3. PLANT PROFILE

3.1. *Butea monosperma*

- Vernacular Names[217]

Hindi: Palas

Bengal: Palas

Gujarathi: Palash

Konkani: Palash

English: Bastard teak

Tamil: Murukamaram

Marathi: Palash

Malyali: Pilacham

Telgu: Paladulu

Figure 3. 1: *Butea monosperma* flower

- Classification[217]

Kingdom: Plantae

Subkingdom: Tracheobionta

Division: Magnoliophyta

Class: Magnolipsida

Subclass: Rosidae

Order:Fabales

Family: Fabaceae

Genus: Butea

Species: monosperma

- Morphological description[218-222]

Flowers:

- Colour: Bright orange red, densely clustered
- Size: Large sized (1.5 to 2 inches long)

- Stalk: dark brown and velvety
- Bracts and bracteoles: small, deciduous
- Calyx: ½-inch long, dark olive green densely velvety outside, clothed with silky hairs, teeth short and deltoid
- Corolla: Corolla is papilionaceous, 11/2 – 2 inches long, clothed salmon coloured.

Leaves:

- Alternate, long petioled and trifoliate.
- Leaflets are ovate-rhomboid or abovate form acuneate or deltoid base, glabrous above and densely silky below.

Bark:

- Bluish gray or light brown in colour.
- Bark contains gum.

Seeds:

- Flat and reniform, faint odour and slightly acrid taste.

Pods:

- Silky and much compressed.
- 10-13 cm long containing one seed at its apex.

➧ Cultivation

The tree is highly drought resistant and grows in open plains in natural habitat. Reproduction is by seeds and starts early in rainy season. For cultivation, the pods may be planted 25-30 cm apart along the lines and lightly covered with soil. Plentiful of water is needed. It was also found that the growth of seedlings of palash was better in pure black soil.[219]

- Chemical Constituents

Flower:

- Triterpene, butein, butin, isobutrin, monospermoside (butein 3-e-D-glucoside) and isomonospermoside, chalkiness', aureoles, flavonoids (palasitrin, prunetin) and steroids.[223]

Gum:

- Tannins, mucilaginous material, pyrocatechin.[223]

Leaves:

- Glucoside, Kino-oil containing oleic and linoleic acid, palmitic and lignoceric acid.

Seed:

- Oil (yellow, tasteless), proteolytic and lypolytic enzymes, plant proteinase and polypeptidase, palasonin.[223]

Bark:

- Kino-tannic acid, Gallic acid, pyrocatechin. [223]

Stem:

- 3-Z-hydroxyeuph-25-ene and 2, 14-dihydroxy-11, 12-dimethyl-8-oxo-octadec-11-enylcyclohexane. Stigmasterol-D-glucopyranoside and nonacosanoic acid.[223]

- Pharmacological activities [223]

1. *Antidiabetic activity*[224, 225]

The ethanolic extract of various parts of *Butea monosperma* was found to be anti-diabetic, hypolipidemic and antioxidant in rats.[226] The clinical studies has also proved its anti-diabetic and hypolipidemic effect normal and diabetic human volunteers [227]

2. Anticonvulsive activity: [227]

Presence of triterpene shows anticonvulsive activity. The ethanol extracts of flowers exhibited anticonvulsant activity. It also raised brain contents of gamma-aminobutyric acid (GABA) and serotonin.[227]

3. Antimicrobial, Antifungal activity:

Methanol and hexane extract of plant bark is proven to be best anti-microbial against gram positive and gram negative bacteria.[225]

4. Liver Disorders

An extract from the flowers of *Butea monosperma* is used in India for the treatment of liver disorders and two antihepatotoxic flavonoids, isobutrin and butrin have been isolated from the extract.[228] The hepatoprotective potential of *Butea monosperma* is proved against CCl_4 induced damage[229] and in thioacetamide induced liver injuries in rats.[230]

5. Anti-diarrheal activity

Ethanol extract of stem bark of *Butea monosperma* inhibited castor oil induced diarrhoea due to inhibiting gastrointestinal motility and PGE2 induced enteropooling in Wistar albino rats. *Butea monosperma* gum has also been found useful in cases of chronic diarrhea. It is a powerful astringent and also decreases bilirubin level.[31]

6. Radical scavenging activities [231]

Methanol extract of *Butea monosperma* flowers were evaluated for radical scavenging activities using different in vitro models like reducing power assay, scavenging of 2,2 diphenyl-1- picrylhydrazyl (DPPH) radical, nitric oxide radical, superoxide anion radical, hydroxyl radical and inhibition of erythrocyte hemolysis using 2,2' azo-bis (amidinopropane) dihydrochloride (AAPH). [31] The effect is proven *in-vitro* in numerous studies. [29, 226]

7. Antiesterogenic and antifertility activity [232]

Methanol extracts of Butea monosperma exhibited effect on uterotropic and uterine peroxidase activities in ovariectomized rats & determine estrogenic/antiestrogenic potential of antifertility substances using rat uterine peroxidase assay. Alcohol extract of flowers of the title plant has also been reported to exhibit anti-estrogenic and antifertility activities. Butein isolated from its flowers show both male and female contraceptive properties.[31]

8. Antitumor activity

Numerous cell line[231-235] and animal studies have proven it to be anti-carcinogenic.[227, 236] The phytoconstituent Butein was found to induce apoptosis in human prostate[235] and lung cell line.[234] Butein inhibits angiogenesis of human endothelial progenitor cells via the translation dependent signaling pathway.[233] It was proven to be protective against hepatocarcinoma in Wistar rats.[237]

- Toxicity studies

The oral acute and sub-acute toxicity study of extract of *Butea monosperma* flowers was performed in mice. It was found to be safe up to 6000 mg/kg.[222]

3.2. *Lycopersicon esculentum*

- Vernacular name[41]

Hindi: Tamatar

Tamil: Takkali

Manipuri: Khamen asinba

Kannada: Goore Hannu

Figure 3. 2: *Lycopersicon esculentum* fruits

- Synonyms[41]

Solanum lycopersicum

Lycopersicon lycopersicum

Lycopersicon esculentum

- Classification[41]

Kingdom: Plantae

(unranked): Angiosperms

(unranked): Eudicots

(unranked): Asterids

Order: Solanales

Family: Solanaceae

Genus: Solanum

Species: S. lycopersicum

- Morphological description

Tomato plants are generally branched. Leaves are more or less hairy and strongly odorous and up to 45 cm (18 inches) long. The five-petaled flowers are yellow, pendant, and clustered. Fruits are berries (1.5 to 7.5 cm) which are usually red, scarlet, or yellow. They are almost spherical to oval and elongate to

pear-shaped. Each fruit contains at least two cells of small seeds surrounded by jellylike pulp.

- Cultivation

The plants are grown in warm weather and much sunlight. Tomatoes are usually staked, tied, or caged to keep the stems and fruits off the ground. The consistent irrigation is required for proper yield.

- Chemical Constituents

There are different varieties of tomato, but all have the similar nutritional characteristics, being an important source of vitamins and minerals. Tomatoes is the third source of vitamin C in our diet and the fourth for vitamin A. It contains all four major carotenoids- alpha- and beta-carotene, lutein, and lycopene. [41]

- Pharmacological activities

1) Hair growth promoter[238]

Studies proved that it promotes hair growth and treats the condition of alopecia in mice without skin irritation

2) Anti-oxidant[41]

As it contains four major carotenoids, it possess strong antioxidant properties.[43]

3) Decrease risk of cardiovascular diseases

Antioxidant nutrients are believed to slow the progression of atherosclerosis because of their ability to inhibit damaging oxidative processes.[239-241]

4) Non-alcoholic fatty liver diseases

It is proven to reverted hepatic alterations and non-alcoholic fatty liver conditions in rats.[242]

5) Cognitive enhancing effect

The cognitive impairment was proven to be improved with cognitive enhancer potential in rats.[243]

6) Anti- tumor activity

Dietary intake of tomatoes and tomato products has been found to be associated with a lower risk of a variety of cancers in several epidemiological studies.[37, 244] The dietary lycopene and tomato extract supplementations inhibit nonalcoholic steatohepatitis-promoted hepatocarcinogenesis in rats.[45] Lycopene is a more potent inhibitor of human cancer cell proliferation than either α- carotene or β-carotene.[245] Lycopene is reported to be aromatase inhibitor.[246]

- Toxicity studies

The acute studies of *Lycopersicon esculentum* fruits was carried in adult Wistar rats. The data suggests no toxic effect up to 5000 mg/kg.[223]

3.3. *Cassia fistula*

- Vernacular Names[247]

Bengali: Amultash

Gujarati: *Girmala*

English: Golden shower

Telugu: Kondrakayi

Malayalam: Tengguli

Hindi: Amaltas

Tamil: Kavani

Figure 3. 3: *Cassia fistula pods*

- Classification[248]

Kingdom: Plantae

Subkingdom: Tracheobinota

Super Division: *Spermatophyta*

Division: Mangoliophyta

Class: Magnoliopsida

Sub Class: *Rosidae*

Order: Fabales

Family: Fabacae

Genus: Cassia

Species: fistula

- Morphological description

C. fistula is a medium sized deciduous tree. The bark of is dark brown and rough. The leaves are alternate pinnate, 30- 40 cm long, 4-8 pairs of ovate, opposite leaflets. The flowers are bright yellow color. The fruits are indehiscent pod- 40 to 60cm long, cylindrical, pendulous containing 25-100 seeds.

- Chemical constituents

Seeds:

- galactomannan free sugars and free amino acids glycerides with linoleic, oleic, stearic and palmitic acids as major fatty acids

Flowers:

- Rhein, fistulin, tannin, volatile oils, Kaempferol

Leaves:

- Free rhein, and its glycosides- sennosides A & B.

Fruit:

- Isoflavone: biochanin A

Pulp of the fruit:

- sugar, tannic matter, proteins, rhein, volatile oil, waxy and resinous derivatives

Pulp of the pod:

- anthraquinone glycosides, sennosides A & B, rhein and its glucoside, barbaloin, aloin,

- Pharmacological activities

1. *Laxative activity*

C. fistula pod infusion was proven safe laxative and can be utilized as substitute for the official Senna.[220]

2. *Anthelmintic Activity*

The anthelmintic activity of *C.fistula* fruit pulp and seeds extracts was proved by Irshad *et.al*. [249] *Pheretima postnuma* worms were taken to test this activity.

3. *Antibacterial Activity*

The isolated compounds form plant showed antimicrobial activity against Staphylococcus aureus, Bacillus subtilis, Klebsiella pneumoniae, Escherichia

coli, Aspergillusniger and Fusarium oxysporum.[247] The antibacterial and antifungal activities of C. fistula against 14 bacteria and 6 fungi were also reported in one of the studies.[246, 250]

4. Antifertility activity

The investigation of petroleum ether extract of seeds of *Cassia fistula* proved the antifertility activity in fertile female albino rats.[251]

5. Anti-inflammatory and Antioxidant activities

One of the studies reported that anti-inflammatory and antioxidant activities of the aqueous and methanol extracts of the *C. fistula* bark in Wistar rats.[252] *Cassia fistula* bark extracts showed free radical scavenging by inhibiting LPO initiated by CCl4 and FeSO4.[252] The extracts exhibited antioxidant activity in various *in-vitro* antioxidant assays.[252-254]

6. CNS activities

The methanol extract of *C. fistula* seeds significantly potentiated the sedative actions of, diazepam, meprobamate, sodium pentobarbitone and chlorpromazine.[255] Also, it potentiated analgesia induced by morphine alkaloids.[255]

7. Hepatoprotective activity

The heapatoprotective effect of ethanolic extract of *Cassia fistula* leaves is proven in isoniazid and rifampicin induced hepatotoxicity in rodents. [256]

8. Hypolipidemic activity

The *Cassia fistula* legume improved serum lipid markers in cholesterol fed rats and also increased ratio of HDL cholesterol/ total cholesterol.[257]

9. Antitumor activity

Rhein, found in aqueous extract of *C. fistula* pods down regulated matrix metalloproteinases-9 and vascular endothelial growth factor in human nasopharyngeal carcinoma cells *in-vitro*.[258] It is also proven to be anti-carcinogenic against U87 cell line *in-vitro* and *in-vivo*.[259] Oral administration of *Cassia fistula* bark extract to DMBA painted animals completely prevented the formation of oral squamous cell carcinoma. [247]

- Toxicity studies

The acute studies of *Cassia fistula* pods proved it to be non-toxic with LD_{50} of 6600mg/kg.[220]