be the optically active gossypol.[18]

6) A sample of the fully ripe seeds (from Madras) yielded c. 20% of a dark red-colored fatty oil having the following constants: sp.gr. 28°, 0.9251; acid val., 0.53; sap.val., 203.2; iod.val. (Hanus), 71.5; R.M. val., 5.5; reichert-Polenske val., 0.37; and unsap.matter.0.72%. the fatty acid composition of oil is: myristic, 1.0%; palmitic, 21.4; stearic, 1.9; oleic, 32.5; and linoleic, 43.2%. The unsaponifiable matter is reported to contain ceryl alcohol and β-sitosterol.[19]
7) The populneao1 was isolated and identified as monobenzyl ether of γ-resacetophenone; gossypol isolated from flowers; its methylation yielded three isomeric optically active hexamethyl ethers, which were characterized kaempferol, quercetin, rutin, kaempferol-3-rutinoside, kaempferol-3-glucoside, kaempferol-5-glucoside and quercetin-3-glucoside isolated from flowers, calycopterin isolated from heartwood.\(^{[20]}\)

8) Two new sesquiterpenoid quinones – thespesone and thespone – isolated from heartwood and their structures elucidated; mansonones C, D, E and F also isolated.\(^{[21]}\)

9) Isolation of alanine, arginine, methionine and tryptophan from seeds. Lupeol, lupenone and β-sitosterol isolated from leaves.\(^{[22]}\)

10) Lupenone, lupeol, β-sitosterol, alkanes (C19-33) and esters (C40-52) were isolated from leaves.\(^{[23]}\)

11) Bark contain tannin (7%), gossypol, a coloring matter leaves – acacetin, 3', 4'-diomequercetin, vanillic, syringic, gentisic, melilotic and ferulic acid and the flower contain populnin, populnetin (both glycoside of kaempferol), herbacetin, quercetin, gossypectin, gossypol and β-sitosterol while the fruits contain gossypol and herbacetin and the seeds contain fatty oil rich in linoleic acid, oleic acid, ceryl alcohol and β-sitosterol.\(^{[24]}\)
1.3.2 Review of pharmacological activity

1) The cytotoxic activity of isolated sesquiterpenoids compounds was evaluated against four cancer cell lines: MCF-7, HeLa, HT-29, and KB. Mansonone E (11) and (+)-gossypol (18) showed significant activities. Their antibacterial properties against Bacillus subtilis, Staphylococcus aureus, and Enterococcus faecalis were presented.\[^{12}\]

2) The ethanolic extract of *Thespesia populnea* bark extract was investigated for anti-inflammatory and analgesic activity at the dose of (p.o.) of 100, 200, 400 mg/kg in mice. The extracts have significant potential anti-inflammatory and analgesic activity.\[^{25}\]

3) *Thespesia populnea* ethanolic extract of bark was administered orally in three different doses (100, 200, 400 mg/kg) in young and aged mice and this possessed a powerful memory enhancing activity in mice.\[^{26}\]

4) The aqueous leaf extract of *T. populnea*, at a dose of 400 mg/kg body weight (p.o.) for 15 days and the testis were subject to structural analysis. It is suggested that the treatment leads to pathological changes in the seminiferous tubules, Sertoli cells and spermatids of the testis in mice.\[^{27}\]

5) Aqueous and methanolic extracts of *Thespesia populnea* bark, at a dose level of 500 mg/kg showed significant antioxidant activity against carbon tetrachloride-induced liver injury in rats.\[^{28}\]

6) The aqueous extract of *T. populnea* fruit, in 5% SCMC showed significant wound healing activity in the excision wound and incision wound models in rats following topical and oral administration, respectively.\[^{29}\]

7) Anti-steroidogenic activity of various extracts of *T. populnea* was screened in female albino mice. The weight of the uterus and ovaries were reduced significantly and the cholesterol and ascorbic acid content in ovaries were significantly elevated due to the treatment with extract of *T. populnea*.\[^{30}\]
8) Four naturally occurring quinones, mansonone-D (MD), mansonone-H (MH), thespone (TP) and thespesone (TPE), extracted from the heartwood of *Thespesia populnea* have been tested for their cytotoxic action by aerobic incubation with human breast adenocarcinoma (MCF-7) cells. The electrochemical results indicate that MH and TPE are more difficult to reduce than TP and MD.\(^{[31]}\)

9) (+)-Gossypol was isolated from the bark of *Thespesia populnea* and tested for its ability to inhibit the fertility of male hamsters. Male hamsters of proven fertility were treated orally for 54 days with 40 mg/kg of (+)-gossypol, 40 mg/kg of racemic gossypol, or 5% gum acacia (vehicle control) and were mated with estrous female hamsters during the fourth and seventh weeks of treatment. Both the control and the (+)-gossypol-treated animals exhibited normal fertility throughout the experiment. The racemic gossypol-treated animals were infertile when evaluated during both the fourth and seventh weeks of treatment. Morphologic examination of the testicular tissue could not explain the loss of fertility. These data demonstrate the inability of (+)gossypol to decrease male fertility and suggest that the activity of racemic gossypol may be due primarily to the presence of the (-) optical isomer.\(^{[32]}\)

10) The antihepatotoxic activity of ethanol extract fractions of *Thespesia populnea* administered orally to groups of rats was evaluated using the CCl\(_4\) model of liver injury. All fractions showed significant activity.\(^{[15]}\)

11) Hypoglycaemic and antihyperglycaemic effect of an alcoholic extract of the fruit of *T. populnea* was investigated in both normal and alloxan-induced diabetes in rabbits, at the dose of 100, 200, 300 mg/kg body weight p.o. The study indicated a significant anti-diabetic activity.\(^{[33]}\)
12) The methanolic extract of stem bark of *Thespesia populnea* has possessed a *in vitro* antioxidant effect in three *in vitro* models viz. 1,1-diphenyl-2-picrylhydrazyl radical scavenging activity, superoxide radical scavenging activity and reducing power assay.\(^{[34]}\)

13) The preliminary anti-implantation activity of isolated pure principle from successive extracts of Petroleum ether and Ethyl acetate and subsequent crude alcoholic extracts of *Thespesia populnea* seeds in female albino rats, showed that the pure principle from petroleum ether extract have significant anti-implantation activity at the dose of 110 mg/kg body weight while ethyl acetate extract was effective at the same dose. The alcoholic extract showed no such significant action.\(^{[35]}\)

14) Lupenone, lupeol, β-sitosterol, alkanes (C19-33) and esters (C40-52) isolated from leaves were evaluated against staphylococcus aureus, S.albus, Bacillus subtilis, Escherichia coli, Klebsiella, Shigella dysenteriae, Proteus vulgaris and Pseudomonas pyocyane in *in vitro*. Alkanes, lupenone and lupeol were active against Gram positive and Gram negative bacteria.\(^{[21,36]}\)
1.4 Scope of present study

Traditional medicines and the plant have been adopted in different cultures and regions without the parallel advance in standards and methods for evaluation. So as to develop the standard method for evaluation of plant material is essential for their quality and purity.

Regulating traditional plant and their products is difficult due to variations in definitions and categorizations of traditional medicines and therapies. For example, a single herbal plant could be defined as either as food, a dietary supplement or herbal medicine, depending on the country. This disparity may possible to change.

Scientific evidence from test done to evaluate the safety and effectiveness of plant medicine is limited. Further study of the plant is needed. Even their methods for research and evaluation are complex for example; it can be difficult to assess the quality of finished herbal formulation. The safety, effectiveness and quality of herbal plant are very essential. It depends on number of their active natural constituents. Isolate the correct active phytoconstituent, evaluate their pharmacological action and compare it with traditional use is very important parameters in medicinal plant \[^{37}\].

Herbal materials are collected form wild plant populations and cultivated medicinal plants. The expanding herbal product market could drive over-harvesting of plants and threaten biodiversity. Poorly managed collection and cultivation practices could lead to the extinction of endangered plant species and destruction of natural resources. So, the demand on the plant materials are possible to adulterate or substitution. So, efforts is needed to preserve the plant and
knowledge by evaluate their identification such as morphological and microscopical nature, various physiochemical standard to avoid the duplication.

The people believe that because herbal medicine is natural or traditional they are safe or carry no risks for harm and effective in their action. However traditional herbs potential on their action but the pharmacological evaluation is necessary to compare it with traditional use which is effective and to avoid adverse reactions if any. It may due to their poor plant quality or it is taken inappropriately or in conjunction with other medicine. Increased patient awareness about safe usage is important as well as more knowledge about the plant and ascertain the pharmacological effectiveness.

The pharmacological validation as Indian medicine is very limited and large number of plants used in folklore with enormous potential have not been validated for their activity.

The present work thus attempts to analyze the wide potential traditional plant *Thespesia populnea* on their bark and leaf which include their identification, isolation of compounds and their pharmacological effects based on the available materials and knowledge.

Therefore this attempt to reduce the lacunae in the existing literature and offers immense scope for researchers engaged in validation of the traditional claims and development of safe and effective herbal drug for various activities. Based on the above points of consideration, *Thespesia populnea* bark and leaf is being selected as traditional drug for investigation.