Plants have been serving as the sources of medicines for primary health care needs and/or health boosting for all people always, as many of them are nutraceuticals. The World Health Organization (WHO) estimated that about an 80% population of developing countries relies on traditional medicines, mostly plant drugs, for health ailments (WHO, 2009). Particularly in rural India, the use of raw plant parts as brews and paste/powders as well as, some preparation/concoctions of Ayurvedic medicines are sought after for several ailments to a great proportion, because of cheap availability. And in urban areas too Ayurvedic medicines, being popular, are available in market shelves (De Silva et al., 2009). Despite the advent of modernism in medicinal system, in this country poverty-stricken and marginalized aborigine-folks (tribals), living in forest patches, particularly, are still practicing the art of the use of crude herbal products as medicines (Ignacimuthu et al., 2008; Panda and Padhy, 2008; Prasad et al., 2008; Singh and Singh, 2009) In tribal-India, the clandestine knowledge of ‘medicinal plants and their modalities’ is transmitted down the generations, which sometimes, becomes a risky affair due to the advent of...
of the modernism itself that affects the attention for knowledge on plants and their identifications by young adults in forest floor (Ignacimuthu et al., 2008; Panda and Padhy, 2008; Prasad et al., 2008; Singh and Singh, 2009). It has been estimated that in the Indian subcontinent, about 45,000 species of wild plants are present, of which about 7,500-8,000 medicinal plant species are used in health care needs by tribals, and only about 1,500 plants are in use in Indian *Ayurveda, Unani* and *Siddho* systems, largely for elite mass (De Silva et al., 2009).

Furthermore, the integrity of the rich phytodiversity typical to a tropical forest is at stake in India for reasons signposted: 1. Increasing pressures on forest due to iniquitous and unsustainable human invasion for a myriad of forest-products, mainly timber; 2. The unwitting and unavoidable regular cataclysmic episodes of forest-fire in summer on a colossal scale due to the fire-catching milieu itself; and 3. Intentionally fire is used for clearing forest patches for additional crop-lands for shifting cultivations (Pfifl et al., 2002; Taylor and Alexander, 2006). Consequently, creation of forest-fallow is common with eventual shape-changing and maiming of vegetations. Thus, continual surveys to record the traditional medicinal knowledge linked to forest plants used by aborigine people are undertaken, despite availability of formal and institutional inventory of phytodiversity of Indian Eastern- Ghat mountain ranges, for the fear of extinction of nearly unknown or lesser known forest-plants. It is easier said than done systematically in our country at every forest zone, however. This thesis records ethnobotanical information on 70 plants from a handful of tribal pockets of Kalahandi District, Odisha. These 70 plants are in use by tribals for treating mostly infectious ailments. This work is an attempt to validate the curative effects of certain plants in tribal use for treating infections, by monitoring antimicrobial activity with pathogenic bacteria isolated from clinical samples of a hospital.
Viewed-from-the-trenches of public health, diseases with Gram-positive (GP) and Gram-negative (GN) bacterial strains have always been a matter of serious clinical concern (Souli et al., 2008; Khan and Raffaele, 2011), since pathogenic bacteria become progressively drug/antibiotic resistant. For example, morbidity and decimation rates due to multidrug resistant (MDR) bacteria causing suppurative and urinary tract infection (UTI) have been of utmost clinical consternation in the last 4 decades (Giamarellos-Bourboulis et al., 2006). Surgical site infections (SSIs) and toxic shock syndromes are mostly caused by GP bacterial pathogens. Furthermore, reports on MDR strains of *Escherichia coli*, *Pseudomonas aeruginosa* and *Acinetobacter baumannii* as the atrocious candidates of pathogens. UTI episodes with the extended spectrum beta-lactamase (ESBL)-production are plenty (Mittal et al., 2009; Begum et al., 2013). However, MDR GP bacteria are less prevalent than MDR GN ones (Falagas and Bliziotis, 2007); but, strains of *Staphylococcus* and *Enterococcus* spearhead as grievous pathogens among MDR GP cocci (Subedi and Bramhadathan, 2005; Sood et al., 2008), which are considered as the important determinants of public health problems, worldwide. *Staphylococcus aureus* causes mild to severe or potentially fatal illness. There are about 30 species of *Staphylococcus*, but the most serious infections are caused by the once known harmless commensal *S. aureus*. Indeed, the problem from its infection have been multiplied by the development of resistance to β-lactams and a large number of antibiotics of other groups, aminoglycosides, glycopeptides, fluoroquinolones, sulfonamides, etc. By the by, MDR methicillin resistant *S. aureus* (MRSA) has been considered as the superbug in the health domain as it shivers down the hospital’s spine with nosocomial infections (Nickerson et al., 2009), today. The most common ailments caused by *S. aureus* are impetigo, cellulitis, scaled skin syndromes and mastitis — all leading to infections of newborns from their mothers. When *S. aureus* enters
the blood stream, invasive infections, bacteraemia/sepsis, staphylococcal pneumonia, endocarditis, osteomyelitis and the toxic shock syndrome occur; it also causes illness of gastrointestinal tract, including the food poisoning (Mandell et al., 1995). It was never so difficult to control all these ailments due to \textit{S. aureus} earlier, but infections from its multidrug resistant (MDR) and methicillin-resistant strains cause intractable, damndest infections (Cornaglia, 2009), due to prevalence of clonal complexes of the pathogen worldwide, abysmal annoyance in the health domain has been reported (Gillespie et al., 2005). MDR \textit{S. aureus} is now the silently violent, ghoulish superbug in the health domain, initiating longer hospital stays and eventual higher costs often in patients with surgical episodes as well as, causing higher decimation rates. If the patient is aged/immunocompromised one, the escalation of MDR GP and GN pathogens to innards of body through as blood stream infections (BSIs) would cause terminal illness at lungs often, the most vulnerable site of infectious diseases.

The other dominating GP pathogen, \textit{Enterococcus} sp. causes UTI and SSI. In fact, \textit{Enterococcus faecalis} is a saprophytic component of the enteric flora and causes severe comorbidities from peritonitis, intra-abdominal abscess and endocarditis, when it gains a portal entry to the blood stream, as this pathogen has remarkable capacity of adherence to human serum (Sipes et al., 1977; Schaberg et al., 1991) in causing bacteremia. Belonging to the Group D streptococci, \textit{E. faecalis} have been reported to have intrinsic resistance to higher generation antibiotics groups, cephalosporins, aminoglycosides, \(\beta\)-lactams and vancomycin. So, it has the potentiality of precipitating outraging episodes linked to gastroenteritis and UTI (Low et al., 2001). Enterococci were reported as the second most common cause of nosocomial infections in the US and Canada; the highest detected rate of enterococcal UTI was reported in Canada (16.8 \%), followed by the US (12.5 \%) and Europe (11.7 \%) (Low et al., 2001). Detailed study on
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pathogenic *E. faecalis* has not been published from India, which has been included in this work; but its drug sensitive strain has a cheese-tendering role in milk-industry, as it is known.

Not surprisingly, uncomplicated 80–90 % UTI cases, in otherwise healthy adults occur with the second-most important causative GN bacterium, *A. baumannii*, worldwide (second to *Escherichia coli*). Even community-acquired infections by ESBL-producing *A. baumannii* were reported in 2007, in the US (De Busscher et al., 2009; Yoon et al., 2014). Furthermore, *A. baumannii* is dreadful, precipitating numerous global cataclysmic episodes with an ever-increasing resistance patterns to cefepime, ceftazidime, ciprofloxacin, gentamicin, levofloxacin, piperacillin/tazobactam, trimethoprim/sulfamethoxazole, as reported from North America, Europe, Asia Pacific and Latin America (Perez et al., 2007). Further, the GN bacterium, *Citrobacter freundii* is a widely prevalent nosocomial pathogen, associated with a blizzard of infections, diarrhoea, septicemia, meningitis and ailments in urinary and respiratory tracts often, and was reported as carbapenem resistant from China (Shen et al., 2009). *Proteus mirabilis* are reported to have multidrug resistance for broad-spectrum beta-lactam antibiotics, carbapenems, streptomycin, tetracycline, sulphonamides, trimethoprim and fluoroquinolones, in Thailand (Girlich et al., 2001). These pathogens too were reported from India (Dalela, 2012). With the capability of intercontinental migration, MDR pathogens cause constant clinical consternation.

The evolutionary capabilities of bacteria in development of resistant strains are of surprising standard intrinsically. Many clinical and social factors enhance the problem of the emergence of MDR pathogens, as discussed often (Khan and Raffaele, 2011). Obviously, subtle problem of infection from MDR bacteria largely affects economic and social/public-health avenues, leading to the necessity of urgent search for suitable antimicrobials from alternate sources. Phytochemicals in crude extracts have always been proved by *in vitro* studies.
controlling MDR bacteria (Khan et al., 2009; Arokiyaraj et al., 2012). Moreover, phytocompounds in crude extracts inherently with a diverse structural complexity and being too of non-microbial origin, no microbe, no matter how well genetically equipped and developed, can ever over-ride these coalesced chemicals in vitro, and should be in vivo also, when those are accessorized with regular chemotherapy. Accumulated ethno-medicinal reports from different countries are idealistic, a priori, in the control of infectious diseases without any scientific verification, but those could form the basis of further work on drug targeting module against MDR pathogens (Khan et al., 2009). Thus, taking recourse to plants for newer chemicals, from well-known and lesser-known plants as antimicrobials, would be a prudent alternative, not least because the Streptomyces-source of antibiotics is exhausted, but also because of the fact that a large amount of pure phytochemicals has been serving holistically along with mainstream medicine. Indeed, many a natural phytochemical encourage the preparation of complementary drugs, for targeting MDR pathogens by the myriad of in vitro reports. MRSA and several common MDR pathogens \textit{P. aeruginosa}, \textit{A. baumannii} and tubercle bacillus need be controlled carefully. A non-committal attitude towards these natural chemicals would be a medical infraction. Obviously, host toxicity testing remains an essential corollary in designing phytochemicals as complementary medicines. It is consensus that phytocompounds can be used as drugs and, it is likely to be held effectively in the future (MacLennan and Pendry, 2011), being encouraged by the WHO. Several plants have unusually strong unpleasant aroma, which should have a control over MDR bacteria, emulating any dove-tailed synthetic drug. Such plants are often well-known, but are not systematically explored for due exploitation against pathogens, for example, the weed \textit{Lantana camara}. 
Moreover, MRSA even has been isolated from family members and pets in the same household, indicating zoonotic spread (Guardabassi et al., 2004). Today, several GN bacteria resistant to all the major classes of antibiotics have emerged and these are the ferocious PDR bacteria; such uropathogenic strains (more prominently, *A. baumannii*, *Klebsiella pneumoniae* and *P. aeruginosa*) cause utmost comorbidities and immature mortality (Falagas and Bliziotis, 2007). The suspicion is that attack by such strains of bacterial pathogens would cause damnedest commotion in public health and extrication from such a gruesome infection would be a staggering victory for a patient.

In the last several decades, researches on antimicrobial activities of edible, non-edible and poisonous (lesser known and well known) plant species against several strains of both non-pathogenic and pathogenic bacteria, as well as fungal pathogens *in vitro* have been documented (Maurice, 2002; Burt et al., 2004; Gurib-Fakim, 2006; Butler and Buss, 2006; Phillipson, 2007; Mahady et al., 2008; Ngueyema et al., 2009; Khan et al., 2009). A search of the PubMed database (data from 1975 to 2014) yielded approximately, 2,000 reports that describe antimicrobial activities of plant species and their chemical constituents. Plant extracts have been tested against different strains of common pathogenic bacteria: *A. baumannii*, *Bacillus cereus*, *B. subtilis*, *Chlamydia pneumoniae*, *Enterococcus faecalis*, *E. coli*, *S. aureus* (the wild strain), MRSA, *Streptococcus pneumoniae*, *K. pneumoniae*, *P. aeruginosa*, *Helicobacter pylori* and a few more. The torrent of published data describing *in vitro* and clinical antibacterial activities of natural products is so vast that it could easily fill a book or two. Those reports describe control over strains from culture collection centers, which should be drug-sensitive strains; but, very few isolated reports record antimicrobial activities of plant extracts on MDR pathogenic bacteria. Moreover, several reports on the use of phyto-extracts for the control of MRSA are published,
indicating a promise in the field of drug targeting or use phytodrugs as complementary medicines for MDR pathogens. Herein, attempts for the identification of complementary/ supplementary drugs from plants are discussed for MDR pathogenic bacteria. Single or coalesced raw herbal products and their concoctions are used almost universally, which prompted the development of industry based user-friendly goods that lead emergence of ‘medicinal plant trade’ and associated business tycoons.

In this thesis, community acquired (CA) sources of bacteria or patients attending outpatients department (OPD), and nosocomial infectious bacteria from hospital acquired (HA) sources or patients admitted to indoor patients department (IPD), consisting of ‘wards and cabins’, ‘intensive care unit (ICU) and neonatal intensive care unit (NICU)’ were taken into accounts of deliberate surveillance, to assess the infection dynamics of representative pathogenic bacteria. Antiograms of all most all isolated bacteria from OPD and IPD sources were determined. The genera taken up for nosocomial/community surveillance are *Staphylococcus*, *Enterococcus* among GPs, and *Acinetobacter, Proteus* and *Pseudomonas*, among GNs.

In this thesis, results of screening of antibacterial efficacy of aqueous and ethanolic extracts of 70 medicinal local and tribal plants are described; qualitative phytochemical analyses of all plants were recorded. From the obtained results on antibacterial efficacy using 70 plants, 5 plants were selected for a detailed work. Furthermore, antibacterial activities of 8 different solvent extracts using 8 non-polar to polar organic solvents were monitored. The solvent extracts of the selected 5 plants were used for the determination of minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values against 8 pathogenic GP and GN bacteria, isolated from clinical samples of the teaching hospital (research collaborating centre), IMS and Sum Hospital, with standard microbiological procedures. By the by, prevalence of a
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representative bacterium in hospital and community settings was done in detail, which signifies its infection dynamics.

Of 5 selected plants, the plant with the best antibacterial activity against MDR strains of all 8 selected bacteria was chosen. Standardization of leaf powders was done, according to WHO guidelines. Bio-assay guided fractionations using seven non-polar to polar solvents of the crude leaf-extract were done, using liquid-liquid partition method. Antibacterial activities of crude methanolic leaf extract as well as, its fractions were evaluated. The best solvent fraction was used for the determination of MIC and MBC values against MDR strains of used bacteria and, for the analysis with gas chromatography-mass spectroscopy (GC-MS) possibly to locate leading compounds that could be the coveted antimicrobials. Moreover, crude extract of the leading plant was tested for host toxicity, against in vitro cultured lymphocytes from human umbilical cord blood. Furthermore, in vitro combination-efficacy of ‘vancomycin and n-butanol fraction of leaf-extract’ of the plant against a bacterium resistant to an advanced antibiotic vancomycin presently in use for GP bacteria was assessed for the synergy of ‘phyto-extract and moribund antibiotic’ for possible future use in designing ‘integrative medicine’, which may now be less spectacular.

Work described in this thesis could be considered unique compared to the most previous works in the field of monitoring antimicrobial activities of medicinal plants, as drug-sensitive bacteria from a type culture collection center as well as, MDR strains of 8 common bacterial pathogens, obtained directly from clinical samples from patients in the hospital, were used.