CHAPTER 1

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The Euphorbiaceae are a large family of about 300 genera and 7500 species of cosmopolitan distribution. This family includes a number of medicinal plants. *Euphorbia* and *Jatropha* are the two largest genera, which are characterized by the presence of white milky or colored latex. The members of these taxa are known sources of alkaloids, flavonoids, phenolic acids, amino acids, coumarins, diterpenes, proanthocyanidins, saponins, steroids and triterpenoids. These compounds are biologically active and possess antioxidant, anticancer, antidiabetic, antiarrhoeial, antiasthmatic, antimicrobial, antiviral and cytotoxic activities.

Many species of the genus *Euphorbia* are traditionally used as anticancer drugs. *Euphorbia hirta*, commonly known as “asthma plant,” has found use as a herbal remedy for the treatment of asthma and coughs and the herb is also known for its anticancer property. Members of the genus *Jatropha* are known for their purgative and anticancer properties. The important drugs obtained from these two genera are Dudhi (*E. hirta*), Dugdhika (*E. thymifolia*), Snuhi (*E. nerifolia*), vajradruma (*E. tirucalli*) and Dravanti (*J. curcas*). These drugs are being used for the treatment of diseases such as cancer, diabetes, diarrhoea, asthma, leprosy, jaundice, rheumatism, intestinal disorders, gynaecological disorders, skin diseases etc. (Sivarajan and Balachandran, 1991; Anon., 2002). As the Ayurvedic texts, based on which the plants are recognized and named, give the names of the plants in Sanskrit, there is great confusion on the botanical identity of these plants. Consequently the drugs are adulterated with similar looking plants and or plant organs. To rectify this problem, in the present work, a detailed study of both pharmacognosy and phytochemistry of the above-mentioned plant, as well as the related plants which arc used as substitutes, is carried out.

Plate No.1 a. *E. geniculata* Orteg

b. Inflorescence
Linn., *J. multifida* Linn and *J. podagrica* Hook. A brief description of the plants selected is given below:-

1. *E. geniculata* Orteg (Plate No. 1a-b)

*E. geniculata* is an erect annual herb having terete glabrous stem. Leaves are elliptic, oblong or ovate and opposite, flowers are flesh colored in corymbose cymes and capsules are trilobed.

**Parts Used:** Leaves

**Medicinal Uses:** Leaves are reported to have antifungal and antibacterial activities (Anon., 2002)

Various workers have conducted investigations of these taxa. The first report of the general anatomy of the family *Euphorbiaceae* is by Metcalfe and Chalk (1950). Metcalfe (1954), Sayeeduddin (1956), Webster (1967) and Sehgal and Paliwal (1974) have conducted the anatomical studies of *Euphorbiaceae* and they classified the family according to the anatomical characters such as stomata, trichomes and venation pattern. Kaempferol, its rutinoside, quercetin and quercitrin, β-amyrin-OAc, β-sitosterol, campesterol, stigmasterol, cholesterol and a triterpenoid saponin, geniculatin are reported from the plant. The saponin present has been identified as 3β- glucuronopyranosyl - (1→3) - oxylolean -12-en- 28 -oic acid. (Ismail *et al.*, 1977; Rizk *et al.*, 1978; Tripati and Tiwari, 1980). Rahman and coworkers (2002) isolated geniculatoside F from the aerial parts of the plant and the compound was identified as stigma 16-en-3 alpha – O- (beta-D-galactopyranoside). The plant is also reported to contain a toxic principle eupatol, which causes poisoning and pathological disorders in grazing animals (Anon., 2002).

2. *E. hirta* Linn. (Plate No. 2a) (Syn: *Chamaesyce hirta* Millsp. *Euphorbia pilulifera* Auct., non L; *Euphorbia capitata* Lam.)

*E. hirta*, commonly known as snakeweed or asthma plant, is a small annual herb, with yellowish hairy stem. The leaves are small oppositely arranged and up to 5 cm long. The leaves and stem secrete a milky sap. The inflorescence is a dense, greenish yellow axillary cluster. Seeds are 0.8 mm long ovoid and trigonous and light reddish brown in colour.
Plate No.2 a. *E. hirta* Linn
Parts Used: Leaves, roots and whole plant

Medicinal Uses: This plant is used for the treatment of cough, chronic bronchitis, asthma and other pulmonary disorders due to its antispasmodic and anti-asthmatic principles (Wong-Ting Fook, 1980). It is also used for relieving hay fever and catarrh (Le Strange, 1977). In addition to its use in the treatment of asthma, *E. hirta* is commonly applied to eczematous skin (Johnson, 1999). This plant is used in the treatment of chronic diarrhoea and dysentery (Rothe and Paddakhe, 2005). It is also applied topically to ulcers and in the case of oedema. The juice is considered tonic, narcotic and antiasthmatic (Kirthikar and Basu, 1975). The latex is used to cure eye sore (Anon., 2002). Lyophilized aqueous extract of this plant has been reported to have analgesic, antipyretic and anti-inflammatory properties (Lanhers et al., 1991). The same extract also has some behavioral effect in mice. Sedative properties could be confirmed with high doses (100mg of dried plant/kg) where as anticonflicting effects appeared at lower doses (12.5 and 25mg of dried plant/Kg) (Lanhers et al., 1990). From the leaves, gallic acid, quercitrin, myricitin, 3-4-di-O-galloyl quinic acid, 2,4,6 – tri-O-galloyl-D-glucose and 1,2,3,4,6 – penta-O-galloyl- beta -D-glucose were isolated (Chen, 1991). Various bioactive compounds reported from the plant are cycloartenol, 24-methylene-cycloartenol, β-sitosterol, euphorbol, hexacozolate, β-amyrin acetate, 1-hexa cosanol, ingenotriacetate, campesterol, stigmasterol, diterpenoids, quercetin and its 3-rhamnoside, rutin, friedelin, taraxerol, aphidicol, leucocyanidol, jambulol, euphorsterol, triacontane, an alkaloid xanthorhamnine, dimeric tannins and euphorbins A, B and C (Anon., 2002). A flavonoid, quercitrin with anti diarrhoeal activity was isolated from this plant (Galvez et al., 1993). The anti diarrhoeal activity of quercitrin is due to its aglycone, quercetin which is released by the glycoside in the intestine. The whole plant possesses an anti diarrhoeic marker quercetin 3-O-β-D- rhamnoside and it is found that the varying proportions of plant parts in the samples were responsible for variation in active marker concentration (Mallavadhani et al., 2002). The aqueous extract of this plant reduced the release of prostaglandins I₂, E₂ and D₂ and also exerted an inhibitory effect on platelet aggregation and carrageenan induced rat paw oedema. Its diuretic and purgative action has been well documented (Johnson et al., 1999). The anthelmintic activity of the crude extract of this plant was reported.
The study showed that after its administration into local dogs produced a significant increase (P< 0.05) in PVC, RBC, Hb conc., TWBC and lymphocyte counts. The faecal egg counts also showed a remarkable and significant reduction in the levels of the identified helminthes (Adedapo et al., 2005). The aqueous extract also inhibited aflatoxin contamination in rice, wheat, maize, groundnut and mustard crop. Leaves are reported to have antifungal and antibacterial activities. The root exudates exhibited nematicidal activity (Anon., 2002). The aqueous and ethanol extracts of this plant have antimicrobial activity (Reezal et al., 2003). The results indicated that gram-positive bacteria (S. aureus and B. subtilis) appeared to be more sensitive to both aqueous and ethanol extracts when compared with the inhibition zones measured on the growth of gram negative bacteria (E. coli and S. enteritidis). The aqueous extracts of the leaves of this plant showed antifungal activity against the C. albicans and C. tropicalis growth. E. hirta, E. nerifolia and E. thymifolia were reported to contain terpenes, anthocyanins, alcohols and steroids (Agarwal and Baslas, 1980).
Plate No.3 Euphorbia microphylla Heyne
a. Habit
3. *E. microphylla* Heyne (Plate No. 3a)

A nearly glabrous annual, stems numerous spreading from the root, 4-10 cm long, whitish, slender, glabrous and dichotomously branched. Leaves opposite, coriaceous, obliquely oblong, usually entire, gland very shortly stipitate with a small limb. Capsules glabrous keeled, styles short, deeply 2-fid. Seeds quadrangular very bluntly pointed, yellowish brown and smooth.

**Parts Used:** Whole plant

**Medicinal Uses:** The plant juice is used as a good galactagogue. Plant extract has antibacterial activities against both gram-positive and gram-negative bacteria (Chatterjee et al., 1991).

β-Sitosterol, β-D-glucopyranoside and apigenin 7-O-β-D-glucopyranoside are isolated from this plant (Chatterjee et al., 1996). Biswas et al., (2003) reported the effect of *E. microphylla* extract on catecholamine levels of brain and plasma in rats. Methanolic extract of this plant reported to have antiulcer properties (Datta et al., 2002).

4. *E. nerifolia* Hook. (Plate No. 4a) (Syn: *E. ligularia* Roxb.)

Commonly known as *Snuhi*, this is a large branched shrub or tree with the pairs of stipular spines on tubercles or swellings of the branchlets. Leaves alternate, crowded at ends of stems and branches, subfleshy, glabrous, obovate-lanceolate or spathulate. Inflorescence cyathia, globose, often reddish; flower involucres yellowish red. Fruit smooth, glabrous; styles 3-fid.

**Parts Used:** Leaves, whole plant.

**Medicinal Uses:** The plant is bitter, pungent, laxative, carminative, useful in abdominal troubles, bronchitis, tumors, and loss of consciousness, leucoderma, piles, inflammations, enlargement of the spleen, anemia, ulcers and fevers. The milk is pungent, laxative, and good for abdominal troubles, tumors and leucoderma. The leaves are heating, improve the appetite and reduce pains, inflammations and abdominal swellings. The milky juice is used as purgative and rubefacient (Kirthikar and Basu 2003). *In vitro* screening of crude latex showed low grade anticoagulant activity and normal fibrinolysis in rabbit plasma (Anon.,
Plate No.4 *Euphorbia nerifolia* Linn

a. Habit
The latex of this plant is reported to have wound healing activity (Rask et al., 1996). The latex of this plant is also reported to have anti-inflammatory activity and found that acetone extract has the greatest anti-inflammatory activity (Iyar et al., 2002).

Triterpenoids such as glut-5-en-1-one, glut-5-en-3β-yl-acetate, taraxerol, friedelon-3α-O1 and 3-β-O1 were isolated both from the leaves and stem (Anjeneyulu et al., 1973). Bark of this plant contained 24-methylene cycloartenol, cycloartenol, euphorobol hexacozooate euphorbol, 12-Deoxy-4β-OH phorbol, 13-dodecanoate-20-acetate, tulipanin 3,5 diglucoside and pelargonin 3,5-diglucoside (Lavie and Jan. 1968; Evans and Schmidt, 1976). The major components of the latex were cycloartenol, nerifolione, nerifoliene (a tetracyclic triterpene 9, 19-cyclolanost-22 (22), 24-diene-3β-Ol) and euphol (Iyar et al., 1998; Mallavadhani et al., 2004). The roots yielded ingenol triacetate euphorbol, 12-Deoxy phorbol-13, 20 diacetate and Delphinidin 3, 5 diglucoside, diterpenes, antiquorin, nerifolene and jolkinolide (Rishi et al., 1979; Zechmeister 1970; Sen et al., 1970; Anon., 2002).

The latex of this plant can be preserved and coagulated to get biocrude, which can be directly processed for petroleum hydrocarbons. Highest percentage of biocrude content was obtained from the latex preserved with a combination of formaldehyde and ammonium hydroxide.

5. *E. nivulia* Buch-Ham (Plate No. 5a-d)

This plant, commonly known as *Patrasnuih*, is a tree with straight trunk and terete jointed spreading often whorled branched with straight stipular spines. Pairs of spines inserted on flat brown or black corky areas of the branchlets. Leaves are glabrous fleshy linear, oblanceolate or spatulate. Cyathia, usually paired in sub terminal cymes, borne at the leaf scars towards the ends of the branchlets. Capsules sharply 3-lobed.
Plate No. 5 *Euphorbia nivulia* Buch-Ham

- a. Habit
- b. Branch with leaves
- c. Young shoot
- d. Stem
Parts Used: Leaves, roots and whole plant.

Medicinal Uses: The juice is mixed with neem oil and is used externally for rheumatism. The warm juice is good for ear ache, and it is rubbed over the eyes to remove dimness of sight. The latex is used for the treatment of enlargement of liver and spleen, syphilis, dropsy, leprosy, whooping cough, dyspepsia, jaundice and colic. The coagulated latex is reported in Ayurvedic system for bronchitis and rheumatism. Leaf juice is used as a purgative (Anon., 2002; Chopra et al., 1956). The latex exhibited antimicrobial activity against Staphylococcus aureus and Escherichia coli. The latex of this plant contained cycloart-25-en-3β-OI, cycloaudenol and cycloarteno epoxy triterpenoid, cyclonivoloid (Rao et al., 1985; Satyanarayana et al., 1991). Tetracyclic triterpenes have been obtained from the latex of this plant (Satyanarayana et al., 1997). The latex is reported to have three ingol diterpenes, 3-acetyl-8-methoxy-7-angolyl-12-hydroxylingol, 3,12-diacetyl-7-hydroxy-methoxylingol and 3, 12-diacetyl-7-angolyl-8-hydroxylingol and a triterpene cyclonivolulinol (Ravikanth et al., 2003; 2002). Sitosterol is reported from the leaves and stem of this plant (Anon., 2002). Aqueous alcohol extracts of the leaves of this plant possessed antimicrobial activity. The results indicate that the aqueous alcohol extract were active at concentrations ranging from 3-12.5μg/ml for gram-negative and 12.5-200 μg/ml for gram-positive bacteria (Annapurna et al., 2004). The leaves of this plant possessed non-articulate laticifers, thin walled irregular shaped parenchyma and lamellar collenchyma (Joseph and Rangari, 2002)

The plant is one of the potentially tappable latex producing plants in India. The latex has many applications, it is used for glass-glass and aluminium-aluminium adhesion for making electrical insulation and moisture resistant paper coating, water resistant wood panel coating and corrosion resistant coatings for mild steel plate (Anon., 2002).

6. *E. thymifolia* Linn. (Plate No. 6a) (Syn: *Chamaecycce thymifolia* Millsp.)

The plant, commonly known as dugdhika, is a small hairy annual herb. Stem prostrate, slender, cylindrical more or less hairy. Leaves are opposite, rounded at the apex, glabrous above and slightly pubescent beneath inflorescence.
Plate No. 6. *Euphorbia thymifolia* Linn
a. Habit
Cyathia in axillary cymes, stalk very short gland minute. Capsules pubescent. Seeds are quadrangular and bluntly pointed.

Parts Used: Seeds and Whole plant.

Medicinal Uses: The drug dugdhika is considered acrid, bitter, hot in action, diuretic and aphrodisiac. It purifies blood; cures skin diseases, poisonous affections, cough, asthma and other respiratory disorders. The plant juice is a good galactagogue. Its decoction is given with honey to treat haematuria (Sivarajan and Balachandran, 1991; Anon., 2002). Leaves and seeds are considered stimulant, astringent, anthelmintic and laxative and given to children in bowel complaints. The plant juice is used to cure ringworm. It is also used for the treatment of diarrhoea and dysentery (Kirthikar and Basu, 1975). Plant is also used as a blood purifier. The extract of the plant showed antibacterial and antifungal activities. The extract of this plant prepared with 1.5% HCl could inhibit the growth of gram-positive (Bacillus subtilis) and gram- negative (Escherichia coli) bacteria (Jabbar and Khan, 1965). The plant was found to be effective in the treatment of patients of bronchial asthma. (Sharma and Sharma, 1972; Sharma et al., 1982). Ether and chloroform extracts of this plant were also reported to inhibit activity against the growth of E. coli and Shigella flexneri (Khan et al., 1988). Ether acetate extract of this plant possessed antibacterial and antifungal activities (Lal and Gupta, 1970; Rao and Gupta, 1970; Satyanarayana and Kawdikar, 1978; Kawdikar et al., 1976). Rugosin B was reported to reduce the minimum inhibitory concentration of β-lactamsin methicillin- resistant Staphylococcus aureus (Shiota et al., 2000). The extract and pure compounds such as rugosin B isolated from the plant were reported to possess antioxidant activities. Beside antioxidant activities, 3-O-galloyl-4,6-(S)-hexahydroxydiphenoyl-D-glucose and ethyl acetate (EtOAc) fraction also showed anti-herpes simplex virus (HSV) -2 activity. The Ethyl acetate extract significantly reduced virus infectivity at a concentration of 4.0 µg/ml, whereas 3-O-galloyl-4,6-(S)-hexahydroxydiphenoyl-D-glucose diminished virus infectivity at a concentration of 0.5 µg/ml (Lin et al., 2002). The plant yields a green essential oil; the main constituents of this oil are cymol, carvacrol, limonene, 2 sesquiterpenes and salicylic acid. The oil is used in medicinal soaps for the treatment of erysipelas, as a spray to keep off flies and mosquitoes, and as a
The plant is also used as an insecticide.

Pharmacognostic studies of this plant had been carried out by Sinha and Pathak (1984). 12-Deoxyphorbol, 13, 20-diacetate, 12-deoxy-4β-hydroxyphorbol -13-dodecanoate-20-acetate, rugosin B, corilagin, geraniin, bixinin, 5-desgalloylstachyurin, casuarin, epitaraxerol, n-hexacosanol, euphorbol, 24-methylene- cycloartenol and quercetin 3- β- galactoside, glut-5-en 3β-yl acetate, 12-dien-3β-Ol and tirucalol were found to be present in the aerial parts of this plant (Pradhan and Khanigir 1967; Evans and Schmidt 1976; Kinghorn and Evan, 1975; Agarwal and Baslas, 1981). The whole plant reported to contain isomallotinic acid (Lee and Takashi 1990). 5,7,4-Trihydroxy flavone-7-glucoside is isolated from the leaves and stem. The plant also contained irritant factors 12-deoxyphorbol-4β-hydroxyphorbol and alkaloid.

The latex can be preserved and coagulated to get biocrude, which can be directly process for petroleum hydrocarbons (Anon., 2002).

7. *E. tirucalli* Linn (Plate No. 7a)

*E. tirucalli*, commonly known as milk bush or milk hedge, is an unarmed shrub or small tree with erect branches and smooth cylindrical whorled branchlets bearing small linear-oblong, caducous leaves (in rainy season). Trunk covered with rough, greenish brown bark having a cracked appearance. Inflorescence usually terminal, sub sessile in few cyathia. Seeds are ovoid and smooth.

**Parts Used:** Latex, leaves and whole plant

**Medicinal Uses:** The plant is hot; useful in biliousness, leprosy and leucorrhoea. The milk is abxiteric, carminative, useful in abdominal troubles, tumors. Stem bark is used for the treatment of colic, asthma and gastralgia (Chopra et al., 1956). The juice is purgative, carminative, useful in gonorrhoea, whooping cough, asthma, dropsy, leprosy, enlargement of the spleen, dyspepsia, jaundice, colic, tumors, stone in the bladder (Dymock, 1983). The fresh milk juice is applied to warts and used as a rubefacient embrocation in rheumatism. It is good alterative in syphilis and a good application in neuralgia. (Kirthikar and Basu, 2003).
Plate No.7 *Euphorbia tirucalli* Linn

a. Habit
Stem of this plant contained hentriacontane, hentriacontanol, \( \beta \)-sitosterol, taraxerol, flavonol, kaempferol and glucose (Gupta and Mahadevan, 1967). Fresh and undried stem bark contained Euphorcinol and taraxerane triterpene euphorgenol (Khan et al., 1989; Razool, et al., 1989). The undried latex contained cycloeuphordenol (Khan et al., 1988). Macrocyclic diterpene ester, serum proteases, \( \alpha \)-amyrin, taraxerol, coumarin and euphorbosterol were detected from the latex of this plant (Khan and Malik, 1990). The roots were found to possess cyanidin-3-5 diglucoside and tulipanidin-3-glycoside. The fresh aerial parts of this plant yielded gallic acid, 1-O-galloyl-D-glucoside, 1,2,3-tri-O-galloyl-D-glucoside, pedunculagin, 2,3-(S)-hexahydroxy-diphenoyl-D-glucopyranoside, putranjivain A, corilagin, casuarin, 5-des-galloylstarchyurin, putranjivain B, 3,3-di-O-methylgallic acid, 3,3,4-tri-O-methyl-4-O-rutinosyl ellagic acid, quercitrin and rutin (Lin et al., 2001). Furstenberger and Hecker, (1977) had located five irritant Euphorbia factors such as 13-O-acetyl-12-O-acylphorbol and 12-O-acetyl-13-O acylphorbol derivatives, two mixtures of homologous 3-O-acyl ingenol derivatives from this plant. Tirucallins A, B and euphorobia F, monomeric and dimeric ellagitannins were also isolated from this plant. Taraxerone, tirucallol and sitosterol were also reported from this plant (Chatterjee et al., 1977).

The plant is reported to be a major source of renewable fuel and chemical feed stock. Hexane is the most convenient solvent for biocrude production (Anon., 2002).

8. *Jatropha curcas* Linn (Plate No. 8 a-c)

*J. curcas* (Dravanti), commonly known as *Physic nut*, is a large deciduous soft-wooded shrub or small tree. Leaves are smooth, alternate, heart-shaped, slightly lobed, 5-10 cm wide and 10-15 cm long, form on extended stalks 6-13 cm long. The leaves are green in colour with 3-5 veins of lighter coloration radiating outwards from the point of attachment of the stems and have 6-10 prominently raised veins on the under side. Small groups of light green flowers form in loose clusters on short stems. Fruits are green fleshy, oval shaped in clusters of which are 3 cm long. Seeds split into 3 portions when ripe, opening to release 3 brown to black, ovoid or oblong seeds which are 2 cm long.
Plate No.8 *Jatropha curcas* Linn

a. Habit

b. Inflorescence

c. Fruiting branch
Parts Used: Leaves, latex, stem, root, seed and seed oil.

Medicinal Uses: Dravanti is reported to be bitter, acrid, astringent and anthelmintic. It is also useful in chronic dysentery, abdominal complaint, anaemia, ulcer, diseases of heart and skin (Agarwal, 1986; Nadkarni, 1976). The plant is traditionally used as a haemostatic. The leaves are reported to be galactagogue, rubefacient, insecticidal and are used in foul ulcers, tumors and scabies. Fresh juice from the skin arrests bleeding from wounds, ulcers, cuts and abrasions. The latex of this plant is reported to have anticancer properties (Anon., 1959; Sivarajan and Balachandran, 1991). The seeds are powerful purgatives, acrid, sweet, aphrodisiac, digestive and are useful in piles, wounds, and enlargements of spleen and skin diseases. Seed oil is used as a cleansing application for wounds, sores, ulcers and rheumatism (Kirthikar and Basu, 2003; Pandey et al., 2005; Ved et al., 1999). The roots of this plant reported to have anti-inflammatory activity (Mujumdar and Misar, 2003). The methanolic extract of this plant have antidiarrhoeial activity also (Mujumdar et al., 2001). The sap and leaf extract of this plant possessed germicidal actions on the growth of common bacteria of Staphylococcus, Bacillus and Micrococcus species and also exhibited strong inhibitory effect on normal larval growth of mosquito (Fagbenro et al., 1998).

Pharmacognostic studies on Dravanti have been carried out by Gupta, (1985) and Reghunathan and Mitra (1982). Dele Olowokudejo (1993) had recorded paracytic and brachy paracytic stomata, flakes of wax deposits and stalked glands in the leaves of five Jatropha species. Non-articulate and articulate laticifers and crystals were also located in this plant (Deyham and Craig, 1978). Ahmed (1996) had located branched non articulate laticifers, solitary and small groups of fibres in the bark of this plant.

Stigmasterol, β-Sitosterol, triterpene alcohol and flavonoid glycoside were isolated from the leaves of this plant (Khafagy et al., 1977). Leaves contained flavonoids, vitexin and isovitexin, apigenin, triterpenes, α-amyrin, stigmasterol and stigmastenes. (Subrahmanian et al., 1971). Bark of the stem is reported to contain β-amyrin, taraxerol and β-sitosterol (Asolkar, et al., 1992). Tigliane type diterpenoids 16-hydroxy phorbol, 12-deoxy 16-hydroxyphorbol and dinorditerpene were also found (Adolf et al., 1984; Vanden berg et al., 1995; Ravindranath et al., 1999).
2002). The latex of this plant is reported to have coagulant and anticoagulant activities, the whole latex (P< 0.01) reduced the clotting time of human blood. Diluted latex, prolonged the clotting time: at high dilutions, the blood did not clot at all (Osoniyi and Onajobi, 2003). The Latex of this plant contain proteolytic enzyme curcain and curcacycline A which inhibits the human T cell proliferation (Nath and Dutta, 1991). Latex of this plant contain resin also. Tannin, wax, resin, saponin, reducing sugars and traces of volatile oil were also isolated from the bark. Bark, leaves and tender stems yielded a dark blue dye used for coloring cloth (Anon., 1952).


*J. glandulifera*, commonly known as *Chandrajyoti*, is a small evergreen tree containing much clear pale yellow juice, trunk short, stout, dichotomously branched. Leaves are long, and as broad as long, palmately 3-5 lobed the margins serrate, each serrature ending in a gland tipped bristle, base cordate with a broad blunt shallow sinus. Petiole long without glandular hairs, stipules very long, divided into many filiform segments, each with a glandular head. Flowers monoecious greenish yellow in glandular corymbose cymes. Capsules long ellipsoid-oblong, smooth 3-lobed. Seeds smooth and shining black.

**Parts Used:** Leaves, roots and seeds.

**Medicinal Uses:** Leaves are analgesic and also used for the treatment of asthma and bronchitis. Root is good for piles, abdominal enlargements and also reduces glandular swellings. The juice of the plant is used to remove films from the eyes. The fixed oil from the seeds has purgative properties. It is also applied to sinuses, ulcers, foul wounds, ringworm, rheumatism and paralysis (Kirthikar and Basu, 2003; Rothe and Paddakhe, 2005).

Two esters of naphthaquinone alcohol and shikonin were isolated from the trunk and branch of this plant and the compound identified as 3, 3-di-Methyl acryllyl shikonin and acetyl shikonin (Ballantine, 1969). The roots contained jatropholone A, fraxetin and a coumarino lignan (Partha saradhi and Pardha Saradhi, 1984). The bark of this plant contained glucose, myricyl alcohol, myristic, stearic and petroselianic acid (Anon., 1952).
Jatropha glandulifera Roxb.
10. *J. gossypifolia* Linn. (Plate No. 10 a-c)

*J. gossypifolia*, commonly known as *Bellyache bush*, is an erect woody perennial shrub which grows to a height of 2.5-3 m. It has thick sappy stems, leaves with 3-5 deep lobes, and small red and yellow flowers. Stems, leaf stalks and leaf margins are covered with coarse, gland tipped, sticky, brown hairs. Inflorescence a terminal cymes. Fruit is a capsule 3-furrowed, truncate at both ends. Seeds grayish red with a caruncle.

**Parts Used:** Bark, latex, leaves, seeds and whole plant

**Medicinal Uses:**

The leaves are applied to boils, carbuncles, eczema and itches. The leaves are boiled and used to cure fever. The decoction of the leaves is used as a blood purifier and also used to treat veneral diseases. The decoction of the bark is used as emmenagogue. The juice is used to cure sores and soot is and antidote for snake bites (Kirthikar and Basu, 2003). The latex is purgative and good for wounds. The oil is used for the treatment of rheumatism (Pandey *et al.*, 2005). Whole plant is used for skin diseases, leaves and bark are used for boils, headache and itching (Ved *et al.*, 1999; Jain, 1991). The plant is also used as an insecticide (Chaterjee *et al.*, 1980).

The main constituents of the leaves are flavonoids apigenin, vitexin, isovitexin and pentose glucoside of cyanidin (Sankara Subrahmanian *et al.*, 1971; Anon., 1959). Isogadain and gadain are the lignans reported from the plant (Das, *et al.*, 1996; Banerjee *et al.*, 1984). Stem bark yielded alkaloid jatrophone, resin, isophytosterol and tannin. Latex of this plant contained a cyclic heapeptide cylogossine A (Horsten *et al.*, 1996). Jatroholones A and B were isolated from the roots (Purushothaman and Chandrasekharan, 1979). The roots possessed a macrocyclic diterpenoid jatrophone reported to have antileukemic activity (Adolf *et al.*, 1984). The chemical constituents isolated from the whole plant are cleomiscosin A, a coumarino lignoid and jatrophenone. This compound possessed significant antibacterial activity (Das *et al.*, 2003; Ravindranath *et al.*, 2003). Jatrophone, a diterpenoid isolated from the alcoholic extract of this plant, possessed tumour inhibiting activity (Kupachan *et al.*, 1970).
Plate No. 10 *Jatropha gossypifolia* Linn

a. Habit

b. Inflorescence

c. Fruiting branch
The hypotensive and vasorelaxant effects of ethanolic extract of the leaves and stem of this plant have been detected in rat and it is found that the oral administration of this extract caused a significant and dose dependent reduction of the systolic blood pressure (Abreu et al., 2003). The leaf extract of this plant had anticoagulant properties also (Oduola et al., 2005). The coagulant activity and the mechanism of action of stem latex as a haemostatic agent were investigated. The results of whole blood clotting time were significantly reduced when stem latex was introduced than when the tests were performed without stem latex.

11. *J. multifida* Linn. (Plate No. 11 a-b)

*J. multifida*, commonly known as *Coral plant*, is a large shrub. The leaves form at the end of red stalks and are green, 10-20 cm wide and deeply divided into 7-11 narrow, lance-shaped sections tapering to long points. Small, bright red flowers develop in clusters on the end of long stalks at the end of branches. Fruits are 2-3 cm long, yellow in colour and usually contain 3 ovoid, brown seeds which are 2 cm long.

**Parts Used:** Leaves, roots and seeds.

**Medicinal Uses:** The leaves are used for the treatment of scabies, ulcers, venereal diseases and wounds. Roots are used as antidote and tonic (Ved et al., 1999; Jain 1991). The latex is applied over wounds and ulcers and the oil is used both internally and externally as an abortifacient. The fruit is pungent and heating, purgative useful in piles, wounds, and enlargement of spleen, pains, and skin diseases. The seeds are sweetish, purgative, aphrodisiac, the seeds are powerful purgative (Kirthikar and Basu, 2003).

Latex of this plant contained cyclic decapeptide Labaditin and multifidin a cyanoglucoside (Kosai et al., 1989; Van den berg et al., 1995; Hemalatha and Radhakrishnaiah, 1995). Anti- complement constituents was isolated from the latex of this plant the compound identified as proanthocyanidin, which inhibited the classical pathway complement activity in human serum (Kosai et al., 1989). Other compounds reported from leaves of this plant included saponin, resin and tannin.
Plate No. 11 *Jatropha multifida* Linn

a. Habit

b. Inflorescence
12. *J. podagrlica* Hook (Plate No. 12 a-b)

The plant, commonly known as *Gouty stalk nettle spurge / Gouty stalked jatropha*, is a perennial growing to 1.5 m, with a thick, swollen stem up to 60 cm in diameter. Only a few large, rounded, leathery leaves with 3-5 broad lobes, 10-20 cm wide, form the top of the plant and are attached by stout stalks. Flowers are orange / red to scarlet. They produce smooth green ovoid to oblong fruits, 15mm long, which turn brown when mature and form a multi-branched bunch. The fruits burst open and 2-3 reddish grey to dark brown mottled seeds, 12 mm long.

**Parts Used:** Leaves and stem

**Medicinal Uses:** Leaves and stem possessed antibacterial and antimicrobial properties.

Roots of this plant yielded β-sitosterol, jatrogrossidion, 4E-jatrogrossidentandion, 15-epi-4E jatrogrossidentadion (Aiyelaagbe et al., 1998). A ferulic acid ester, n-heptyl ferulate together with 8-hydroxy-6, 7-dimethoxy coumarin, acetyl aleuritolic acid and γ-sitosterol were isolated from the stem and roots of this plant (Ee et al., 2005). The root extracts of this plant was reported to have antimicrobial activity. Hexane extracts of the yellow root bark and hexane and methanol extracts of the root wood showed moderate antifungal activity against the yeast fungus, *Candida albicans* (Aiyelaagbe et al., 2000). Tetramethylpyrazine, an alkaloid isolated from the stem of this plant, inhibited vascular or extra vascular smooth muscle preparation and possesses hypotension activity after intravenous administration in anaesthetized rats (Ojewole and Odebiyi, 1980; 1981). The stem of this plant was reported to contain an alkaloid which showed antibacterial property (Odebiyi, 1980). Two cyclic peptides, podacycline A and B were isolated from the latex of this plant (Van den berg et al., 1996).
Plate No.12. *Jatropha podagrica* Hook

a. Habit

b. Flowering and Fruiting branch
Objectives of the Present Study

1. Pharmacognostic studies of various parts of plants such as leaves, roots and stem. This includes:
   a. Micromorphology of leaves
      i. Determination of palisade ratio, stomatal index and stomatal frequency.
      ii. Determination of vein islet number.
      iii. Determination of vein termination number.
      iv. Powder study of the parts used.
   b. Anatomical and histochemical study.

2. Phytochemical analysis of various parts of the above listed plants.
   a. Isolation and identification of different chemical constituents using standard chromatographic and spectrophotometric methods.
   b. Quantitative estimation of different chemical compounds.
   c. Comparative study of various chemical constituents of the above listed plants.

3. Locating both pharmacognostic and phytochemical markers useful in the identification of various plants and plant extracts so that quality control procedures for these plants are standardized.
GLOSSARY OF SOME BOTANICAL MEDICAL/ MEDICINAL TERMS USED IN THE TEXT
### Glossary of Botanical Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acuminate</td>
<td>Tip drawn out into a narrow prolonged termination</td>
</tr>
<tr>
<td>Acute</td>
<td>Tip forming an acute angle, without a special tapering</td>
</tr>
<tr>
<td>Caducous</td>
<td>Falling away early</td>
</tr>
<tr>
<td>Cordate</td>
<td>Heart shaped, the base is rounded in forming a notch or sinus where the stalk is attached.</td>
</tr>
<tr>
<td>Coriaceous</td>
<td>Tough and rigid, leathery.</td>
</tr>
<tr>
<td>Cyme</td>
<td>Floral cluster wherein the central flower opens first.</td>
</tr>
<tr>
<td>Elliptic</td>
<td>Oblong but ends tapering towards both the ends.</td>
</tr>
<tr>
<td>Glabrous</td>
<td>Surface smooth without any hair</td>
</tr>
<tr>
<td>Hispid</td>
<td>Covered with rough bristly hair.</td>
</tr>
<tr>
<td>Lanceolate</td>
<td>Lance shaped</td>
</tr>
<tr>
<td>Oblong</td>
<td>Nearly elliptical, with sides more or less parallel, ends blunted, 2-4 times as long as broad.</td>
</tr>
<tr>
<td>Pubescent</td>
<td>Covered with fine, soft hair.</td>
</tr>
<tr>
<td>Serrate</td>
<td>Small and sharp teeth directed forward like the teeth of a saw, pointing to the tip of the blade</td>
</tr>
<tr>
<td>Serrulate</td>
<td>Diminutive of serrate, and is equivalent to minutely Serrate.</td>
</tr>
<tr>
<td>Spathulate</td>
<td>Spoon shaped.</td>
</tr>
<tr>
<td>Succulent</td>
<td>Fleshy or spongy.</td>
</tr>
</tbody>
</table>
Glossary of Medical / Medicinal Terms

Abdominal pain: Pain in abdominal region due usually to constipation, indigestion, etc.

Abortifacient: An agent that induces abortion

Acidity: Sourness, a sign of indigestion.

Alterative: Tending to cure or restore to health.

Anaemia: Condition where Red Blood Cells count is below the normal level.

Analgesic: Relieves pain without causing loss of consciousness.

Anthelmintic: Destroying or expelling worms.

Antibacterial: An agent capable of reducing or stopping the action of bacteria.

Antidote: A medicine which neutralizes a poison.

Antipyretic: Counteracting fever.

Antiseptic: An agent that destroys the pathogenic micro-organisms or their toxins in blood or other tissues.

Antispasmodic: An agent that relieves spasms (a sudden repetitive violent muscular contractions.

Aphrodisiac: A drug that stimulates sexual desire.

Arthritis: A condition characterized by inflammation and pain of joints.

Asthma: A condition of lung leading to difficulty in breathing.

Astringent: An agent that cause contraction of the tissues, arrest the secretion, or control the bleeding.
Blood pressure: The pressure caused due to flow and pumping of the blood by heart on the walls of blood vessels.

Blood purifier: Agents believed to remove impurities or deficiencies from blood.

Burning sensation: Includes feeling hot inside the body or in palms, soles, etc.

Cancer: A malignant new growth or tumor in any part of the body.

Carminative: A drug expelling the excessive gas in the stomach or intestine.

Catarrh: Inflammation of mucous membrane of the larger air passages of lungs, with catarrhal discharge.

Colic: Spasmodic pains in the abdomen.

Conjunctivitis: Inflammation of the membrane lining the eyelids and covering the eye ball.

Constipation: Difficulty in passing faeces.

Cough: An effort of the lungs to throw off injurious matter, accompanied by harsh sound from throat.

Diabetes: A metabolic disorder resulting in elevated blood glucose, and discharge of large amount of glucose containing urine.

Diarrhoea: A common symptom of gastro-intestinal disease resulting in frequent discharge of watery stool.

Disinfectant: A substance which destroys harmful germs, bacteria, viruses, etc.
Diuretic  Having the power to promote the flow of urine.
Dropsy  An excessive accumulation of clear watery fluid in any part of the body.
Dyspepsia  Impairment of functioning in digestion
Eczema  An inflammatory disease of skin with itching and burning.
Emetic  An agent that causes vomiting.
Emmenagogue  An agent that promotes menstruation
Erysipelas  An inflammatory disease affecting the skin marked by a bright redness
Fever  Abnormal bodily heat and quickening of pulse.
Flatulence  Presence of excessive gas in the stomach.
Galactagogue  Stimulates secretion of milk.
Gonorrhoea  An inflammatory disease of the genitor-urinary passages causing pain on discharge, transmitted through sexual contact.
Gastralgia  Stomach ache.
Gynaecological Ailments of women related to conception complaints and delivery.
Hay fever  Acute irritative inflammation of the mucous membrane of the eye and upper respiratory passages.
Hypertension  High blood pressure.
Hypotensive  Agents to reduce blood pressure.
epidermis.

Sedative
Soothes or allays irritability.

Sore
A general for a variety of boils and wounds.

Stomachic
An agent that improves appetite and digestion.

Tonic
A drug that invigorates or improves the normal tone of an organ or the patient generally.

Tumor
Generally an abnormal swelling of body other than those due to direct injury.

Veneral diseases
Sexually transmitted disease.

Vermifuge
Which removes worms from the intestine.

Vomiting
Throwing up the contents of the stomach by the mouth, often with violence.

Warts
A skin disorder with a horny surface and finger like shape.

Worms
A variety of worms which are parasites on human body or part of body.

Wound
Incision in soft tissues, muscles, or skin caused by external injury.