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10. Medicinal Plants and Their Industrial Potential

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Abstract:

Plants have been used as a source of medicine for the treatment of different diseases from thousands of years ago. There is numerous evidences are available for use of plants as a medicine in the treatment of diseases in Indian, Egyptian, Chinese, Greek and Roman system of medicine. Pharmacognosy is the study of medicines derived from natural sources, mainly from plants which may further lead to development of new drug. The exploration, extraction and screening of biological diversity such as herbs, spices, microbes and other natural resources is the worldwide activity in recent years. Phytochemicals are the naturally available bioactive compounds which are derived from different plant parts and are primarily responsible for biological activities. The most important chemical compounds which are present in the plants are alkaloids, phenols, saponins, carbohydrates, terpenoids, steroids, flavonoids and tannins etc. Plants are served as major natural resources for traditional as well as modern medicinal system all over the world. The therapeutic potential of plants and plant products can be traced back to thousands of years ago. The information with respect to medicinal benefits of plants with other therapies has been preserved in several documentations

Keywords:

Medicine, Industry, Ecology, Geography, Drug, Natural

10.1 Introduction:

Medicinal plants, also called medicinal herbs, have been discovered and used in traditional medicine practices since prehistoric times. Plants synthesize hundreds of chemical compounds for various functions, including defense and protection against insects, fungi, diseases, and herbivorous mammals. There is evidence of herbs having been used in the treatment of diseases and for revitalizing body systems in Indian, the Egyptian, the Chinese, the Greek and the Roman civilizations. Plants have a vast potential for their use as curative medicine. There is an increasing interest both in the industry and in scientific research for herbs because of their functional properties, which exceed many currently available synthetic compounds.

A few medicinal properties of plant species used in Asian traditional medical practices have been demonstrated in controlled experiments and have become a desirable option to Europeans and Americans seeking cost effective health care, and improved health status. As the data supporting the role of specific plants in health promotion and disease prevention continue to increase, such as herbal medicine and phytocentric have evolved as alternative medical practices in Europe and North America (Palaniswamy2006). Reports also indicate a tremendous increase in the use of alternative medical practices around the world, which almost always involve the use of herbal medicine. Plants constituents may be isolated and used directly as therapeutic agents or as starting materials for drug synthesis or they may serve as models for pharmacologically active compounds in drug synthesis. Well known examples include digitoxin, morphine, atropine, penicillin, coumarine, colchicines (Hansel at el 1972). A systematic investigation of drugs used in indigenous systems of medicines in India on modern scientific lines was started more than 60 years ago. Thousands of species are yet to be explored for their potentially active compounds and a systematic investigation is necessary to bring out the best out of them for the benefit of human welfare (Chopra et al 1992). Crude extracts of some famous medicinal plants are used to control plant pathogens (Kubo et al 1981). The use of plant extracts and phytochemicals both with known antimicrobial properties is of great significance, in the past few years. A few investigations have been conducted worldwide to prove antimicrobial activities from medicinal plants (Nascimento et al 1990; Alonso-Paz et al 1995). For a long period of time, plants have been a valuable source of natural products for maintaining human health, especially in the last decade, with more intensive studies for natural therapies. According to World Health Organization (Santos et al 1995). The effect of plant extracts on bacteria has been studied by many researchers in different parts of the world (Reddy *et al* 2001; Ateb and Erdo 2003). Agarry et al. (2005) have shown the potent antimicrobial activities of the gel and leaf of *Aloevera* against a wide range of bacteria and fungi. Bearberry and cranberry juice have been used to treat urinary infections while plant species such as lemon balm, garlic and tea tree are described as broad-spectrum antimicrobial agents (Rios and Recio 2005).

Antibacterial activities of aqueous and methanol extracts of some medicinal plants reported by Girish and Satish (2008) against some human pathogenic bacteria showed the methanol extracts had wider range of activity on these organisms than the aqueous extracts, which indicates that the methanol extracts of all selected plants may contain the active components. The methanol extracts of fortynine different plant extracts were screened for antifungal activity, out of which forty-three plant extracts exhibited varying degrees of inhibition activity against the fungi (Varaprasad et al. 2009).

Mostly the pharmacological activity of medicinal plants resides in its secondary metabolites which are comparatively smaller molecules in contrast to the primary molecules such as proteins, carbohydrates and lipids. These natural products provide clues to synthesize new structural types of antimicrobial and antifungal chemicals that are relatively safe to man (Kalimuthu et al 2010).

10.2 *Calotropis Gigantea:*

Arka (*Calotropis gigantea*) an important drug of Ayurveda is known in this country from the earliest time. *Calotropis gigantea* is a weed plant commonly known as giant milk weed. The plant belongs to Apocynaceae family which includes latex bearing plants (Table 10.1). Apocynaceae is a family of flowering plants that includes trees, shrubs, herbs, stem succulents, and vines, commonly called the dogbane family.

Table 10.1: Systematic classification *of Calotropis gigantea* given by three taxonomists

Classification	Bentham& Hooker	Engler &Prantl	Hutchinson
Kingdom	Plantae	Plantae	Plantae
Class	Dicotyledones	Dicotyledones	Dicotyledones
Division	Gamopetalae	Sympetalae	Lignosae
Order	Gentianales	Asclepiadaceae	Asclepiadaceae
Family	Asclepiadaceae	Asclepiadaceae	Asclepiadaceae
Genus	*Calotropis*	*Calotropis*	*Calotropis*
Species	*gigantea*	*Gigantean*	*gigantea*

10.2.1 Botanical Description:

*Calotropis gigantea*stem is usually simple, rarely branched, woody at the base and covered with a fissured, corky, branches are succulent and densely white tomentose, copious milky sap exuded when injured. Leaves are simple, oval, broad and flat in opposite pairs, subsessile, stipule absent; apex abruptly and shortly acuminate to apiculate, base cordate, margins entire, succulent. leaves are white tomentose when young, later glabrescent and glaucous.

Inflorescence are cymose, umbellate cyme, dense, multiflowered, umbellate, peducled, cymes, arising from the nodes and appearing axillary or terminal. Flowers are hermaphrodite, pentamerous, pedicle are 1-3 long; calyx 5-lobed, shortly united at the base, lobes ovate, glabrescent (Figure 10.1).

These plants are reproduced via cross pollination through insect such as monarch butterflies. Fruits are simple, fleshy, inflated, subglobose to obliquely ovoid follicle up to 10 cm or more in diameter. Numerous (400- 600) seeds are released when the ripe pod bursts. Seeds are brown, Flattened, Tuft of long, white, silky hairs at top. Many, small, flat, obovate, compressed with silky white pappus, broadly ovate and flat tomentose with tuft of silky hairs.

Figure 10.1: *Gigantea* Stem

10.2.2 Ecology:

Calotropis gigantea is drought resistant, salt tolerant to a relatively high degree, grows wild up to 900 meters (msl) throughout the country (Sharma and Tripathi2009) and prefers disturbed sandy soils with mean annual rainfall: 300-400 mm. Through its wind and animal dispersed seeds, it quickly becomes established as a weed along degraded roadsides, lagoon edges and in overgrazed native pastures. It has a preference for and is often dominant in areas of abandoned cultivation especially disturbed sandy soils and low rainfall. It is assumed to be an indicator of over cultivation (Gamble,1935)

Figure 10.2: *Gigantea* Leaves and Flower

10.2.3 Geographic Distribution:

It is a native of India, China and Malaysia and distributed in the following countries: Afghanistan, Algeria, Burkina Faso, Cameroon, Chad, Cote d'Ivoire, Democratic Republic of Congo, Egypt, Eritrea, Ethiopia, Gambia, Ghana, guinea-

Bissau, India, Iran. Iraq, Israel, Kenya, Kuwait, Lebanon, Libyan, Arab Jamahiriya, Mali, Mauritania, morocco, Mozambique, Myanmar, Nepal, Niger, Nigeria, Oman, Pakistan, Saudi Arabia, Senegal, sierra Leone, Somalia, Sudan, Syrian Arab Republic, Tanzania, Thailand, Uganda, United Arab emirates, Vietnam, Yemen, Republic of Zimbabwe, Exotic:

Antigua and Barbuda, Argentina, Australia, Bahmas, Barbados, Bolivia, Brazil, Chile, Colombia, Cuba, Dominica, Dominican Republic, Ecuador, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, St Kitts and Nevis, St Lucia, St Vincent, and the Grenadines, Surinam, Trinidad and Tobago, Uruguay, Venezuela and Virgin Islands (US) (Gamble1935).

10.2.4 Vernacular names:

The drug *Calotropis gigantea* Linn has different names in different languages. In Arabic it is called as "Ashur''; in English "Gigantic'' or "Swallow wort'' or milk weed; in Hindi, "Ak" or "Ark" or "Madar".

Table 10.2: Vernacular names of *Calotropis gigantea*

Sanskrit	Arka, Ganarupa, Mandara, Vasuka, Svetapushpa, Sadapushpa, Alarka, Pratapass,
Hindi	Aak, Madar
English	Crown flower, giant Indian milkweed. Bowstring hemp, crown plant
Kannada	Ekka
Tamil and Malayalam)	Erukku
Telugu	JilledíPuvvu
Gujrati	Aakando
Marathi	Lalakara

10.3 Medicinal utility of *Calotropis gigantea:*

Antimicrobial activity: Aqueous, methanol, ethanol and petroleum ether extracts of the leaves of *C. gigantea* were reported to possess anti-Candida activity against clinical isolate of *Candida albicans, C. parapsilosis, C.tropicalis* and *C. krusei*(Kumar et al 2010).

The aqueous extract of leaves of *C.gigantea* was reported to possess antibacterial activity against *Staphylococcus aureus, Escherichia coli, Bacillus cereus, Pseudomonas aeruginosa, Micrococcus luteus* and *Klebsiella pneumonia* (Kumar et al 2010).

The aqueous extract of the latex of *C. gigantea* was reported to exhibit significantly inhibitory effect on *S. aureus, B. cereus, E. coli* and *C. krusei*(Singh et al 2010). Antifungal activity of *C. gigantea* was reported against plant pathogenic fungi like *Fusarium mangiferae*that causes serious threat in mango cultivation (Usha et al 2000).

Asthma: Rahul Mayee et al (2011) was studied the ethanolic extract of root of *Calotropis gigantea* by using various in vivo and invitro models. The results of these studies indicated usefulness of ethanol extract of *Calotropis gigantea* in asthma.

Anti-cancer: Vishnu Priya et al (2015) studied the Methanolic Root Extract of *Calotropis gigantea* Induces Apoptosis in Human Hepatocellular Carcinoma by Altering Bax /Bcl-2 Expression.

Anthelmintic and cytotoxic potential: Yoheshmurti et al (2015) evaluated the Different extracts of *Calotropis gigantea* leaves were evaluated for in vitro anthelmintic activity against Indian earthworms Pheretimaposthuma, and for in vitro cytotoxic activity against the Hep-2 (human larynx epithelial carcinoma) cell line. Dose dependent activity was observed in different extracts of plant leaves.

CNS Activity: Argal and Pathak, (2006) studied the alcoholic extract of peeled roots of *Calotropis gigantea* R.Br. (Asclepiadaceae) was tested orally in albino rats at the dose level of 250 and 500 mg/kg bodyweight for CNS activity.

Epilepsy: Subhas S et al. (2010) evaluated on anti-convulsant activity of stem barks of *Calotropis gigantea* linn in experimental animals.

Fever: Chitme et al. (2005) was studied the roots of *Calotropis gigantea* have been used in leprosy, eczema, syphilis, elephantiasis, ulceration and cough in the Indian system of traditional medicine. The present communication evaluated its antipyretic activity by using yeast-induced and TAB (Typhoid) vaccine-induced pyrexia in rats and rabbits. In both yeast-induced and TAB vaccine-induced fever, the fever was significantly reduced and the body temperature was normalized by administration of 200 and 400 mg/kg dose intraperitoneally. Based on the results of the present study it can be concluded that the extract of *C. gigantea* has potential antipyretic activity against both yeast-induced and TAB vaccine-induced fever, indicating the possibility of developing *C. gigantea* as a cheaper and potent antipyretic agent

Antitussive: Y. A., Jaliwala et al (2005) was studied the pharmacological evaluation of anti-tussive, anti-asthmatic and expectorant activities of *Calotropis gigantea* R.Br. in experimental *Calotropis* is used alone and sometimes with other plants to cure variety of human and animal sailments. The plants have immense potential to cure various diseases and disorders.

Table 10.3: Ethano- pharmacological Importance of *Calotropis* Species

Sr. No.	Medicinal Properties	References
1	Asthma	Kirtikar and Basu 1935; Shah and Joshi 1971; Jain et al 1973; Chaudhuri et al 1975; Bhalla et al 1982; Saxena 1986; Caius 1986; Das 1996; Snigdha Roy 2008
2	Abortifacient	Sahaet al 1961; Patel and Patel 2004
3	Analgesic, anticonvulsant, anxiolytic and sedative	Nadkarni 1976; Allen 1994; AminuddinGirach 2001; Argal and Pathak 2006; Pathak and Argal 2007; Argal and Diwivedi 2010
4	Antifertility and emmenagogue	Patel and Patel 2004
5	Anti-inflammatory activity	Pardesiet al 2008; Das et al 2009
6	Antinociceptive activity	Soares et al 2005
7	Anthelmintic activity	Zafar Iqbal et al 2005
8	Anti-cancer activity	Choedonet al 2006
9	Anti dote for Scorpion stings and Insect Bites	Hutt and Houghtom 1998; Narumon 2005; Kadhirvel et al 2010
10	Anti-tumor activity	Dash, 1991; Jayaweera 1980–1982; Dassanayake 1980–2000; Pal and Jain 1998; Taylor et al 1996
11	Anti-diarrheal and anti dyssentry activities	Satyavati et al 1976; Dash 1991; Jayaweera 1980–1982; Dassanayake1980–2000; The Wealth of India 1992; Pal and Jain 1998; Tayloret al 1996; Caius 1986; Das 1996; Havagiray et al 2004; Chitme et al 2004; Chitme et al 2005
12	Antimicrobial activity	Valsaraj et al 1997; Samy &Ignacimuthu 2000; Rao 2000; Ashraful et al 2008
13	Antiviral activity	Locheret al 1995
14	Anxiety and pain	Boericke 2001; Sharma 2001
15	CNS activity	Argal and Pathak 2006
16	Cold	Caius 1986; Das 1996
17	Expectorant	Kirtikar and Basu 1975; Shiddamallayya et al 2010
18	Cytostatic activity	Smit et al 1995
19	Cytotoxic activity	Ayoub and Kingston, 1981; Smit et al 1995; Locher et al 1995; Kupchan et al 1964; Oliveira et al 2007
20	Dyspepsia	Blair 1907; Ghosh 1988

Sr. No.	Medicinal Properties	References
21	Eczema	Caius 1986; Das 1996; Kirtikar KR and Basu 1998; Chitme et al 2004; Chitme et al 2005
22	Elephantiasis	Caius 1986; Das 1996
23	Epilepsy	Jain et al 2001; Pathak and Argal 2006
24	Elephantiasis of the legs and scrotum	Kirtikar and Basu 1975
25	Expectorant	Kirtikar and Basu 1935
26	Fever	Caius 1986; Das 1996
27	Fibrinolytic activities	Rajesh et al 2005
28	Free radical Scavenging activity	Mueen Ahmed et al 2003
29	Healing the ulcers and blotches	Blair 1907; Ghosh 1988; Ferrington 1990
30	(Goat) Motility of mature Haemonchuscontortus of goat origin	Sharma et al 1971
31	Indigestion	Kirtikar and Basu 1975
32	Kesarayer disease	Kumar and Vallikannan 2009
33	Leprosy	Shah and Joshi 1971; Jain et al 1973; Chaudhuri et al 1975; Jayaweera 1980–1982; Bhalla et al 1982; Saxena 1986; Dash 1991; Dassanayake 1980 –2000; Taylor et al 1996; Pal and Jain 1998; Kirtikar and Basu 1998; Chitme et al 2004
34	Liver injuries as well as on oxidative stress, Hepatoprotective	Jayaweera 1980–1982; Dash 1991; Dassanayake 1980 –2000; Pal and Jain 1998; Taylor et al 1996; Lodhi et al 2009
35	Mental disorders	Upadhyaya et al 1994; Srivastava et al 2007
36	Migrine	Prusti and Behera 2007
37	Nasal ulcer, laxative,rheumatoid arthritis, bronchial asthma, diabetes mellitus,nervous disorders	Narumon 2005
38	Piles	Shiddamallayyaet al 2010
39	Pregnancy interceptive activity	Srivastava et al 2007
40	Purgative	Baldwin 1979
41	Removing anemia	Blair, 1907; Ghosh 1988; Ferrington 1990
42	Rheumatism	Srivastava et al 2007
43	Ringworm of the scalp	Kirtikar and Basu 1975
44	secondary syphilis, gonorrhea,ascites, helminthiasis, and jaundice	Kirtikar and Basu 1998; Chitmeet al 2004

Sr. No.	Medicinal Properties	References
45	Skin diseases	Dash, 1991; Jayaweera 1980–1982; Dassanayake 1980 –2000; Taylor et al 1996; Pal and Jain 1998
46	Spleen disorder	Shiddamallayyaet al 2010
47	Swelling and inflammation in sprain	Manandhar 1990
48	TB and leprosy	Kirtikar and Basu 1935; Grange and Davey 1990
49	Uterus stimulant	Sahaet al 1961; Chopra et al 1965
50	Vermicidal activity	Garg and Atal 1963
51	(Vertenery) Camel diseases treatment	Sharma et al 1971; Antoine-Moussiauxet al 2007
52	Worms	Dash, 1991; Jayaweera 1980-1982; Dassanayake 1980–2000; Taylor et al 1996; Pal and Jain 1998
53	Wounds and ulcers	Jayaweera 1980–1982; Dassanayake 1980–2000; Caius 1986; Dash 1991; Das 1996; Taylor et al 1996; Pal and Jain 1998
54	Wound healing activity	Biswas and Mukherjee 2003; Havagirayet al 2004; Chitme et al 2004; Rajesh et al 2005; Snigdha Roy 2008; Pradeep et al 2009; Nalwaya et al 2009

10.4 Significant Contribution in the Field:

A review of literature reveals that a significant contribution has been made on antimycotic potential of genus *Calotropis*. The antimicrobial activity of two species of *Calotropis* viz. *Calotropis gigantea* and *Calotropis procera* are summerised as-

Table 10.4: Antimicrobial activity of *Calotropis* species

Plant Species	Part/Parts Used for Antimicrobial Activity	Target Microbes	References
Calotropis gigantea	Latex extract	Candida albicans, Saccharomyces cerevisiae, Trichophyton mentagrophytes, T. rubrum Aspergillus fumigatus, A.niger, A. flavus, Penicillium chrysogenum	Subrarmanian and Saratha,2010
Calotropis gigantea	Latex	Gram-positive, Gram-negative Bacteria	Subrarmanian and Saratha,2010

Plant Species	**Part/Parts Used for Antimicrobial Activity**	**Target Microbes**	**References**
Calotropis gigantea	Root Bark	Sarcina lutea, Bacillus megaterium, Pseudomonas aeruginosa, Bacillus subtilis, Shigella sonnei, E. coli	Alam et al 2008
Calotropis gigantea	Flowers	Staphylococcus aureus, Bacillus subtilis, Escherichia coli, Pseudomonas vulgaris, Candida albicans	Argal and Pathak 2007
Calotropis gigantea	Leaf extract	Bacillus cereus, B.subtilis, S. aureus, S.epidermidis, S.subfava, Alcaligenes fecalis, Enterobactor aerogenes, E.coli, Klebsiella pneumonia, Proteus vulgaris, P. aeruginosa, P. pseudoalcaligenes, Salmonella typhimurium, C. albicans	Jigna et al 2005
Calotropis procera	Stem, Leaves, Flowers	Alternaria alternata, Aspergillus flavus, A. niger, Bipolaris bicolor, Curvularialunata, Penicillium expansum, Pseudomonas marginales, Rhizoctonia solani, Ustilago maydis	Vadlapudi and Naidu 2009
Calotropis procera	Leaves	C. albicans, A. niger	Suvarna and Patil 2009
Calotropis procera	Apical twig and Latex	S. aureus, S. epidermidis, B. cereus, P. aeruginosa, Klebsilla pneumonia, Serratia marcescans, Enterobactor aerogenes, Salmonella paratyphi A, S. typhi, Bacillus subtilis, Micrococcus luteus and E. coli	Parabia et al 2008
Calotropis procera	Leaf and Latex	S. aureus, S. albus, Sterptococcus pneumonia, A. niger, A. flavus, Microsporumboulardii and Candida albicans	Kareem et al 2008

Plant Species	Part/Parts Used for Antimicrobial Activity	Target Microbes	References
Calotropis procera	Stem bark	Epidermophyton flocosuum and Trichophyton gypseum	Kuta 2008
Calotropis procera	Leaves	Microsporumcanis and Trichphyton rubrum	Kuta 2006
Calotropis procera	Leaves, Roots and Stem Barks	T. rubrum, Microsporumgypseum, A.niger	Hassan et al 2006
Calotropis procera	Leaves and stem	Bacillus subtilis, S. aureus, E. coli, Klebsiella pneumonia, Salmonella typhi, C. albicans	Oladimeji et al 2006
Calotropis procera	Root extract	Neisseria gonorrhaeae, Staphylococcus aureus, Escherichia coli	Filgona et al 2005
Calotropis procera	Latex	Candida albicans	Sehgal et al 2005
Calotropis procera	Whole Plant	Macrophominaphaseolina	Oluma et al 2002
Calotropis procera	Leaf and Root Bark	S. aureus, E. coli, C. albicans, Pseudomonas aeruginosa, K. aerogenes, Enterobactor aerogenes	Tahir and Chi 2002
Calotropis procera	Leaf	Root knot nematode, Meloidogyne incognita and wilt fungus, Fusarium oxysporium	Sharma and Trivedi 2002
Calotropis procera	Leaves	Bacillus subtilis, E. coli, Staphylococcus epidermidis, Yersinia enterocolitica	Salamah et al 1989

10.5 Types of activities of different plant parts of *Calotropis gigantea* of different solvent extracts:

Different parts of the plant have immense potential to cure various diseases and disorders. It is used in various polyherbal preparations. The antibacterial activity of methanol extract and its petroleum ether, chloroform and ethyl acetate fractions from the root bark of Akanda (*Calotropis gigantea*) were investigated by (Ashraful et al 2008).

The Latex of *Calotropis gigantea* (200 mg/kg/day) was evaluated for its wound healing activity in albino rats using excision and incision wound models. Latex treated animalsexhibit 83.42 % reduction in wound area when compared to controls which was 76.22 %.The extract treated wounds are found to epithelize faster as compared to controls.Significant ($p<0.001$) increase in granuloma breaking strength (485±34.64) was

Observed (Nalwayaet al2009).Ethanolic extract (50 %) of stems of *C. gigantea* at doses of 250 and 500 mg/ kg were studied for hepatoprotective activity in male Wistar rats with liver damage induced using carbon tetrachloride, 2 ml/ kg twice a week. The protective effect of *C. gigantea* extract was compared with the standard drug silymarin. Various biochemical parameters such as aspartate amino transferase (AST), alanine amino transferase (ALT), glutathione (GSH), lipid peroxide (LPO), superoxide dismutase (SOD), glutathione peroxidase (GPx) and catalase (CAT) were evaluated. The results revealed that the *C. gigantea* extract significantly decreased AST, ALT ($p < 0.001$) and lipid peroxide ($p < 0.01$) levels. The antioxidant parameters GSH, GPx, SOD and catalase levels were increased considerably compared to their levels in groups not treated with *C.gigantea* extract (Lodhiet al2009).

T. cordifolia extract has been reported against bacterial growth and improved phagocytic and intracellular bacterial capacities of neutrophils in mice (Sengupta et al 2009). *C. gigantea* was also examined against clinical bacteria (*Escherichia coli* and *Staphylococcus aureus*) and phytopathogenic bacteria (*Xanthomonas vesicatoria*and *Ralstonia solanacearum*). Leaves extraction was done using different solvents such as methanol, ethanol, ethyl acetate and chloroform. Resultsshowed poor inhibition on tested human and phytopathogenic bacteria. (Sukanya et al 2010).

Leaves of *C. gigantea* were reported to carry antioxidant activity (Singh N 2010). The leaves of *C. gigantea* were successively extracted with chloroform, ethyl alcohol, ethyl acetate and dichloromethane using Soxhlet extractor with well plate method antibacterial activity was determined against certain Gram-positive bacteria like *B. subtilis* NCIM 2063, *Micrococcus luteus* NCIM 2704, *Staphylococcus aureus* NCIM 2079 and Gram-negative bacteria namely, *K. pneumoniae* NCIM 2719, *P. vulgaris* NCIM 2027 and *E. coli* NCIM 2118. Ethyl acetate and dichloromethane extracts showed better and broader spectrum of activity whencompared to other extracts. Ciprofloxacin (10 µg /well) was used as the standard antibacterial agent (Bharathi et al 2011). The ethanolic extracts of roots of C. gigantea were examined by using various in vivo and in vitro animal models. In vitro model like isolated guinea pig ileum preparation was studies to know basic mechanism by which extract shows relaxant activity. The study shows that extract is effective against histamine induced contraction. These studies showed significant protection at lower doses while further increase in dose level showed reduced activity. The results of these studies indicated usefulness of ethanol extract of *C.gigantea* in asthma (Mayee et al 2011).

The leaves extraction was done in n-hexane, ethanol, methanol, chloroform, water and ethyl acetate and tested against B. cereus, B. subtilis, E. coli, K. pneumoniae, S. aureus, S. typhi and M. luteus for its antibacterial activity. Ethyl acetate extract was found to be most effective with MIC value also ranging from 0.25 to 1.0 mg/ml. Aqueous leaves extract showed weak antibacterial activity (Seniya et al 2011).

Ethyl alcohol, ethyl acetate, chloroform, acetone, n-hexane and dichloromethane extracts from the leaf, stem and root of akanda (*Calotropis gigantea*L.) were investigated against two phytopathogenic bacteria: *Xanthomonas oryzae*pv. oryzaeand *Ralstonia solanacearum*,and a symbiotic bacterium *Rhizobium* sp. Leaf and root extracts of ethyl alcohol, ethyl acetate and chloroform; and stem extracts of ethyl alcohol and ethyl acetate showed antibacterial activities against all the test organisms.

The maximum inhibition zone of the entire test organisms was found with the leaf extracts followed by the root and the stem extracts. Among all the extracts, the maximum zone of inhibition of *X. oryzaepv. oryzae* have been observed with the leaf extracts of ethyl acetate followed by the stem and the root extracts of acetone, respectively. The maximum zone of inhibition of *R. solanacearum* and *Rhizobium sp.* was found with the ethyl alcohol leaf extract followed by the stem and the root extracts. The minimum inhibitory concentration (MIC) of all the extracts ranged from 2.0 - 8.0 mg/mL (Hasan et al 2011).

The crude n-hexane, carbon tetrachloride, chloroform, ethanol and water extract of leaves were evaluated against 16 microorganisms including Gram positive, Gram negative and fungi. The carbon tetrachloride and ethanolic fraction showed little antimicrobial activity with average zone of inhibition 9.5 mm and 8.4 mm respectively at a concentration of 400 µg/disc. The antimicrobial activities were compared with doxycycline (30 µg/ disc) which showed an average zone of inhibition of 40 mm (Hossain et al 2012).

Phytochemical properties of leaf of *C. gigantea* obtained from methanol and petroleum ether extracts were investigated. The results suggest that the Phytochemical properties of the leaf for using various ailments. This research has been proved as a path to many scientists who may implement the result of the present work in developing drugs from *C. gigantea* against human pathogenic microorganisms (Singh S et al 2014).

n-hexane, benzene, acetone, ethanol, aqueous extract of root and latex were screened for its antimicrobial and phytochemical activities against infectious disease causing bacterial such as *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus* using the well diffusion method. In this study, bacterial extract showed a varying zone of inhibition of the growth of tested organism than n-hexane, benzene, ethanol, and aqueous. Phytochemical properties of root and latex of *Calotropis gigantea* obtain from n- hexane, benzene, acetone, ethanol and aqueous extracts were investigated. The results confirmed that presence of antibacterial activity and phytochemical in the shade dried extract of *C. gigantea* against the human pathogenic organisms (Kori and Alawa 2014).

10.6 Conclusion:

Medicinal plants from the Mediterranean region show great potential in the improvement of health and in the prevention of disease. Epidemiological studies indicate that some of these plants reduce the incidence of inflammatory diseases and cancer by inducing programmed cell death, thus arresting proliferation.

10.7 References:

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