1. INTRODUCTION

All the living forms are directly or indirectly dependent upon the plants on earth ecosystems. Man is completely dependence on plants for his existence. The necessities of human life such as clothing, shelter, agriculture, medicine, etc. are supplied by plants. As far as the ethnobotany is concerned it is worth studying. A proper documentation of primitive knowledge is essential because the ethnic groups have acquired it by long experience and they are in constant touch with the forest. They don’t even have any record but impart the knowledge orally to next generation. However, the new generation is least interested in this knowledge. However, most of the ethnobotanical studies appear to have been restricted among the tribal or urban people for recording their knowledge about plant wealth and search for new resources of edible plants, herbal drugs and other aspects of plants.

The term ethnobotany applies to total inter-relationship between human beings and plants (Jain, 1986). Use of medicinal plants in treating diseases is an ancient tradition that has existed with human habitations. Many rural communities in the developing world today use traditional medicines especially where modern drugs are unaffordable or inaccessible (Cunningham, 1991; Cunningham and Zondi, 1991). Developed countries have shown keen interest in traditional or alternative medicine of animals and humans (Schillhorn van Veen, 2001). Number of plants were used for the treatment of diseases of the digestive tract, whose active principles include bitter substances (many species of Asteraceae), glucosides (for example salicine in *Salix alba*, Salicaceae) essential oils and jelly (*Linum usitatissimum*, Linaceae; *Malva sylvestris*, Malvaceae) (Viegi et al., 2003).

Tribal groups residing in Uttarakhand using 66 species of plants which are used to treat gastrointestinal problems (vomiting, constipation, digestive disorders, loss of appetite and alimentary diseases) prevailing in their
live stocks (Pande et al., 2004). Matekaire et al. (2004) observed that high levels of botanical consistency and veterinary consistency were seen for septic wounds (61%, 89%), helminthes (61%, 61%), retained afterbirth (63%, 71%), eye problems (74%, 83%), delayed parturition (51%, 67%) and fractures (68%, 72%) to livestocks of Zimbabwe. It has also been reported that veterinary use of Cistus incanus, Colutea arborescens, Daphne laureola, and Erigeron acer improved the animal health as well as the quality of milk and dairy products (Pieroni et al., 2004). Conroy and Thakur (2005) reported that Mucuna pruriens based treatment was effective against gastro-intestinal parasites than commercial antihelmintic medicine in Fenbendazole of Dharwad district.

Kiruba et al. (2006) enumerated 34 species of angiosperms belonging to 21 families in Puthalam village of Cape Comorin, such as Azadirachta indica, Calotropis procera, Cassia absus, Cassia occidentalis, Cleome viscosa, Euphorbia hirta, Pongamia pinnata and Tamarindus indica are used for wound healing; Abrus precatorius, Abutilon indicum, Borassus falbellifer, Cocos nucifera, Dendrocalamus strictus and Mangifera indica were used as a medicine for foot and mouth diseases, Acalypha indica, Adhatoda vasica, Aloe vera and Cassia tora for skin diseases and eye problems. Bandyopadhyay and Mukherjee (2005) observed that swelling of abdomen, retention of urine and stool, loose motion, intestinal worm, swelling of neck due to cold and suppression of milk mastitis were the prevalent ailments found among the domestic animals in which plant parts were given as such, seldom in combination with some other plants.

Plants such as plantain (Plantago major, Plantaginaceae), marigold (Calendula officinalis, Asteraceae), nettle (Urtica dioica, Urticaceae), marsh mallow (Althea officinalis, Malvaceae), dill (Anethum graveolens, Apiaceae) and willow (Salix alba, Salicaceae) were the mostly used for the treatment of diarrhoea in ruminants (Lans et al., 2007). Similarly, leaves of Melia azadirachta and seeds of Butea monosperma were boiled and given to the animals to remove
intestinal parasites in Udaipur district of Rajasthan (Ambika et al., 2007). Over ground parts of the flowered Klamath weed (Hypericum perforatum, Hypericaceae) have been boiled in water were administered as a drink to cattle and sheep if swelling occurs (Jaric et al., 2007). Santhana Krishnan et al. (2008) reported that Wattakaka volabilis, Andrographis paniculata and Commelina benghalensis were administered in curing mastitis, foot and mouth disease and bloat in animals.

Different plant materials were being used to expel retained placenta in cattle including Aloe tenuior (leaves) (Dold and Cocks, 2001). Vitex doniana (bark), Hibiscus esculentus (fruit), Carica papaya (leaves), Salvador a persica (root) (Toyang et al., 2007), Glyphea brevis (leaves), Spondin monbin (leaves) (Chah et al., 2009) and Tribulus terrestris (whole plant) (Thomas et al., 2011). Ganesan et al. (2008) enumerated 113 plant species belonging to 100 genera and 46 families used by rural people of southern districts of Tamilnadu which were used for the treatment of anthrax, bone fracture, bloat, bronchitis, black quarter, corneal opacity, dog bite, enteritis, foot and mouth diseases. Similarly, whole plant of Cissus quadrangularis, bark of Wrightia tinctoria, leaves of Vitex negundo, powdered seeds of Piper nigrum and bulbs of Allium sativum were given to cure foot and mouth diseases in Udaipur district of Rajasthan (Ambika et al., 2007).

In Greater Cholistan desert of Pakistan, Blepharis indica was used as galactagogue; Calotropis procera and Phyllanthus niruri were used as emollient, demulcent and antiphlogistic; Capparis deciduas, Ricinus communis were used as carminative; Citrullus colocynthis and Vitex negundo were used as vermifuge (Fraz, 2009). Alyemeni et al. (2010) reported that 24 plants either single or in combinations were used for curing various livestock ailments such as gastrointestinal disorders, deworming, carminative, and flatulence in Arab system of medicine. In Rajasthan, tribal people formulated four remedies to cure constipation, broken horn, bone fracture, asthma, haematuria, conjunctivitis and for easy delivery (Galav et al., 2010). Kaul (2010) revealed that use of 154
botanicals in home remedy patterns of 55 common ailments to alleviate human and veterinary ailments with less side effects in high altitude of Northwest Himalayan region.

Dey and De (2010) observed that 25 plant species were used in treatment of diseased domestic animals and especially for fracture of bones and dog bites. Dilshad et al. (2010) documented Capsicum annuum, Lepidium sativum, Allium sativum, Sesamum indicum, Citrus limon, Zingiber officinale, Citrullus colocynthis, Curcuma longa, Cuminum cyminum, Rosa indica, Centratherum anthelmisticum, Triticum aestivum, Nigella sativa and Peganum harmala were used to control bovine mastitis in cows and buffalo in Pakistan. In china, medicinal plant species such as Saussurea costus, Senecio scandens, Plantago depressa, Rubus corchorifolius, Bupleurum yunnanense and Polygonum paleaceum were collected from the wild to treat diarrhea, heat, fever, colds, retained afterbirth and skin conditions and sores in animals (Galav et al., 2010).

Maphosa et al. (2010) stated that 21.4% of the Asphodelaceae member plants and Aloe sp. were mostly utilized for the treatment of gastro-intestinal parasites in goats in South Africa. Offiah et al. (2011) identified that members of Fabaceae (21%) and Combretaceae (14.04%) families when oral administration of leaves and barks of those plants were used for better management of diarrhoea in ruminant livestocks. common cattle diseases such as foot and mouth disease, anthrax, pneumonia, ectoparasites, helminthiasis, constipation, diarrhea, dysentery and mastitis were treated with different herbal ailments in their livestocks (Kumar Singh et al., 2011). Das (2011) reported that Bambusa bambos and Cassia occidentalis young leaves along with green fodder were fed to cow after delivery for the early removal of the placenta in Ganjam district of Orissa.

It has been reported that different formulations prepared from Acacia arabica, Achyranthes aspera, Adathoda vasaka, Aristolochia indica,
Calotropis gigantia, Tinospora cordifolia, Tylophora asthmatica and Urtica dioica were used to treat snake bites to the ruminants (Patel, 2011). In Jalam district of Uttar Pradesh, apart Brassica napus (used in five formulations), Zingiber officinale, Trachyspermum ammi and Trigonella foenum-graecum (used in three formulations) were extensively used to treat mastitis and diphtheria (Kumar and Bharati, 2012). Mondal and Biswas (2012) listed out different forms of herbal preparations from 35 plants that were used as effective medicine to treat various disease and disorders of domestic animals in Bankura District of West Bengal.

Muhamed Mubarack et al. (2012) enumerated 5 species belonging to the family Poaceae were used as ethnoveterinary medicine followed by Mimosaceae (4 species) from the 21 species selected in Western Ghats of Coimbatore, Tamilnadu. In Amaro district, Southern Ethiopia, Shilema et al. (2013) have reported that the five most common plant species used for treatment of animal trypanosomosis were Lepidium sativum, Echinops kebericho, Allium sativum, Withania somnifera and Myrica salicifolia. In a survey made by Lakshminarayana and Narasimha Rao (2013) it was observed that some important medicinal plants were used by tribal communities (Savara, Jatapu, Konda dora, Gadaba, Kuttiya, yerukula and Manne dora) to treat 22 common veterinary ailments in the Srikakulam district of Andhra Pradesh, India.

For ethnoveterinary practices, 32 plant species representing 32 genera and belonging to 27 families were identified as potential source of medicines for the common veterinary diseases viz., bloat, cold and cough, colic pain, dysentery, eye problems, foot and mouth diseases, fractures, intestinal worms, mastitis, post-natal problems, renderpest, sores and wounds. Santosh Kumar and Bhujel (2013) recorded that plants like Acorus calamus, Alstonia scholaris, Asparagus racemosus, Curcuma longa, Hypericum urala, Stephania japonica and Swertia chirayita were well known medicinal plants could be effectively useful for the treatment of common ailments of the animals viz., bone
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fracture, injury, wounds, indigestion, urinary trouble, poisoning by fodder and infestation by the parasites by the people of Darjeeling Himalaya, India.

Lulekal et al. (2014) stated that medicinal plant species belonging to families Asteraceae, Asclepiadaceae, Euphorbiaceae and Ranunculaceae were reported to be of frequent use in the local ethnoveterinary medical system. Roots (65%) of 33 species were the most often utilized for remedy preparation. *Embelia schimperi* showed highest fidelity level value (90%) to treat gastro-intestinal diseases showing conformity of knowledge on this species healing potential in Ankober District, North Shewa Zone, Amhara Region, Ethiopia.

1.1. *ADANSONIA DIGITATA* L.

*Adansonia digitata* is a large tree and member of Family *Bombacaceae* occur in deciduous forest in different states in India. Locally it is called *Gorkh chinch*. The plant occurs in the savannas of Africa and India, mostly around the equator. It can grow up to 25 meters tall and can live for several years. The trunk could reach a circumference of 4 meters, a height of 20 meters and a foliage diameter of 20 meters. The baobab is leafless for nine months of the year and we can say that it looks like has been picked out of the ground and staffers back in upside down direction, the trunk would be the trap root, the branches or the fingers the capillary roots.

This may be the reason of why the baobab is called African’s upside down tree and believed to receive its strength from heaven. A number of other names or metaphors are used such as vegetative elephant and the prehistoric plant monument “abode of the god” (Nirvana, 2007). In Sudan the local name tabaldi and number of other names (such as *gongolase* and *Elhamaraia*) are given (Kheiri, 1996). The baobab was among the first trees appeared on the land next came the slender graceful palm tree. In Africa, it is considered from the native people as the symbol of the continent and traditionally named “chemist tree” or “magic tree” for the therapeutic
properties of its fruit pulp, leaves, seeds, bark, fruit shell and root. Interestingly there is no evidence of side effects or toxicity related to baobab fruit pulp ingestion.

For precautionary purposes, medical advice is suggested during pregnancy and lactation. *Adansonia digitata* is originally from central Africa, and grows spontaneously in the tropical regions of the continent, and some species were exported and cultivated in Florida, named “bottle tree” and in Oceania (*Adansonia gregorii*). Baobab definition is probably derived from the Arabic "bu hibab" or “fruit with several seeds”. The Latin name was taken from the French botanic Michael Adanson, one of the first scientists that studied the plant characteristics, and from the typical fingered shape of the leaves (Baobabtell.com, 2005). This giant normally soars solitary among the most ancient trees on our planet and it grows all on its own, often in desert and rocky terrain, bringing life to the landscape with its unusual extraordinary shape and enormous conical trunk with branches which look like roots reaching to the sky.

This monument of nature is for a short time adorned with enormous and delicate white-yellow flowers and it has deep and very long roots which allow it to withstand even the fury of cyclones. The wood of its trunk is very soft and porous as it has the function of accumulating water, just like a tank, experts have calculated that it can accumulate up to 100,000 liters of water, which allows it to survive during the long periods of drought (Baobabtell.com, 2005). Baobabs live an extremely long solitary life most baobabs live for 500 years. On the west coast of Madagascar there is a truly unique case two Baobabs clinging together in a kind of embrace which is said to have lasted for 600 years, and not by chance are they called “The Lovers”. But it seems that in some parts of Africa there are exemple of 5000 years old tree (Von Maydell, 1986).

The African baobab (*Adansonia digitata* L.) is a multi-purpose tree that is important among African villages as it provides food and a range of raw materials. Its fruits provide essential nutrients and are sold to generate income. As
baobab fruits are important to the livelihoods of many people, it is important to understand the causes of differences in fruit production in order to maximize use and for conservation purposes. Many studies have examined fruit production to understand the causes of variation in fruit yields. In Venda, a region northern South Africa, differences in baobab fruit yield has been recorded for 8 years, thus classifying individual trees as either poor producers or producers (Venter and Witkowski, 2011). Poor producers are adult trees producing less than five fruits each year and some not producing at all.

On the other hand, adult trees producing more than five fruits each year are referred as producers. Causes of this difference in fruit production have not been identified. Among other factors, the observed difference in fruit production could be related to differences in ploidy-level among baobab trees. Importantly, few or no studies to our knowledge have been carried out to confirm whether differences in fruit production among baobab trees are related to a difference in ploidy-level. The well-known and widespread mainland African baobab, Adansonia digitata, is known to be a tetraploid (four sets of chromosomes). Recently, a difference in ploidy-level has been revealed.

A new diploid species, Adansonia kilima, has been identified in Africa (Pettigrew et. al., 2012). Morphological characteristics (floral, pollen, and stomatal size and density), ploidy, and molecular phylogenetics suggest the presence of a new species. This new species has been reported to overlap the well-known and widespread tetraploid A. digitata’s distribution in Venda. Consequently, the presence of a diploid species that reproduces with a tetraploid species could result in triploid progeny and contribute to the observed differences in fruit production in these baobab trees. Morphological results showed that stomata size and density were not significantly different between poor producer and producer trees and these features may not be true indicators of difference in ploidy-level for baobabs.
Gene flow results showed that there was high mean genetic heterozygosity and low population differentiation expressed in all populations. This suggests that inbreeding was not responsible for the differences in fruit production between poor producer and producer trees. Low population differentiation observed among the populations indicated that a large number of common alleles were shared among the populations. Therefore, the high gene flow observed among the populations suggests that poor producer and producer trees were sharing alleles, and what is causing the differences in fruit production remains unclear.

*Adansonia digitata* is mostly regarded as a fruit-bearing forest tree. It is a multipurpose, widely-used species with medicinal properties, numerous food uses of various plant parts, and bark fibres that used for a variety of purposes. Centuries ago the products from this plant were in market, it was well known in Cairo markets in the sixteenth century. More recently the Forestry Department of the Food and Agriculture Organization of the UN (FAO) has issued information on the species and the International Centre for Research in Agroforestry (ICRAF) continues to promote its use as a multipurpose species. A number of bilateral agencies promoted the species in the past e.g. Norway (NORAD) in Kenya, and Sweden (SIDA) in Tanzania.

Regional consultations organised by the International Centre for Underutilised Crops (ICUC) have accorded high priority to enhanced research and development of baobab. Additionally national research efforts, especially in Nigeria and Mali, have provided relatively recent data on food values and agronomy. Other research, especially in India, has accelerated knowledge of compounds valuable in medicine, and work in Saudi Arabia has also tested certain folk medicine concepts. Trials in the dry tropical regions of Africa for plantation development have included the baobab (Delwaulle, 1977; von Maydell, 1981). This publication summarises the most up-to-date knowledge on African baobab.

Whatever its future exploitation, it is likely to remain one of the wonders of nature with its huge, swollen trunk shape, and its close linkages to
numerous human cultures with a concomitant wealth of ethno botanical knowledge. It is to be hoped that exploitation will indeed benefit local people in terms of food and well-being. Interestingly, baobab has affected modern human culture. In Barbados two trees introduced from Guinea are considered one of the seven wonders of Barbados; in South Africa, bonsai baobabs are much sought after; in India, baobab long ago entered the Pharmacopoeia.

Baobabs are characterized by swollen trunks and palmately compound leaves. The trunks consist of soft, fibrous wood that can store water. The leaves of juvenile trees are simple and gradually change to 5-7 foliate compound leaves as the tree gets older. Flowers are borne in the axils of leaves and comprise a single, large, odoriferous white flower made up of both male and female reproductive parts. The fruits are large, ovoid, and covered in a yellow/green velvety indumentum. The pericarp is woody and indehiscent. Seeds are reniform, embedded in a soft dry matrix (Baum, 1995).

In general, seeds are used as a thickening agent in soups, but they can be fermented and used as a flavouring agent, or roasted and eaten as snacks (Palmer and Pitman, 1972; Addy and Eteshola, 1984). When roasted, they are sometimes used as a substitute for coffee. In some cases, seeds are dehulled by boiling, rubbing by hand, then sun drying the kernels before grinding. Seeds are also a source of cooking oil but this is not widespread, although there has been interest in expanding such use due to deficits of vegetable oils. Oil is extracted by pounding the seeds. Fermentation of powdered de-hulled seeds is known to increase protein digestibility. It also reduces the trypsin inhibition activity six fold, but increases tannin content (Addy et. al., 1995). Frequently, baobab seeds are ground with peanuts and water and sugar added to make a sauce used with porridge (Pele and Berre, 1967). Seed pulp is sometimes known as monkey bread is eaten and traded in the region (Dovie et al., 2001).

It is a very important species in the economy of rural and urban people, contributing to their food, fodder, medicine and other uses. Its fruits are important
source of cash income for the certain tribes living in Central and South Sudan (Gebauer, et al., 2002; Adam, 2012). Also it promotes biodiversity conservation through agroforestry systems which help in soil and water conservation to enhance high crop yield (Akinnifesi, et al., 2008). Baobab trees are classified as an endangered species, in their natural savannah ecosystem (Wickens and Lowe, 2008). It is mostly regarded as fruit-bearing forest tree. Each mature tree produces more than an average of 250 capsules which may provide at least 30 kilograms of fruits (FAO, 1988) Ecotypes from different areas in Sudan are widely known to have different fruits in terms of size, shape and sweetness.

Fruits of baobab are very variable in size and shape (Wickens, 1982). El Amin (El Amin, 1990) reported that the fruits are capsule, globose to ellipsoid in shape and they often irregular in shape, apex pointed or obtuse, covered by velvety yellowish hairs. Four types of baobab fruits distinguished in Kordofan only: Classification of fruit shape is vital in evaluating agricultural production and increasing market value, and it is also helpful in planning packaging for conservation. In addition it is often necessary in horticultural research for arrangement of different purposes such as cultivar descriptions in applications for plant variety rights or cultivar registers (Beyer, et al., 2002). Fusiform, crescent shaped, globose and ventricose (Gebauer and Luedeling, 2013). Most studies have been focused on the description of the baobab fruits. No further information on the diversity of baobabs and fruit shapes is available in the literature.

1.2. **Mimusops elengi L.**

Huge numbers of infectious diseases caused by the gram negative bacteria that are resistant to many commonly used antibiotics are the causes of great concern to the clinicians as well as the microbiologists. Phytomedicines, prepared from various plant materials, such as Ayurvedic traditional medicine, are comparatively safe, inexpensive and have less antagonistic effects. Leaf, bark, fruit and seeds of *Mimusops elengi* possess several medicinal properties, viz., astringent
and tonic in dental diseases and uterine disorders documented by (Gogte, 2001; Kirtikar, 1935; Misra and Mitra, 1968; Satyawati and Gupta, 1987). Plant has also been reported for analgesic, diuretic, antiulcer, antipyretic, Dnti-inflDmm Dtory and antimicrobial activities investigated by (Shahwar and Raza, 2009; Katedeshmuk et al., 2010; Rajkumara et al., 2012; Reddy et al., 2014).

In rural areas of developing countries, like India, herbal materials are in use as the primary source of medicines (Chitme, et al., 2003). Nearly 80% of the people in developing countries use traditional drugs for the purpose of primary health maintenance (Kim, 2005). Among the plant species occurring worldwide (Palombo, 2006), only a very less percentage has been investigated phytochemically. Medicines of plant origin used by the medical practitioners are in the form of extract of the whole plants or part of the plants. Some of the effects elaborated by the plant extracts used in the traditional medicine include antiviral, antitumor, antimicrobial, and having central nervous system effect (Audu, et al., 2007). Plants possess bioactive components of therapeutic value to cure several health disorders of humans (Adegoke, et al., 2009).

Research interest on the antimicrobial activity of plant extracts is a raising one because of the current problems with bacterial antibiotic resistance, and the use of phytochemicals as natural antimicrobials is gaining popularity (Nagendra, et al., 2010). One such important traditional medicinal plant is *M. elengi* belonging to the Sapotaceae family, called as ‘Bakula’ in Bengali and it is well known in Ayurvedic medicine. All the parts of *M. elengi* have medicinal properties, and the leaves are reported to be used in the treatment of bacterial diseases by tradition (Padhi and Mahapatra, 2013). Pharmacognostic and phytochemical screening reports on *M. elengi* stem bark has been documented (Mistry and Dighe, 2013). Recently, estimation of triterpene acids using from *M. elengi* stem bark has been published (Dighe and Mistry, 2014; Shailajan and Gurjar, 2015). Antimicrobial, antiviral and hepatoprotective and cytotoxic activities of *M. elengi* are well accepted because of the wealth of scientific literature supporting these effects (Singh et al., 2014).
Aqueous and ethanol extracts *M. elengi* leaves have been tested against *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Salmonella enterica serovar Typhimurium* and *Bacillus cereus*. Ethanol extracts had greater activity than the aqueous extracts of all the remedial plants (Nair and Chanda, 2007). *M. elengi* leaf extracts showed great antioxidant activity in different solvent like n-hexane, dichloromethane and methanol compared to different standard antioxidants (Vinay, et al., 2016). Both enzymatic and non-enzymatic antioxidant activities were conducted by (Kalaiselvi et al. 2015) in assessing the antioxidant properties of *M. elengi*. Antibacterial activity of silver nanoparticles is known (Hindi, et al., 2009), and the biogenic silver nanoparticles produced by *M. elengi* fruit (pericarp) and flower extracts have been reported as excellent antimicrobials against gram positive as well as gram-negative bacterial strains (Kumar, et al., 2014; Jeyasundari, et al., 2016).

Therefore, in the present study, the ethanolic extracts of leaf, seed and bark of *M. elengi* were evaluated phytochemically and tested against six different bacterial strains to identify the potentiality of antibacterial activity. *Mimusops elengi* is considered as a sacred plant among Hindus and has obtained important place in religious text as well as in ancient Sanskrit literature. Its flowers are celebrated in the Puranas and even placed amongst the flowers of the Hindu paradise. Krishna is said to have fascinated the milkmaids of Brindavan on the banks of Yamuna by playing on his flute beneath the *Mimusops elengi* tree. Kalidas has also included in his classical Sanskrit literature, *Mimusops elengi* flowers as symbol of love and beauty (Mitra, 1981). It has made important contribution to the field of science from ancient time as well as to modern research due to its large number of medicinal properties (Nadkarni, et al., 1996).

### 1.3. **Woodfordia Fruticosa L.**

Several plant species have been used by many generations of local ethnic tribes, especially those of the Kalahandi District, Odisha, India for holistic
health care (Dubey, et al., 2012a). This practice has been validated by the Indian Ayurvedic school, Indian traditional medicine, and Indian folklore medicine for several hundred plants (Dubey, et al., 2012b). Woodfordia fruticosa has many ethno-botanical roles as a traditional medicine, such as curing bowel disorders, dysentery, diarrhea, ulcers, and other infectious diseases, in addition to treating rheumatism (Chopra, et al., 1956; Khare, 2004). This plant can cure peptic ulcers induced by Helicobacter pylori (Chung, 1998). Therefore it was thought to be worthwhile to study its antibacterial activity against bacterial pathogens from clinical samples.

Infection and morbidity as a result of multi drug resistant (MDR) bacteria in both community and hospital settings has been a problem for many decades for example, methicillin-resistant Staphylococcus aureus (MRSA) is currently resistant to 23 antibiotic drugs (Dubey, et al., 2013). Other pathogenic bacteria, such as various species of Acinetobacter, Pseudomonas, and Klebsiella have developed clonal nexuses so much that these, mainly Gram-negative, bacteria have been recorded as potent MDR bacteria in nosocomial surveys of patients in our hospital over the past 5 years (Sahu, et al., 2012c; Rath, et al., 2014). The effect of MDR bacterial pathogens can be illustrated by the example of urinary tract infections (UTIs), which are common infections affecting > 50% of the population at some time in their life.

UTIs are treated empirically with an antimicrobial stewardship program, but when the causative bacteria in repeated infections are found to be MDR, the failure of the empirical treatment can be devastating (Mishra, et al., 2013). A patient with a UTI may initially have cystitis, which, if neglected or if the empirical treatment fails, leads to kidney infection (pyelonephritis). Ultimately, the infection may spread to other vulnerable zones such as the heart and lungs. This may cause a cough and an infection spread via the bloodstream from the kidneys may lead to endocarditis and terminal respiratory tract infections. To overcome this snowball effect of a UTI infection, in addition to mainstream treatment with antibiotic drugs, the use of a medicine from a complementary-supplementary source might be a
prudent approach in view of the thousands of published research papers claiming that medicinal plants may have antimicrobial activities (Dubey, et al., 2012a).

The resistant, or rather non-committal, attitude of mainstream medicinal practices has restrained the use of plethora of natural compounds from plant sources (Dubey, et al., 2013). However, the most obvious method of treating a bacterial infection is to use antibiotics from microbes, i.e., from organisms with a similar heritage. If scaled up, crude plant extracts could be fractioned and the active antimicrobial fraction could be isolated and used as a complementary medicine together with the prescribed mainstream drug to control infectious diseases because no microbe, however well-equipped genetically by multidrug-resistance, can win over an array of phytocompounds. This paper describes the antibacterial activities of crude leaf extracts of W. fruticosa and its fractions extracted using seven non-polar and polar solvents. The best solvent fraction was used to determine the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values against MDR strains of nine pathogenic bacteria isolated from clinical samples.

This work is better than other antimicrobial work with plants with standard bacterial reference strains from culture centers with undefined antibiotic sensitivity patterns of used bacteria, available in literature. The best solvent fraction was used for gas chromatography mass spectroscopy (GC-MS) analysis to locate lead compounds that could be the coveted antimicrobial agents. The crude plant extract was tested for possible host toxicity by monitoring its activity against lymphocytes grown in vitro from human umbilical cord blood. The use of a bioactive fraction of a leaf extract of a plant without any host toxicity as a complementary antimicrobial agent for use alongside an antibiotic drug would be a novel approach against MDR bacteria.

1.4. PHYTOCHEMICAL ANALYSES OF MEDICINAL PLANTS

Plant based drugs have been used worldwide in traditional
medicines for treatment of various diseases. The plants have the capacity to produce a large number of organic chemicals so called secondary metabolites (Evans et al., 1986) which are divided into different categories based on their mechanism of functions like chemotherapeutic, bacteriostatic, bactericidal and antimicrobial agent (Purohit and Mathur, 1999). Phytochemicals are compounds found in plants that are not required for normal functioning of the body, but have a beneficial effect on health or play an active role in amelioration of diseases (Ayoole et al., 2008). These natural compounds formed the base of modern drugs as we use today (Edeouga et al., 2005; Akinmo- laudn et al., 2007; Rout et al., 2009).

Approximately 2-20% of the plants found in the world have been found to have pharmacological or biological activities (Suffrendini et al., 2004). In recent years, secondary plant metabolites (phytochemicals), previously with unknown pharmacological activities, have been extensively investigated as a source of medical agents (Krishnaraju et al., 2005) and or have been reported to be responsible for therapeutic activity in various common diseases among animals (Patel, 2013).

1.5. PHYTOCHEMICAL ANALYSES OF PLANTS LEAF EXTRACTS

The leaf extracts of Urena lobata showed the presence of phenolic compounds and alkaloids (Adeloye et al., 2007). Carbohydrates, simple reducing sugars, soluble starch, saponins, alkaloids and tannins were also detected in the leaves of Vitellaria paradoxa (Ndukwe et al., 2007). Phytochemical evaluation of the ethanolic leaf extracts of Argemone mexicana revealed the presence of reducing sugars, flavonoids, sterols/terpene, tannins and alkaloids (Ibrahim et al., 2008). Flavonoids, tannins, triterpenes, steroids, anthraquinones, anthrones, flavonoid, glycosides and coumarins were found to be present in methanolic extracts of leaves of Brucea amarissima, Intsia bijuga, Laportea meyeniana and Pipturus arborescens (Nonita et al., 2010). Aqueous
crude extracts of leaves of Helichrysum longifolium had tannins, flavonoids, steroids and saponins (Olayinka et al., 2010) while aqueous leaf extracts of Ocimum sanctum and Aloe barbadensis revealed the presence of alkaloids, terpenoids, glycosides, carbohydrates, protein, anthraquinones and fatty acids (Kumari et al., 2012) in addition to them.

Moreover, water and alcoholic extracts of leaves of Wrightia tinctoria had carbohydrates, phytosterols, tannins and lignins when the extracts were subjected to phytochemical screening (Sathianarayanan et al., 2011; Pritam and Sanjay, 2011). Sivasankari et al. (2010) have reported that leaf extracts of Caesalpinia pulcherrima and Caesalpinia bonduc exhibited positive response for carbohydrates, tannins, saponins, flavonoids, alkaloids, betacyanins, quinones, terpenoids, phenols, glycosides and cardiac glycosides. Savithramma et al. (2011) screened the presence of flavonoids, tannins, steroids, glycosides and saponins, phenols, terpenoids, alkaloids, anthocyanins, carbohydrates and proteins in the leaves of Thespesia populnea. In Morinda tinctoria, chloroform extract of leaves exhibited reaction for saponins, flavanoids, tannins, steroids, terpenoids, glycosides, cardioglycosides, reducing sugar when compared to water and hexane solvent extracts (Nisha et al., 2011) but methanolic leaf extracts of Canthium parviflorum and Canavalia gladiate had only flavinoids (Pasumarthi et al., 2011).

The ethanolic leaf extract of Eugenia floccosa showed the presence of alkaloid, catechin, coumarin, tannin, saponin, steroid, flavonoid, phenol, sugar, glycoside, xanthoprotein and fixed oil (Kala et al., 2011). Tatiya and Saluja (2011) have reported that steroids, triterpenoids, tannins and flavonoids were the major constituents in the leaf extracts of Bridelia retusa. In Plumbago zeylanica, phytochemical analysis of leaf samples indicated the presence of alkaloids, glycoside, reducing sugars, simple phenolics, tannins, lignin, saponins and flavonoids (Dhale and Markandeya, 2011).
Similarly, some of the active compounds such as alkaloids, saponins, tannins, flavonoids and proteins were present in the solvent extracts of leaves of *Solanum nigrum* and *Solanum myriacanthus* (Gogoi and Islam, 2012). In *Mentha longifolia*, leaves when subjected to phytochemical screening exhibited positive response for many bioactive chemical constituents viz., alkaloids, flavonoids, cardiac glycosides, phenolics, saponins and terpenes but lacked proteins and carbohydrates (Ashfaq *et al*., 2012). Savithrama *et al.* (2012) observed the presence of various secondary metabolites in the extracts of leaves of 31 different plant species in which 25 plants exhibited positive response for flavanoids and reducing sugars. In a study, methanolic and aqueous extracts of the dried leaves were found to contain alkaloids, phenolic compounds, tannins and flavonoids except terpenoids in *Asteracantha longifolia* and saponin in *Pergularia daemia* respectively (Doss and Anand, 2012).

Senthilmurugan *et al.* (2013) reported that ethanolic extracts of leaves of the medicinal plants viz., *Acalypha indica*, *Camellia sinensis*, *Plectranthus amboinicus*, *Curcuma longa* and *Rauvolfia tetraphylla* contained many bioactive chemical constituents including saponins, combined anthroquininones, terpenoids, flavonoids, carotenoids, steroids, xanthoproteins, couramins, alkaloids, quinines and vitamin C. Leaves of *Calotropis gigantea*, *Achyranthes aspera*, *Ficus religiosa*, *Santalum ovatum* and *Ziziphus oenoplia* exhibited the presence of carbohydrates and proteins (Tambekar *et al*., 2013). Recently, Senthilnath *et al.* (2013) have reported many secondary metabolites such as flavanoids, alkaloids, glycosides, proteins, carbohydrates, tannins, saponins, triterpenoids, anthraquinones and phytosterols in the leaves of *Andrograpis paniculata*, *Cassia alata*, *Cardiospermum halicacabum*, *Nyctanthes arboritris* and *Solanum nigrum*.

Seladjí *et al.* (2013) reported that in their qualitative analysis for ethanolic, diethyl ether and aqueous extracts of the leaves and stems of *Moricandia arvensis* and *Pseudocytisus integrifolius* found the presence of
some medicinally active constituents such as flavonoids, tannins, phenolic compounds, anthocyanosides, anthracenosides, volatile oils, coumarins, alkaloids, saponins, triterpenes, steroids and fatty acids. The preliminary phytochemical analysis of methanolic extract of *Cocculus hirsutus* leaves showed the positive reactions for bioactive components like carbohydrates, steroids, alkaloids, glycosides, flavonoids, tannins and saponins (Meena *et al*., 2014). The presence of saponins, cardenolides, triterpenes, flavonoids, steroids, phenolics and tannins was also confirmed in the leaf extracts of *Terminalia superba* (Bamisaye *et al*., 2014).

1.6. **PHYTOCHEMICAL ANALYSES OF PLANT UNDERGROUND PART EXTRACTS**

In *Plectranthus glandulosis*, root extracts contained the alkaloids, tannins, anthraquinones, glycosides, reducing sugars, saponins, flavonoids, phlobatanins, steroids and terpenoids while using hexane, ethyl acetate and ethanol solvents (Egwaikhide and Gimba, 2007). Ethanolic root extracts of *Landolphia owariensis* showed the presence of alkaloids, flavonoids, saponins, tannins and cyanogenic glycosides (Nwaogu *et al*., 2008). Kubmarawa *et al*. (2009) observed the presence of saponins, tannins, and volatile oils while flavanoids, glycosides, alkaloids, and resin were found to be absent in root extracts of *Ficus platyphylla*. Ahmad Wani *et al*. (2010) reported that glycosides, flavonoids, saponins and terpenes were present when methanolic rhizome extracts of *Rheum emodi* and *Podophyllum hexandrum* were subjected to phytochemical screening.

However, carbohydrates were found to be absent in both the plant extracts. Mariswamy *et al*. (2011) analyzed the methanolic extract of root of the *Aerva lanata* and observed the phytochemicals such as steroids, alkaloids, glycosides, terpenoids and flavonoids. The qualitative analysis of various solvent extracts of the *Diospyros lotus* (roots) fractions showed the presence of
secondary metabolites like anthraquinones, terpenoids, steroids and tannins (Uddin et al., 2011).

Nisar et al. (2011) have screened the roots which exhibited the presence of different classes of phytocompounds viz., alkaloids, steroids, flavonoids, terpenoids, anthraquinones, phlobatanins, saponins, glycosides, tannins and reducing sugars in *Rhodendron arboretum*. Methanolic extracts of *Hemidesmus indicus* (roots) revealed the presence of flavonoids (Pasumarthi et al., 2011). Screening of root extracts of *Plumbago zeylanica* noticed the presence of phytoconstituents like glycosides, flavanoids, saponins, alkaloids, carbohydrates, sterols, proteins, phenolic compounds and reducing compounds (Kodati et al., 2011). In a study, ethanolic and methanolic root extracts of *Diospyrus ferrea* and *Aerva lanata* showed maximum phytoconstituents such as flavanoids, saponins, carbohydrates, tannins, alkaloids, cardiac glycosides, triterpenoids, phenols, proteins and steroids as compared to other solvent extracts (Vijayalakshmi and Ravindhran, 2012).

The methanolic extract of *Hyptis suaveolens* root revealed the presence of alkaloids, flavonoids, tannins, steroid and glycosides (Jasani et al., 2012). Root extracts of *Dicoma niccolifera* had tannins, alkaloids, flavonoids, terpenoids, reducing sugars, cardiac glycosides and anthraquinones (Zimudzi et al., 2013). Adeniran et al. (2013) reported that phytochemical analysis carried out on the ethanol extracts of *Cnidoscolus aconitifolius* root showed the presence of tannins, saponins, cardiac glycosides, terpenoids and alkaloids as in all the plant parts but steroid was absent.

### 1.7. HPTLC Fingerprinting of Medicinal Plant Extracts

For the past few decades, compounds from natural sources have been gaining importance because of the vast chemical diversity that they offer. This has led to phenomenal increase in the demand for herbal medicines in the
last two decades and a need has been felt for ensuring the quality, safety and efficacy of herbal drugs. Phytochemical evaluation is one of the tools for the quality assessment, which includes preliminary phytochemical screening; chemo profiling and marker compound analysis using modern analytical techniques. In the last two decades HPTLC has emerged as an important tool for the qualitative, semi-quantitative and quantitative phytochemical analyses of herbal drugs and formulations.

HPTLC was used to estimate Withaferine A, a constituent of *Withania somnifera* in herbal extract and polyherbal formulations (Mahadevan *et al.*, 2003). A rapid and simple high performance thin layer chromatography (HPTLC) method with densitometry at $\lambda = 263$ nm was developed and validated for simultaneous determination of lopinavir and ritonavir from pharmaceutical preparation. Aluminium-backed silica gel 60F254 HPTLC plates as stationary phase and using a mobile phase comprising of toluene, ethyl acetate, methanol and glacial acetic acid, in volume of ratio of 7.0:2.0:0.5:0.5 (v/v) were used. The detector response was reported to be linear in the range of 6.67 to 20.00 µg/spot for lopinavir and ritonavir respectively (Vikas *et al.*, 2008).

Joshi *et al.* (2009) validated the presence of a coumarin glycoside compound by HPTLC studies of the ethanolic extract of *Aegle marmelos*. Further, simultaneous determination of lopinavir and ritonavir was detected in the range of 6.67 to 20.00 µg/spot from pharmaceutical preparation (Vikas *et al.*, 2008). Similarly, presence of gallic acid (356.1), rutin (4591.0) and quercetin (1277.1) from aqueous and ethanolic extract of *Eruca sativa* was confirmed and compared with standard ones (Sajeeth *et al.*, 2010). HPTLC was also used for detection, monitoring and quantification of bacoside A & B in *Bacopa monniera* and its formulations (Shahare and Mello, 2010). Sasikumar *et al.* (2010) reported that HPTLC analysis of market samples of the roots of *Plumbago zeylanica* from Trichy market was of better quality as it produced higher and better plumbagin content than samples collected from gardens of
Phytochemical & Antimicrobial Screening of Plants Against Pathogens

CHAPTER I

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HPTLC analysis of *Cardiospermum halicacabum* showed the presence of bioactive compounds such as arbutin, cardiac glycoside, essential oil, bitter principle, pungent principle, anthracene and saponin in methanolic stem extracts (Patil et al., 2011). *Syzygium jambolanum* was quantitatively evaluated in terms of stability, repeatability, accuracy and phytoconstituents such as glycoside (jamboline), tannin, ellagic acid and gallic acid by HPTLC (Shanbhag and Khandagale, 2011). The standardization of *Cannabis stavia* was done by estimating the content of cannabinoïdse in urine sample using HPTLC (Priyamvada et al., 2010). The HPTLC study on seasonal variations and storage studies of *Plumbago zeylanica* revealed that there was a continuous decrease in absorbance value of plumbagin at 265nm in case of storage sample as compared to fresh sample of *Plumbago zeylanica* indicating its stability efficiency due to environmental conditions (Saraswathy et al., 2011).

Quantitative analysis of β-amyrin and stigmasterol in *Putranjiva roxburghii* leaf powder was observed in the concentration range 0.045 to 0.360 µg per band and 0.041 to 0.328 µg per band respectively (Badole et al., 2011). Pandya and Anand (2011) revealed the presence of Kaempferol from petroleum ether extract of *Oxystelma esulentum* which was found to be 0.879 ± 0.05%w/w. Methanolic extracts of six different *Caralluma* species revealed the presence of alkaloids, flavonoids, saponins and steroids when carried out through HPLTC analysis and were expressed in percentage to determine the species homology (Vajha et al., 2011). Pawar et al. (2011) reported that Andrographolide was found in whole plant *Andrographis paniculata* (0.7746% w/w) and also in herbal formulation Kalmegh Navaya Loha (0.1155 % w/w) when alcoholic extracts were subjected to HPTLC analysis.

Similarly, L- Dopa was validated with a defined peak of Rf value 0.39 in the seeds of *Mucuna pruriens* (Uma sundaram and gurumoorthi, 2012).
The ethanolic fruit extracts of Zanthoxylum rhetsa showed the presence of glycosides, flavanoids, essential oils, anthraquinones, bitter principles, coumarins and flavanoids by HPTLC analysis (Priya and Aparna, 2012). Bhagat et al. (2013) have accepted that the methanolic extract of root of Jatoropa gossypifolia showed eight and six number of spots at 254 and 366 nm in toluene: ethyl acetate (80:20) solvent system. The Rf of spots at 254 nm were 0.05, 0.11, 0.21, 0.33, 0.54, 0.76, 0.88, 0.97 and at 366 nm were 0.03, 0.09, 0.17, 0.69, 0.85, 0.99.

Thin layer chromatography (TLC) was also carried out on ethanol extract (stem) and methanol extract (root) of Calotropis gigantea which showed different Rf values and possible combinations of chromatography solvents for separation of these phytochemicals (Kalaivani et al., 2014). HPTLC finger print for methanolic extract of Wedelia chinensis leaves revealed various peaks with Rf values in the range of 0.01 to 0.97 (Banu and Nagarajan, 2014). It is evident that a wide range of phytochemicals in different extraction of leaf, root, stem, bark and other sources of medicinal plants was well documented using HPTLC.

### 1.8. Antimicrobial Screening of Medicinal Plants

In the developing world, especially in rural areas, herbal remedies continue to be a primary source of medicine. Scientifically, medicinal plants have proven to be an abundant source of biologically active compounds, many of which have already been formulated into useful therapeutic substances or have provided a basis for the development of new lead molecules for pharmaceuticals. The screening of plant extracts and plant products for antimicrobial activity has shown that higher plant represent a potential source of new anti-infective agents (Salvat et al., 2001; Ordonez et al., 2004; Arias et al., 2004) with possible novel mechanism of action (Hamil et al., 2003; Machado et al., 2003; Barbour et al., 2004).
1.9. ANTIMICROBIAL SCREENING OF PLANT LEAF EXTRACTS

Agyare et al. (2006) reported that methanol and petroleum ether extracts of leaf of Nauclea latifolia, Bridelia atroviridis and Zanthoxylum gilletii showed antimicrobial activity against Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Bacillus subtilis, Candida albicans and Aspergillus niger. Moreover, methanol extracts of those plants exhibited higher activity than the petroleum ether extracts against the test organisms. Methanolic leaf extracts of Withania somnifera, Acacia nilotica, Sida cordifolia, Tinospora cardifolia and Ziziphus mauritiana showed significant antibacterial activity against Bacillus subtilis, Escherichia coli, Pseudomonas fluorescens, Staphylococcus aureus and Xanthomonas axonopodis than root and bark extracts (Mahesh and Satish, 2008).

Crude leaf extracts of Excoecaria agallocha obtained from chloroform, ethanol, methanol and aqueous solvents showed significant and or wide range of inhibition zone against both gram positive and gram negative microorganisms (Patra et al., 2009). Aqueous and hydro-alcoholic extracts of leaves of Jasminium abyssinicum, Myrsine Africana and Foenicum vulgare exhibited positive antibacterial activity against Escherichia coli, Pasteurella gallinarum, Manhaemia haemolytica, Salmonella gallinarum, Salmonella typhimurium, Staphylococcus aureus and Streptococcus agalactiae (Habtamu et al., 2010). In Andrographis affinis, acetone extracts of leaf showed higher antimicrobial activity against Proteus vulgaris, Escherichia coli and Staphylococcus aureus (Chinnappan and Alagesabooapathi, 2011).

Mohammad et al. (2011) stated that inhibitory activity of leaf extract of Commelina bengalensis was found to be effective against wide variety of gram positive strains such as Staphylococcus saprophyticus, Staphylococcus aureus, Enterococcus faecalis, Staphylococcus pyogenes, Streptococcus agalactiae, Salmonella typhi, Escherichia coli, Shigella boydii, Shigella
dysenteriae and Pseudomonas aeruginosa. The methanolic leaf extracts of Ageratum conyzoides, Adansonia digitata, Annona muricata, Bryophyllum pinnatum, Cassia sieberiana, and Ocimum gratissimum had inhibitory activity against Escherichia coli strain (Chukwuka et al., 2011) while methanolic leaf extracts of Asteracantha longifolia and Dactyloctenium indicum showed significant antibacterial activity against Staphylococcus aureus (25mm) and Escherichia coli (22mm) respectively (Muhamed Mubarack et al., 2012).

Alcoholic leaf extracts of Plumbago zeylanica exhibited maximum antimicrobial activity against gram positive species Staphylococcus aureus and Bacillus subtilis and gram negative species Escherichia coli and Pseudomonas aeruginosa (Dhale and Markandeya, 2011). Different solvent extracts of leaves of Phyllanthus embilica showed higher zone of inhibition against gram positive bacteria (Staphylococcus aureus and Bacillus subtilis) and gram negative bacteria (Pseudomonas aeruginosa and Escherichia coli) (Dhale and Mogle, 2011). John de Britto et al. (2011) reported that methanolic and aqueous extracts of leaves of Solanum nigrum, Solanum torvum, Solanum trilobatum, Solanum surattense, and Solanum melongena exhibited positive inhibitory response against Xanthomonas campestris and Aeromonas hydrophila. Similarly, leaf extracts of Clitoria ternatea exhibited better antifungal activity against Curvularia lunata and Bipolaris bicolor (Madhavaraao et al., 2011). Similarly, Kalayou et al. (2012) observed that leaf extracts of Calpurinea aurea, Croton macrostachys, Achyrathes aspera, Nicotina tobaccum and Vernonia species possessed more antimicrobial activity against (Staphylococcus aureus and Staphylococcus hycus and Escherichia coli.

In that study, among the three solvents analysed ethanolic leaf extract of Pongamia pinnata and Lowsonia innermis exhibited a maximum resistance against Bacillus subtilus and possessed the highest inhibitory zone against Pseudomonas aeroginosa and Micrococcus luteus respectively when compared to other bacterial strains (Dhanalakshmi et al., 2013). The aqueous
and methanol leaf extract of Gymnema sylvestre showed significant antimicrobial activity against Staphylococcus aureus, Bacillus cereus, Escherichia coli, Klebsiella pneumoniae, Candida albicans, Candida tropicalis, Candida krusei and Candida kefyr (David and Sudarsanam 2013).

1.10. ANTIMICROBIAL SCREENING OF PLANT UNDERGROUND PART EXTRACTS

Mathabe et al. (2006) reported that methanol, ethanol, acetone and hot water extracts from different plant parts (roots, and rhizome) of Indigofera daleoides, Punica granatum, Syzygium cordatum, Gymnosporia senegalensis, Ozora insignis, Elephantorrhiza elephantina, Elephantorrhiza burkei, Ximenia caffra, Schotia brachypetala and Spirostachys africana showed remarkable antibacterial activity against Vibro cholera, Escherichia coli and Staphylococcus aureus, Shigella species and Salmonella typhi. The rhizome of Potentilla erecta and Potentilla alba were found to have antimicrobial property. The ethyl acetate and acetone extracts were tested against Staphylococcus aureus and Escherichia coli and a fungus Candida albicans.

The acetone extracts had the inhibitory effect on Escherichia coli. The ethyl acetate extract of rhizome of Potentilla erecta was found effective on Staphylococcus aureus but it was not effective on Candida albicans (Vasic et al., 2006). The ethanolic extracts of tuberous root of Amorphophallus campanulatus (Araceae) was tested against four Gram positive bacteria (Bacillus subtilis, Bacillus megaterium, Staphylococcus aureus, and Staphylococcus β-haemolyticus) and six Gram negative bacteria (Escherichia coli, Shigella dysenteriae, Shigella soneii, Shigella flexneri, Pseudomonas aeruginosa, and Salmonella typhi). The MIC values ranged from 16 to 128 mg/ml. But the antifungal activity was found to be weak against the tested fungi (Khan et al., 2007). In Piper ribesoides, Zakaria et al. (2007) studied the
antibacterial properties of methanolic root extracts against *Staphylococcus aureus*.

The MIC values of the methanol extract of *Piper ribesoides* were between 3.125 mg/ml and 6.250 mg/ml. In *Landolphia owariensis*, ethanolic leaf and root extracts showed susceptibility of some clinical bacterial isolates *Staphylococcus* spp., *Proteus* sp and *Escherichia coli* (Nwaogu et al., 2008). *Calotropis gigantea* root extracts also had inhibiting activity against *Sarcina lutea, Bacillus megaterium, Bacillus subtilis, Shigella sonnei, Escherichia coli* and *Pseudomonas aeruginosa* (Alam et al., 2008). Positive antimicrobial activity was noticed against *Bacillus subtilis, Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Streptococcus* sp. and *Salmonella* sp. while using ethanolic extracts of root and stem-bark of *Ficus platyphylla* (Kubmarawa et al., 2009).

Bhuvaneswari et al. (2011) demonstrated the antimicrobial effect of methanolic and ethanolic extract of root parts of *Gymnema sylvestre*. The extracts had high inhibiting effect on *Bacillus pumilus, Bacillus subtilis, Pseudomonas aeruginosa*, and *Staphylococcus aureus*. Bakari et al. (2012) reported that ethanolic extracts obtained from resin and root bark of *Commiphora swynnertonii* showed significant antibacterial activities against *Staphylococcus aureus, Streptococcus pyogenes, Bacillus subtilis, Pseudomonas aeruginosa, Salmonella typhimurium* and *Escherichia coli*. Moreover, the inhibitory effect on growth of fungal species *Candida albicans* and *Aspergillus niger* were also observed by them. But chloroform extracts of roots alone exhibited good antibacterial activity against Gram positive and Gram negative bacteria except *Pseudomonas aeruginosa* (Beverly and Sudarsanam, 2013).

Abuhamdah et al. (2013) reported that the crude methanolic extract of *Peganum harmala* (root extract) showed good antibacterial activity against *Staphylococcus aureus* at 1.5 mg/ml while MIC value for root extract
against *Bacillus subtilis* was at 6.25 mg/ml. Moreover, there was weak activity against Gram negative bacteria, while using the root extracts of *Peganum harmala*. It is commercially important plants, and also favorable area for carrying out anthropogenic activities.

Hence this particular area is important from the biodiversity, pharmacologically and economics point of view. Further, literature review showed that phytochemical screening and antimicrobial assays of crude extracts from *Adansonia digitata* L., *Mimusops elengi* L. and *Woodfordia fruticosa* L. against human pathogenic bacteria and plant pathogenic fungi were carried out for this area was less documented. Therefore, the purpose of the present study was to assess phytochemical analysis and antimicrobial activity of crude extracts from *Adansonia digitata* L., *Mimusops elengi* L. and *Woodfordia fruticosa* L. against human pathogenic bacteria and plant pathogenic fungi around Marathwada region in Maharashtra state, India.