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Since ancient times, people have been exploring the nature and more particularly plants in search of new drugs. This has resulted in the use of large number of medicinal plants to treat various diseases. Many of these plants have been shown curative properties and resulted in discovering few new drugs of western medicines. Based on traditional use of plant, some of the pure compounds from the traditional medicinal plants have remained an important source for the drug discovery. Historically, pharmacological testing of biological active compounds are either from natural or synthetic sources. These compounds have become resource for innumerable therapeutic agent. Ergodic screening of important compounds from plant resource has led to the discovery of active drugs (Colman & Green, 1946; Sukh Dev, 1988; Wolf et al., 1995; Gerhartz et al., 1985 and Kroschwitz, 1992). Advances in Biotechnology, Genetic Engineering, Molecular Biology and Nanobiotechnology have enabled scientist to design target specific and cell based mechanism of screening novel drugs from plant extracts.

The consistent research on plants has made to develop the use of plant as decoction and now to isolate the essential phytochemical to treat illness. The use of herbal medicines is mentioned in the history of almost all civilization. With emerge of synthetic drugs; the use of herbal medicines was fainted. Growing urbanization, changing cultural preferences, overexploitation of the plant resources; the lack of organized support and activity with regard to folk and tribal medicine have led most experts working in this field to conclude that these traditions are slowly dying out (Bajaj and Williams, 1995).
In 2002, World Health Organization (WHO) has reported the percentage of people that has used folk medicine at least once in their life. According to that report 48% in Australia, 31% in Belgium, 70% in Canada, 49% in France and 42% in the United States of America have used herbal medicine for the treatment of infection or diseases. In India, 65% of the population in rural areas uses Ayurveda and medicinal plants to meet their primary health care needs (WHO, 2002).

Edeoga *et al.*, (2005) reported that medicinal value of plants lies in some chemical substances that produce a definite physiological action on the human body. Hill, (1952) opined that most of the important bioactive constituents of plants are alkaloids, tannins, flavonoids and phenolics compounds. Kaufman *et al.*, (1999) reported that the medicinal actions of plants are unique to particular plant species or groups is consistent with this concept as the combinations of secondary products in a particular plant are often taxonomically distinct. McChesney *et al.*, (2007) reported that plant derived natural products hold great promise for discovery and development of new pharmaceuticals. Heinrich and Gibbons, (2001) opined pharmaceutical and biotechnological industries are much interested in using this knowledge for the discovery, development and application of new active products on health.

The discovery and isolation of quinine from Cinchona was the landmark and led scientist from new world to take interest in impenetrable jungles and forests. This discovery was made by Caventou and Pelletier (Phillipson, 2001)

### 2.1 MAJOR EVENTS IN PHYTOCHEMISTRY

#### 2.1.1 PHYTOCOMPOUNDS AS ANTICANCEROUS AGENTS

In early 1950’s, the American Cancer Institute initiated search programme for antineoplastic compounds from natural resources. This led to the discovery of taxol from *Taxus brevifolia*, it was the only promising natural product showed anticancerous activity against two leukemia cell lines (Kingston 1993). Gustafson *et al.*, (1992) and Cox (1993) has reported that prostratin (phorbol ester) isolated from bark of
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*Homalanthus nutans* (Euphorbiaceae), acts as non-tumor promoting activator of protein kinase C.

Lee (1993) reported that ‘Vinblastin’ and ‘Vincristine’ well known as Vinca alkaloids were isolated from *Catharanthus roseus*, a traditional Chinese medicinal plant. These two dimeric indole-indoline alkaloids could be used for the treatment of acute childhood leukemia, Hodgkin's disease and metastatic testicular tumors.

Clark (1996) reported that ‘Etoposide’ and ‘Teniposide’, derivatives of Podophyllin exhibit the anticancer activity. Their mode of action is by inhibiting the topoisomerase II. According to Cragg *et al.* (1997) United States National Cancer Institute (NCI) had approved 87 anticancer drugs, out of those 62% were from natural plant origin.

### 2.1.2 PHYTOCOMPOUNDS AS ANTI-HIV AGENTS

Kakiuchi *et al.*, (1985) demonstrated the anti-viral activity of monomeric and dimeric tannins and they found that dimeric tannins perform better than monomeric in terms of interacting with proteins in order to inhibit the growth of retrovirus. Walker *et al.*, (1987) had introduced antiviral property of Castanospermine to the world. It is a plant alkaloid isolated from seeds of the Australian chestnut tree, *Castanospermum australe* (Fabaceae). This alkaloid inhibits the ability of virus to enter the host cell even after attachment to CD4. Ito *et al.*, (1988) reported that the antiviral nature of Glycyrrhizin, isolated from the aqueous extract of liquorice root *Glycyrrhiza glabra*.

Hudson *et al.*, (1993) explained that the two compounds viz. ‘Hypericin’ and ‘Pseudohypericin’, isolated from *Hypericum perforatum* have anti-HIV activity. According to them, these compounds do not show inhibitory action on reverse transcription but they inhibit its release. The compounds stabilizes HIV capsid structure and prevents it’s uncoating. According to Boyd *et al.*, (1994) Michellamines A, B, and C (atropisomeric naphtylisoquinoline alkaloid dimmers) isolated from tropical liana *Ancistrocladus korupensis* the rainforest of Cameroon exhibit anti-HIV activity.
Lee et al., (1994) isolated ‘Suksdorfin’ from the fruits of Lomatium suksdorfii. It inhibits HIV replication in T cells and in a monocytic cell line as well as in peripheral blood mononuclear cells. According to the data published by Currens et al., (1996a and b) ‘Calanolide A’ exhibits inhibitory activity against HIV-1 in vitro. It is a coumarins derivative isolated from the tree Calophyllum lanigerum. It is hypothesize that it interferes with binding of deoxynucleotide triphosphate (dNTP). In 1996, Hashimoto et al., has tested thirty-eight tea polyphenols for anti-HIV activity and they found that ‘S-Cascorbyl (-)-epigallocatechin’ and ‘theasinensis-D’ exhibit anti-HIV activity.

2.1.3 PHYTOCOMPONDS AS ANTIINFLAMMATORY AGENTS

Mann, (1992) reported that bark and leaves of willow (Salix spp.) are among the most famous plants with antiinflammatory properties. The anti-inflammatory nature is due to the salicyclic compounds. Further research has led to the discovery of ‘acetylsalicylic acid’, a salicyclates derivative which is now well known as ‘Aspirin’

There are many other reports available on the antiinflammatory compounds isolated from plant resources such as ‘Ursolic acid’ from Plantago major inhibits COX-2 (Ringbom et al., 1998); ‘Rhamnetin’ from Guiera senegalensis inhibit 5-lipoxygenase activity (Bucar et al., 1998); ‘Isocoumarins’ from Hydrangea dulcis inhibit mast cells (Matsuda et al., 1999); ‘Eugenol’ from Ocimum sanctum acts on COX-1 (Kelm et al., 2000); ‘Wogonin’ isolated from Scutellaria baicalensis acts on COX-2 expression (Chen et al., 2001); ‘Maesanin’ from Maesa lanceolata inhibits 5-lipoxygenase (Abourashed et al., 2001); ‘Terminoside A’ from Terminalia arjuna affect Nitric oxide production (Ali et al., 2003), ‘Resveratrol’ from Vitis vinifera acts on Mast cells (Baolin et al., 2004); ‘Orixalone A’ from Orixa japonica inhibits Nitric oxide (Ito et al., 2004); ‘Ugandensidal’ isolated from Warburgia ugandensis inhibits 5-lipoxygenase and 12-lipoxygenase (Wube et al., 2006).
2.1.4 PHYTOCOMPOUNDS AS ANTIDIABETIC AGENTS

Logendra et al., (2006) isolated ‘4,5-di-O-caffeoylquinic acid’, ‘6-demethoxy-capillarisin’ and ‘2’,4’-dihydroxy-4-methoxydihydrochalcone’ from the ethanol extract of Artemisia dracunculus and showed its inhibitory effects towards the enzyme aldose reductase, a key enzyme involved in diabetic complications indicating its antidiabetic effect. Goldstein and Wieland, (2008) reported that ‘Galegine’ compound from Galega officinalis, belonging to guanidine group exhibits antiglycemic property.

Muraoka et al., (2008) isolated α-glucosidase inhibitors, such as ‘salacinol’, ‘kotalanol’, ‘de-O-sulphated-salacinol’ and ‘de-I-sulphated-kotalanol’ from Salacia reticulate and showed its inhibitory effects, which was found to be similar to that of voglibose and acarbose (antidiabetic drugs). Grace et al., (2009) reported the antidiabetic nature of Anthocyanin-rich extracts obtained from blueberries. The antidiabetic nature was comparable to drug metformin. Tian et al., (2010) reported that ‘Methylswertianin’ and ‘Bellidifolin’ fractions of the Swertia punicea improves insulin sensitivity in type 2 diabetic mice. McDougall and Stewart, (2005) and Gunawan-Puteri and Kawabata, (2010) showed that ‘Ellagitannins’ are class of plant biomolecules that inhibit α-glucosidase enzymes. Rao et al., (2010) have reviewed the active compounds of the antidiabetic plants, their medicinal important plant part and their family. Yang et al., (2012) found 15 bioactive molecules from Morus alba with α-glucosidase and tyrosinase inhibitory activity. It contains compounds like flavanes, prenylated stilbenes and iminosugars.

2.1.5 PHYTOCOMPOUNDS AS ANTIMICROBIAL AGENTS

Duke (1985) reported that ‘Hypercin’ from Hypericum perforatum exhibits antidepressant and antimalarial property. In 1991, Scalbert reviewed the antimicrobial properties of tannins against filamentous fungi, yeasts, and bacteria. Kazmi et al., (1994) reported that anthraquinone from Cassia italic exhibit bacteriostatic property for Bacillus anthracis, Corynebacterium pseudodiphthericum, Pseudomonas aeruginosa and bactericidal for Pseudomonas pseudomalliae.
Perrett et al., (1995) showed that ‘Alpinumisoflavone’ (flavonoid) from West African legume prevents schistosomal infection. Afolayan et al., (1997) reported that ‘Galangin’ (3,5,7-trihydroxyflavone), derived from the perennial herb Helichrysum aureonitens as antibacterial and antifungal.

2.2 EUPHORBIACEAE AND ITS PHYTOCHEMICAL STUDIES

Euphorbiaceae is generally distinguished by the milky sap (when present) unisexual (evolved) flower, ovary trilocular and superior, axile placentation. Gibbs (1974) summarized and reviewed phytochemical constituents of Euphorbiaceae. Webster (1975) recognized that the seed fats of Euphorbiaceae reveal the heterogeneity of the family. The history of classification systems for the Euphorbiaceae at the subfamilial and tribal level has been reviewed in the Kew symposium on Euphorbiales (Webster, 1987). The Euphorbiaceae, although one of the largest dicot families and conspicuous throughout the tropics, have been relatively neglected by systematists in the 20th century (Webster, 1994) According to Webster, (1994) this family consists of wide range of plants right from simple weeds to tropical plants. These members are distributed in all over world. The habitat of these members is also very diverse, they are found from desert to rainforests. Due to its diverse nature, it has become complicated to classify and study its ethanomedicine. Bloomquist (2004) and Ahmad et al., (2006) has reported that different habitat conditions like soils, pH, temperatures and moisture, influences the plant physiology; affect the manufacture and accumulations of difference chemical substances.

The diversity exhibited by Euphorbiaceae has always attracted scientist from all over world to explore more and more members of this family. The essence of medicinal properties lies in the phytochemistry of plants, therefore phytochemical study is considered as basic and important way for exploring any medicinal plants.

The juice of Kirganelia reticulata leaves is used to cure diarrhea in infants. The leaves are employed as diuretic and cooling medicine. The stems are used to treat sore eyes and the powdered leaf is used in sores, burns, suppurations and chafing of the skin (Chopra et al., 1956). Many Euphorbiaceae plant concoctions and fresh latex
are used in alternative medicine. For example, *E. tirucalli* is known for its curative features against diseases like warts, cancer, gonorrhea, arthritis, asthma, cough, earache, neuralgia, rheumatism, toothache, excrescences and tumors as reported by Duke (1983); Van Damme (1989); Cataluna (1999).

The family comprises of plants that possess a poisonous substance called ‘Ricin’ which is a protein found in *Ricinus communis* (Palatnick and Tenenbein, 2000). Some members are said to cause or influence susceptibility to certain body ailments. For example *Euphorbia tirucalli*, *Euphorbia leuconeura* and *Jatropha curcas* known to be cocarcinogenic and can influence/promote excessive cell division resulting in tumor growth (Hirota and Suttajit, 1988; Van Damme, 2001; Vogg et al., 1999). Further, Hooper (2002) reports the use of *Euphorbia polycarpa*, *Euphorbia hirta* and *Acalypha indica* L. for treatment of different ailments in the ancient Ayurveda system. In ancient Chinese medicine, Lai et al., (2004) has reported that 33 species belonging to 17 genera of Euphorbiaceae used in herbal medicine. The stems of *Phyllanthus reticulates* are used to treat sore in eyes and the powdered leaf is used in sores, burns, suppurations and chafing of the skin.

Latex of *Euphorbia tirucalli* and *Euphorbia royleana* is known to cause conjunctivitis on contact with eyes (Shlamovitz *et al.*, 2009; Van Damme, 1989). Awoyinka *et al.*, (2007) has screened *Cnidoscolus aconitifolius* for its phytochemical composition and found that plant is rich in phenols, saponins, cardiac glycosides and phlobatannin, whereas flavonoids and anthraquinones are absent. They also showed its antibacterial activity against *Salmonella typhii* and *Staphylococcus aureus*.

Balakrishnan and Chakrabarty (2007), opined that Euphorbiaceae have developed various life forms from herbs, shrubs, stunted succulents to tall canopy trees. Shruthi *et al.*, (2012) recorded that leaf of *Kirganelia reticulata* contains alkaloid, flavonoids, phenols, steroids and tannins whereas, Pandith (2012) showed that alkaloids, tannins, saponins, glycosides, phenols, flavonoids, anthraquinone, terpenoids and steroids are present in *Acalypha indica* and *Euphorbia hirta*. Nagaraju *et al.*, (2012) reported the phytochemical profile, anti-oxidant and anti-inflammatory property of *Euphorbia thymifolia*.

Number of researchers has worked on Euphorbiaceae in the aspect of phytochemicals. Mamatha *et al.*, (2014) reported that steroids, glycosides, carbohydrates, flavonoids, triterpenoids, gums, fats and oils, tannins and phenolic compounds are present in *Euphorbia thymifolia*. Bijekar *et al.*, (2014) has reviewed the ethanomedicinal properties of Euphorbiaceae family. In this review they have enlisted 108 members of this family, their plant parts and medicinal property and concluded it as rich source of medicinal components and have mentioned the need of doing extensive research on it.

### 2.3 MAJOR PHYTOCHEMICALS

#### 2.3.1 ALKALOIDS

Alkaloids are one of the largest secondary metabolites synthesized from amino acids and contain nitrogen bases group. They are alkaline in nature and the degree of alkalinity varies with the position of functional group.

Staubmann *et al.*, (1999) reported the presence of alkaloids namely ‘5-hydroxypyrrolidin-2-one’ and ‘pyrimidine-2, 4- dione’ in *Jatropha curcas*. Alkaloids are known for its anesthetics and (Central Nervous System) CNS stimulant activity (Madziga *et al.*, 2010). Demisse and Lele (2013) have isolated novel alkaloids, whose probable empirical formula is C\textsubscript{25}H\textsubscript{35}O\textsubscript{4}N. The isolated compound showed significant antimicrobial and anticancerous activity.

Vafa and Heinrich (2014) have reviewed the list of alkaloids that are being used as major constituent in commercial available drugs either in its native or derived form such as Aconitine its product name is Aconitsat™ it is used for the treatment of Rheumatism, neuralgia, sciatica. Atropine, trade name AbdominoIT™, Espasmo™,
Protecor™ or Tonaton™ to treat Parkinson, Berberine, product name is Kollyr™, Murine™, Sedacollyre™ is used to treat eye irritations, AIDS, hepatitis. Berna et al., (2014) isolated two alkaloids such as ‘cuspidatin’ and ‘cuspidatinol’. These compounds were further tested for cytotoxic activity against L1210 Murine Leukemia Cell Line.

2.3.2 FLAVONOIDS AND PHENOLS

Flavonoids are a group of polyphenolic compounds with known properties which include free radical scavenging, inhibition of hydrolytic and oxidative enzymes and antiinflammatory action (Frankel, 1995). Like as phenolic acids, flavonoids are secondary metabolites of plants with polyphenolic structure. Flavonoids are well known for their antioxidant activity. Ardhaoui et al., (2004); Vorsa et al., (2007) and Ghasemzadeh and Ghasemzadeh, (2011); reported that several flavonoids are being used in pharmaceutical, cosmetic and food preparations.

Amzad and Rahman, (2015) isolated and have characterized 6 flavonoids from the leaves of Orthosiphon stamineus. The isolated flavonoid compounds were ‘eupatorin’, ‘sinensetin, 5-hydroxy-6,7,3’, ‘4’-tetramethoxyflavone’, ‘salvigenin’, ‘6-hydroxy-5,7,4’-trimethoxyflavone’ and ‘5,6,7,3’-tetramethoxy-4’-hydroxy-8-C-prenylflavone’.

2.3.3 TERPENOIDS

Terpenoids composed of “isoprenoid” units constitute one of the largest group of natural products accounting for more than 40,000 individual compounds, with several new compounds being discovered every year (Sacchettini et al., 1997; Peñuelas and Munné-Bosch 2005). All terpenoids are synthesized through the condensation of Isopentenyl Diphosphate (IDP) and its allylic isomer Dimethyl Allyl Diphosphate (DMADP) (Carretero-Paulet et al., 2002).

It’s medicinal properties like antimicrobial, antifungal, antiparasitic, antiviral, antiallergenic, anticancer, antispasmodic, antihyperglycemic, antiinflammatory, and
immunomodulatory have been reported by Wagner and Elmadfa (2003); Sultana and Ata (2008) and Rabi and Bishayee (2009).

Reports are also available on the isolation and characterization of terpenoids, Sharma et al., (2010) who have isolate β-amyrin (terpenoids) from a chloroform extract of Euphorbia hirta. Chemical structures of the isolated compounds were identified by TLC and spectroscopic data. Yang et al., (2012) isolated terpenoids viz. ‘Nimbidiol’ and ‘Pristimerin’ by using n-hexane–ethyl acetate–methanol–water solvent system and through HPLC. Mariajancyrani et al., (2013) isolated compound called ‘Oleananoic acid acetate’ from leaves of Bougainvillea glabra choicy leaves.

2.3.4 TANNINS

The tannins of different plant species have different physical and chemical properties (Mangan, 1988). From the chemical point of view it is difficult to define tannins since the term encompasses some very diverse oligomers and polymers (Harborne, 1999; Schofield et al., 2001). Tannins are also defined as water-soluble polyphenolic substances and have ability bind to proteins that form insoluble or soluble tannin-protein complexes. They have been closely associated with plant defense mechanisms against mammalian herbivores, birds and insects (Hagerman and Buther, 1981; Hassanpour et al., 2011). As a consequence, tannins are able to make complex with polysaccharides (cellulose, hemicelluloses and pectin) and nucleic acids, steroids, alkaloids and saponins (Haslam, 1986 and ChaichiSemsari et al., 2011)

The proteins that show the most affinity for tannins are relatively large and hydrophobic, have an open, flexible structure and are rich in proline (Kumar and Singh, 1984; Hagerman and Butler, 1991; Hagerman et al., 1992; Mueller-Harvey and McAllan, 1992). Antimicrobial, antihelminthics, protein bypassed effects in ruminants of tannins has been carried out by Athanasiadou et al., (2001); ChaichiSemsari et al., (2011); Hassanpour et al., (2011); Sadaghian et al., (2011) and got positive results. Essam and Al-Jumaily (2012) isolated tannins from Plantago lanceolata and purified by TLC and HPLC. Further these fractions were tested for antimicrobial activity.
2.3.5 SAPONINS

Saponins are naturally occurring secondary metabolites. They are glycosidic compounds and contain triterpenoid or steroidal aglycones linked to oligosaccharide moieties through ether and ester linkages (Miyakoshi et al., 2000; Oleszek, et al., 2001; Karimi, et al., 2011).

Many herbal drugs contain saponin as their primary constituents (Lacaille-Dubois et al., 1996; Osamu Tanaka, 1990). Saponin also exhibit antitumor activity, they inhibit growth of tumor cells by inducing oxidative stress (Kim et al., 1999), targeting mitochondria (Wang et al., 2004) and by activating death receptors (Cheung et al., 2005).

Kwak et al., (2003) investigated the triterpenoid saponin ‘Loniceroside C’, isolated from Lonicera japonica, a medicinal plant known as an antiinflammatory agent for centuries. Li et al., (2002) isolated two triterpenoid saponins from the stem bark of Kalopanax pictus, both saponins showed significant antiinflammatory activity.

To understand the role of secondary metabolites in plant physiology is always been knotty. They are generally considered to have an important role in the defense of plants against pathogens, pests and herbivores due to their antimicrobial, antifungal, antiparasitic, insecticidal and antifeedant properties (Morrissey and Osbourn, 1999; Sparg al et., 2004; Augustin al et., 2011; Osbourn al et., 2011).

Saponins also exhibits a range of biological activities like immunostimulatory, hypocholesterolemic, anticarcinogenic, antiinflammatory, antimicrobial, antiprotozoan, molluscicidal and have anti-oxidant properties (Tessa Moses et al., 2014).

2.4 ANTIMICROBIAL STUDIES IN EUPHORBIACEAE

Bacterial infection is one of the most serious global health issues in 21st century (Morris and Masterton, 2002). This issue is more complicated in developing
countries like India; suffer disproportionately from the burden of infectious diseases. India the second most populous country in the world is in the midst of a triple burden of diseases; the unfinished agenda of communicable diseases, noncommunicable diseases linked with lifestyle changes and emergence of new pathogens and overstretched health infrastructure (Quigley, 2006).

Discovery of antibiotics had successfully controlled the spread of bacterial infection and has saved many lives but its excessive use of antibiotics resulted in the emergence of bacterial resistance (Cohen, 2000). Phytochemical research has shown that plants could be good source for antimicrobial agents. The screening of plant extracts for antimicrobial activity has shown that they are potential source of novel antibiotic prototypes (Afolayan, 2003). Now with the emerge of multidrug resistance pathogen and antibiotics side effects on our body, this situation is demanding for the search of natural and effective substitute. Changing only molecular structure of known antibiotics may also not help us to agitate this situation. When infections become resistant to first choice or first line antimicrobials, treatment has to be switched to second-or third-line drugs, which are nearly always expensive (Sibanda and Okoh, 2007). The plant material that are used in traditional medicine are generally proved to be more effective and relatively cheaper than modern medicine (Mann et al., 2008)

Chika et al., (2007) reported the antimicrobial activity of Euphorbia hirta against Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa and Bacillus subtilis. According to the author, this antimicrobial activity is due to the presence of tannins, alkaloids and flavonoids present in the plant extract.

Oyi et al., (2007) reported the antimicrobial activity of latex of Jatropha curcas. They carried out the antimicrobial assay against microbes namely Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa, Stapylococcus aureus, Streptocococcus pyogenes and Candida albicans.

Mdlolo et al., (2008) screened the leaf extracts of Phyllanthus parvulus and Phyllanthus burchelli for the presence of secondary metabolites and also reported in vitro antibacterial properties against Escherichia coli, Pseudomonas aeruginosa,
Proteus mirabilis, Serratia marcesens, Bacillus subtilis, Microflora conti and Klebsiella oxytoca. They found that plant is rich with tannins, alkaloids, saponins, anthraquinones and flavonoids.

Aliyu et al., (2008) reported the medicinal properties of 12 medicinal plants viz. Acacia albida (Leguminosae), Anchomanes (Araceae), Boscia senegalensis, (Capparidaceae), Bridelia ferruginea (Euphorbiaceae), Ficus ingens (Moraceae), Indigofera arrecta (Papilionoideae), Moringa oleifera (Moringaceae), Mormodica basalmina (Cucurbitaceae), Pavetta crassipes (Rubiaceae), Phyllanthus amarus (Euphorbiaceae), Vernonia blumeoides (Asteraceae) and analyzed their antimicrobial activity against Methicillin-resistance Staphylococcus aureus (MRSA).


Bokshi et al., (2012) has assessed ethanol extract of leaves of Acalypha hispida and found that extract showed potent cytotoxic effect (LC50 19.9 5μg/mL) which was comparable to standard cytotoxic drug chloramphenicol (LC50 7 μg/mL). They have also determined its phytochemical constituent such as flavonoids, saponins, glycosides, reducing sugars and steroids.

2.5 EUPHORBIACEAE MEMBERS:
2.5.1 BALIOSPERMUM MONTANUM (WILD.) MUELL-ARG.

Ravindra and Raju (2008) have reviewed the medicinal properties of B. montanum. He has listed its contribution in Ayurveda, traditional medicine, Ethanobotany and Pharmacognosy studies. They cited that the roots of B. montanum contains phorbol esters, viz. montanin (C32H48O8; yield, 0.018%), baliospermin (0.003%), 12-deoxyphorbol-13-palmitate (0.021%), 12-deoxy-16-hydroxyphorbol-13-palmitate (0.001 %) and 12-deoxy-5β-hydroxyphorbol-13-myristate (0.007%) and its
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anti-cancerous activity. Further they have also informed the medicinal property such as antioxidant, immunomodulatory, antihelminthics and hepatoprotective.

Johnson et al., (2010) evaluated the phytochemical and anti-bacterial potential of mother plants in vivo and in vitro derived callus of B. montanum and reported that preliminary phytochemical is more in callus than mother plants.

Kumar (2011), reported the anti-inflammatory property of root of B. montanum. They showed that the root extract is effective against acute inflammation (carrageenan paw edema, and Ibuprofen-induced paw edema) in a dose related manner but no significant inhibitory effect on chronic inflammation.

Seethalaxmi et al., (2012) reported the plant phytochemical composition in methanol extract and its antioxidant assay of B. montanum and concluded that B. montanum can be a potential source of new useful drug.

Lalitha and Gayathiri (2013) carried out phytochemical and anti-inflammatory analysis of crude ethyl acetate leaf extract of B. montanum. They found that plant contains phytochemical like flavonoids, tannin, steroids, glycosides, amino acid and carbohydrates. They also demonstrated the anti-inflammatory activity of ethyl acetate extracts of B. montanum against Peripheral Blood Mononuclear Cells (PBMC) cells using MTT assay.

Bijekar et al., (2014) have reported the presence of alkaloids, carbohydrates, glycosides, steroids, flavonoids, coumarins, saponins, tannins, protein and amino acids, gum and mucilage, terpenoids, anthroquinones and phenols in different plant parts of B. montanum.

2.5.2 DRYPETES ROXBURGHII (WALL.) HURESAWA

Varma et al., (2010) has screened the hypoglycemic activity of ethanol extracts of leaves of Putranjiva roxburghii and showed that the ethanol extract of Putranjiva roxburghii has beneficial effects on blood glucose levels.
Limbani et al., (2011) reported pharmacognostic and phytochemical evaluation of the leaf of *Putranjiva roxburghii*. Phytochemical analysis showed the presence of important classes of phytoconstituents like cardiac glycosides, anthraquinone glycosides, saponin glycosides, flavonoids, phenolics, alkaloids, sterols, triterpenoids and carbohydrates. Durre Shahwar et al., (2012) reported the phytochemical constituent and anti-oxidant activity of methanol leaf extract of plants viz. *Putranjiva roxburghii*, *Conyza bonariensis*, *Woodfordia fruticosa* and *Senecio chrysanthemoids*.

Rama Murthy et al., (2014) has designed standardize protocol for in vitro zygotic embryo culture and micropropagation of potentially economic important tree *D. roxburghii* and showed that MS medium supplemented with 3% (w/v) sucrose and 3.0 μM GA₃ are best for embryo culture, efficient embryo germination and seedling.

Rajagopal et al., (2014) evaluated anti inflammatory activity of *Putranjiva roxburghii* by HRBC membrane stabilization. The ethanol extract of the leaf was analyzed for antioxidant activity.

Bijekar et al., (2015) revealed the presence of alkaloids, carbohydrates, glycosides, steroids, flavonoids, coumarins, saponins, tannins, protein and amino acids, gum and mucilage, terpenoids, anthraquinones and phenols in root, stem and leaf of *D. roxburghii*.

2.5.3 CODIAEUM VARIEGATUM (L.) BL.

Paul Moundip (2005) analyzed the antiamoebic activity of *C. variegatum* in *vitro* using polyxenic culture of *Entamoebic histolytica*.

Olusola et al., (2007) conducted phytochemical screening of six clone cultivars of *C. variegatum* (Spirale, Royal, Broad Spotted Guinea, Punctatum, Sunray and Royal-like) were chemically and cytologically investigated to evaluate their therapeutic potentials. They found that shoots were relatively rich in alkaloids, cardiac glycosides, saponins, tannins, cardenolides, steroids and phyllates. Flavonoids, phlobatannins, phenols and anthraquinones were sparingly present.
Asma et al., (2008) established in vitro propagation of croton. They found that Murashige and Skoog (MS) basal salt mixtures with BAP (0.5 mg/L) and 25 mg/L of malt extract along with 25 mg/L of peptone effectively enhanced the shoot formation.

Bhot et al., (2010), studied *C. variegatum* growth in plant tissue culture where the nodal explants were used to develop multiple and elongated shoots. In vitro developed multiple shoots were induced to develop roots and further these plants were hardened.

Sangeetha et al., (2011) they studied wound healing activity of *C. variegatum* in three types of models in rats viz. excision, incision and burn wound model. The results were also comparable to those of a standard drug, nitrofurazone in terms of wound contracting ability, wound closure time and tensile strength.

Sana et al., (2012) conducted series of experiments on *C. variegatum* to optimize shooting and rooting media and found that enhanced shoots and buds proliferation formation can be achieved by using the MS media with 2 mg/L of Kinetin (KIN) and Benzylaminopurine (BA). The higher concentration of these hormones (5mg/L each) resulted in shoot formation. The in vitro roots were successfully induced by 5.0 mg/L of 2, 4-Dichlorophenoxyacetic acid (2, 4-D).

Bijekar et al., (2014) showed the presence of alkaloids, carbohydrates, glycosides, steroids, flavonoids, coumarins, saponins, tannins, protein and amino acids, gum and mucilage, terpenoids, anthroquinones and phenols in root, stem and leaf of *C. variegatum*.

From the above review, it is clear that the phytochemical screening has been done on large number of medicinal plants including Euphorbiaceae members, but due to their wide distribution, succulent nature, high mutation load, environment stimuli has made Euphorbiaceae as robust source of secondary metabolites indicating it as potential resource of future drugs. Hence, in the present investigation an attempt has been made to study phytoconstituent of some members of Euphorbiaceae viz **B.**
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*montanum, D. roxburghii* and *C. variegatum*. Understanding their photochemical composition will allow us to further exploitation of their medicinal properties. The developed phytochemical data could also used in taxonomic purpose.