1.0. GENERAL INTRODUCTION

1.1. What are Marine plants?

Plants that have been adapted to thrive greater than 0.5% NaCl are called halophytes, e.g.; mangroves and seaweeds. Mangroves are woody plants that grow at the interface between land and sea in tropical and subtropical latitudes, which often classified either as excretives and succumbers or excluders. Excretives / exclusives have glandular cells capable of secreting excess salts from plant organs, eg. *Avicenna germinas*. Succumbers used to accumulate water within large vacuoles to minimize salt toxicity eg. *Salicornia, Suaeda, Sesuvium porulacastrum, Allenrolfea, Arthrocremmum, Halimione*. Seaweeds are floating submerged plants of shallow marine meadow, having salt tolerance, because the osmolarity of cytoplasm is adjusted to match the osmolarity of the seawater, so that desiccation of the plant does not occur (Manoj Singh, 2011).

Halophytes have long been recognized, but it was not until the 20th century that they were studied systematically (Huchzermeyer and Flowers, 2013). While we still have much to learn about these salt-tolerant plants, it is clear that more than one mechanism operates to generate tolerance and hence the difficulties in engineering
tolerance in more salt-sensitive species. Consequently, it is important to understand
tolerance mechanisms operating at various levels, molecular, physiological and
ecological, in order to develop an understanding of what is involved in being a
halophyte.

The long-term aim of such research is to be able to utilize knowledge of
halophytes for improvement of the performance of crops in salt-affected soils. However, halophytes are not only valuable as scientific models, but also have
potential as crops in their own right in saline agriculture (Rozema and Flowers,
2008; Panta et al., 2014), where they may be used for food, fibre and industrial
purposes (Rozema et al., 2013).

Natural products based compounds have an immense impact of modern medicine
about 40% of prescription drugs are based on them. Medicinal plants are potential
source of drugs playing an important role in the world’s economy. Over 60% of world
human population and 80% in the developing countries depends directly on plants for
the medicinal purposes (Abeysinghe, 2010). The marine world offers an extremely
rich resource for important compounds of structurally novel and biologically active
metabolites (Kathiresan and Bingham, 2001).

Halophytes are salt-resistant or salt-tolerant plants and have remarkable ability
to complete their life cycle in saline condition. During evolution, they have developed
different morphological, anatomical, and physiological strategies to proliferate in
high-salt environments (Flowers and Colmer, 2008; Grigore et al., 2014). Halophytes
have occasionally been reviewed for their general physiology (Flowers, 1985),
photosynthesis (Rozema and Van Diggelen, 1991; Lovelock and Ball, 2002),
response to oxidative stress (Jithesh et al., 2006), flooding tolerance (Colmer and
Flowers, 2008), salinity tolerance (Flowers and Colmer, 2008) and adaptations (Flowers et al., 2015). Additionally, other researchers have also examined halophytes under special topics as sustainable cultivation, saline agriculture, and integrative anatomy (Xu et al., 2016).

**Description about Mangroves**

A mangrove is a tree, shrub, palm or ground fern, generally exceeding one half metre in height, that normally grows above mean sea level in the intertidal zone of marine coastal environments and estuarine margins (Duke, 1992). A mangrove is also the tidal habitat comprising such trees and shrubs. The word ‘mangrove’ refers to the habitat in the same way as we think of ‘rainforest’ with its mixture of plant types. Sometimes the habitat is called a ‘tidal forest’ or a ‘mangrove forest’ to distinguish it from the trees that are also called mangroves. Mangrove forests, constitute an important coastal ecosystem, are among the world’s most productive ecosystems (Duke, 2006). They are sometimes called ‘tidal forests’, ‘coastal woodlands’, ‘walking forests in the sea’, ‘root of the sea’ or ‘oceanic rain forests’. These forests are found at the interface between land and sea in tropical and sub-tropical latitudes where they exist in conditions of high salinity, extreme tides, strong winds, high temperatures and muddy anaerobic soils. There may be no other group of plants with such highly developed morphological and physiological adaptations to extreme conditions (Kathiresan, 2002; Kathiresan and Bingham, 2001).

The mangroves play a very important role in peoples’ lives and economy. The value of mangroves is expressed in a common way as ‘home’ for marine and terrestrial animals, as a ‘kitchen’ producing food for people and animals, as a ‘water treatment plant’ in purifying water, as a ‘hospital’ in providing medicines, as ‘lung’ in
purifying air in coastal area, as ‘carbon bank’ to reduce global warming, as a ‘coastal wall’ in protecting soil erosion and wind stress, as a ‘natural laboratory for eco biologists and finally as a ‘bridge’ in connecting the land and sea (Sanit Aksornkoae, 2002).

During mangrove restoration, mangrove seedlings often suffer from barnacles that attach themselves to the plants, seriously affecting photosynthesis and stem lenticels metabolism. The weight of barnacles may cause the seedlings to break off, and even die. Therefore, they can be serious fouling animals endangering mangrove ecological restoration engineering (Han et al., 2004).

Mangroves can grow in conditions of high salinity, extreme tides, strong winds, high temperatures and muddy, anaerobic soils. There may be no other group of plants with such highly developed morphological and physiological adaptations to extreme conditions. Because of their environment, mangroves are necessarily tolerant of high salt levels and have mechanisms to take up water despite strong osmotic potentials. Some also take up salts, but excrete them through specialized glands in the leaves. Others transfer salts into senescent leaves or store them in the bark or the wood. Still others simply become increasingly conservative in their water use as water salinity increases. Morphological specializations include profuse lateral roots that anchor the trees in the loose sediments, exposed aerial roots for gas exchange and viviparous water-dispersed propagules (Kathiresan and Bingham, 2011).

Mangroves are part of a marginal ecosystem, able to tolerate extreme environmental factors such as high salinity and constant inundation (Vannucci, 2001). There are about 59 species of mangroves and few mangroves associates are found in India. In west coast of India 34 species belonging 21 families are
represented *Acanthus illicifolius* and *Rhizophora mucronata* are being classified as an associate mangrove and true mangrove by Botanical Survey of India (Banerjee *et al.*, 1989) and as a mangrove by others (Agoramoorthy *et al.*, 2007). Mangroves and mangrove associates possess novel agrochemical products, compounds of medicinal value, and biologically active compounds (Bandaranayake, 2002). Extracts from different mangrove plants and mangrove associates are active against human and plant pathogens (Chandrasekaran *et al.*, 2009).

**Antimicrobial and Antioxidant activity of Mangroves**

For a long period of time in history, plants have been valuable and indispensable sources of natural products for the health of human beings and they have a great potential for producing new drugs (Morales *et al.*, 2004).

Mangroves are “coastal woodlands” or marine tidal forests comprising of trees, shrubs, palms, epiphytes, ground ferns and grasses. They occupy large tracts along sheltered coasts, estuaries and in deltas. They are specially adapted to withstand salinity, wave action and can grow in poor soil. Mangroves occur approximately in 112 countries (Bandaranayake, 1998).

*Avicennia alba* is a species of tropical mangrove belonging to the family *Acanthaceae*. The common local name for this plant is “Ilva mada”. This species is found far away from salt water, unlike other species. *Avicennia alba* is a rich source of naphthoquinones (Ito *et al.*, 2000) and leaves of *A.alba* tested for antioxidant activities showed positive result (Banerjee *et al.*, 2008). It provides a rich source of steroids, triterpenes, saponins, flavonoids, alkaloids and tannins (Patra *et al.*, 2010).
Suh et al. (2014) reported that the antioxidant and antithyrosinase properties of two mangrove tree species *Rhizophora stylosa* and *Sonneratia alba*. *Anisophyllea laurina* ex Sabine (family *Rhizophoraceae*) leaves and stem bark are well-known as traditional medicine for treating malaria in Guinea (Balde et al., 2015).

Ethanol and methanol extracts of the leaves and stem bark of *Anisophyllea laurina* have shown potential as antibacterial and antifungal agent (Onivogui et al., 2015). Kargbo et al. (2015) were reported that the ethanol crude extract from leaves and stem bark of *A. laurina* exerted an inhibitory effect on α-glycosidase and α-amylase. The bark extract of *Rhizophora annamalayana* Kathir. (Musthafa et al., 2013), and the leaf extracts of *Rhizophora mucronata* Lamk. and *R. apiculata* (Annapoorani et al., 2013) have been reported to possess positive activity for antioxidant properties. The metabolites and bioactivities of *R. apiculata* and *R. stylosa* have been reviewed (Nebula et al., 2013; Kainuma et al., 2015).

There are also reports that document the importance of various parts of *Avicennia* species as ethno medicinal. It has been mentioned in the ancient literatures that the tea prepared from the bark of some of its species is believed to treat a variety of digestive disorders like peptic ulcers, diarrhoea including haemorrhoids, rheumatic pain and so on (Sumithra et al., 2011a; Thirunavukkarasu et al., 2011).

Recent pharmacological investigations have also reported diverse medicinal properties of the plants belonging to the genus *Avicennia* against cancer, HIV, hepatitis, diabetes, inflammation, diarrhoea, oxidative stress-related diseases and so on (Rege et al., 2010; Sharief and Umamaheswararao, 2011; Shafie et al., 2013).
Many reports have documented that the genus *Avicennia* possesses some unique metabolites of varied chemical classes, which may be responsible for their wide range of pharmacological activities (Ganesh and Jannet, 2011; Shanmugapriya et al., 2012; Poompozhil and Kumarasamy, 2014).

The genus *Xylocarpus* consists of *Xylocarpus granatum*, *X. moluccensis*, *X. mekongensis*, *X. rumphii* that are ethnomedicinally important mangrove plants. Extracts of leaves, barks, pneumatophore and fruits of these plants have been reported for various ethnomedicinal uses such as fever, malaria, inflammation, dysentery, diarrhoea, cholera, abdominal problems, diabetes, elephantiasis, antimicrobials etc. In recent times, these plants are also reported for their antioxidant, anticancer, antidiabetic, antidyshlipidemia, antimicrobials, antidiarrhoeal, antifilarial, antiulcer and cardiotonic properties (Akter et al., 2016). Srivastava et al. (2014) investigated the antibacterial and cytotoxic activities of *X. mekongensis* methanolic, ethyl acetate and chloroform bark extracts and also antioxidant activities from these extracts were determined.

*Acanthus ilicifolius* has traditionally been used for treatment of skin diseases, small pox, ulcers, snake bite and rheumatism. Its antiviral, antioxidant and anticarcinogenic activity has been demonstrated recently. *A. ilicifolius* shows significant analgesic activity (Raut Sachin et al., 2014).

**Description about Seaweeds**

Seaweeds are large algae (macro algae) that grow in salt water or marine environment and lack true stems, roots and leaves (Krishnamurthy, 1996). Seaweeds commonly grow on coral reefs or in rocky landscape or can grow at great depths if sunlight can penetrate through the water (Mateljan, 2006).
Seaweeds or macro algae are available in the intertidal, shallow and deep waters in the marine environment (Kaliyaperumal, 1998). They have been reported to contain many important compounds which act as antibiotics, laxatives, anticoagulants, anti-ulcer products (Chanda et al., 2010). Seaweeds are known to produce a variety of secondary metabolites which have been characterised as a broad spectrum of antibacterial agents (Cox et al., 2010; Ibtissam et al., 2010; Rhimou et al., 2010; Jebasingh et al., 2011; Lavanya et al., 2011; Omar et al., 2012; Sujatha et al., 2012; Zbakh et al., 2012) antiviral (Gomez et al., 2010), anticancer compounds (Boopathy and Kathiresan, 2010) antioxidant compounds (Iiho et al., 2003; Vinayak et al., 2011) antifouling compounds (Manilal et al., 2010) pharmaceutical preparations (Yuvaraj et al., 2011). The occurrence of many species of seaweeds in Little Andaman and South Andaman has been documented (Mohanraju and Pujari, 2012; Karthick et al., 2013).

The ocean environment contains over 80% of world’s plant and animal species (Jha and Zi-rong, 2004) and with more than 150,000 seaweeds found in the intertidal zones and tropical waters of the oceans, it is a primary source of natural products (Falcao, 2006).

Marine macroalgae are important ecologically and commercially to many regions of the world, especially in Asian countries such as China, Japan and Korea (Smit, 2004). They are valuable food resources which contain low calories, and they are rich in vitamins, minerals, proteins, polysaccharides, steroids and dietary fibers (Lahaye, 1993).

Seaweed is a macroscopic, multi cellular, benthic marine algae. The term includes some members of the red, brown and green algae. A seaweed may belong
to one of several groups of multicellular algae: the red algae, green algae, and brown algae. As these three groups are not thought to have a common multi cellular ancestor, the seaweeds are a polyphyletic group. In addition, some tuft-forming blue green algae (Cyanobacteria) are sometimes considered to be seaweeds. Three major groups of seaweeds are recognized according to their pigments that absorb light of particular wavelengths and give them their characteristic colors of green, brown or red (Collins, 2001). The green algae (Chlorophyta) are truly green with no pigments to mask the chlorophyll. The green algae are very diverse and range from microscopic free-swimming single cells to large membranous, tubular and bushy plants (Davies, 2002).

Brown algae (Phaeophyta) are multi-cellular and are found in a variety of different physical forms including crusts and filaments. Like all photosynthetic organisms, brown algae contain the green pigment chlorophyll. They also contain other gold and brown pigments, which mask the green color of chlorophyll. The dominant pigment found in brown algae is called fucoxanthin (Bartle, 2005).

Marine organisms are source material for structurally unique natural products with pharmacological and biological activities (Faulkner, 2001; Da Rocha et al., 2001). Among the marine organisms, the macroalgae (seaweeds) occupy an important place as a source of biomedical compounds (Manilal et al., 2010). About 2400 natural products have been isolated from macroalgae belonging to the classes Rhodophyceae, Phaeophyceae and Chlorophyceae (Faulkner, 2001). The antimicrobial activity was regarded as an indicator to detect the potent pharmaceutical capacity of macroalgae for its synthesis of bioactive secondary metabolites (Smit, 2004).
Seaweeds are important sources of marine ecosystem having various biological activities (Kayalvizhi et al., 2012). Seaweeds have been one of the richest and most promising sources of bioactive primary and secondary metabolites (Faulkner, 2002) and their discovery has significantly expanded in the past three decades (O’Sullivan et al., 2010). The algae synthesizes a variety of compounds such as carotenoids, terpenoids, xanthophylls, chlorophyll, vitamins, saturated and polyunsaturated fatty acids, amino acids, acetogenins, antioxidants such as polyphenols, alkaloids, halogenated compounds and polysaccharides such as agar, carrageenan, proteoglycans, alginate, laminaran, rhamnan sulfate, galactosyl glycerol and Fucoidan (Guven et al., 2010).

Seaweeds are known to be a rich source of secondary metabolites which may act as antimicrobial, antiviral, anticancer, antioxidant properties. Present study shows the antibacterial activities of certain seaweeds representing all the groups of seaweeds collected from South Andaman, India. Earlier studies by (Jebasingh et al., 2011) with crude extracts of the Green algae Ulva lactuca showed higher activity against certain human pathogens. The same phenomenon was also observed in another species of Ulva fasciata against oral pathogens (Sujatha et al., 2012) and with fish pathogens (Priyadharshini et al., 2012). Most of the marine algae showed moderate to high level activity against Staphylococcus aureus (Jebasingh et al., 2011; Zbakh et al., 2012).

Seaweeds are considered as a source of bioactive compounds as they produce a great variety of secondary metabolites characterized by a broad spectrum of biological activities (Zubia et al., 2008). A series of polyphenolic compounds such as catechins, flavonols and flavonol glycosides have been identified from methanol
extracts of red and brown seaweeds and found to have antioxidant and antimicrobial activity (Sailler et al., 1999).

The antibacterial substances in seaweeds can usually be extracted by water or organic solvents such as methanol, ethanol, acetone, ethyl ether, diethyl ether, ethyl acetate, chloroform, dichloromethane, benzene, hexane, chloroform: methanol (2:1), and chloroform: ethanol (1:1, 2:1) (Bansemir et al., 2006).

Ravikumar et al. (2011) investigated the antimicrobial properties of organic solvent extracts of 17 different coastal medicinal plants collected from Kanyakumari, Southwest coast of India and inferred that, chloroform extract of Datura metel (Solanaceae) showed better antimicrobial activity against clinically important pathogenic bacterial and fungal strains.

Antimicrobial and Antioxidant activity of Seaweeds

Marine natural products or extracts with microbial activities have been isolated from a wide number of seaweeds (Chambers et al., 2006). Seaweeds are the renewable living sources which are also used as food and fertilizer in many parts of the world. They have been screened extensively to isolate lifesaving drugs or biologically active substances all over the world. Natural products are major resource for drug development. A large number of plants, microbes, and marine animals have been examined for bioactive secondary metabolites (Firakova et al., 2007). Marine algae such as harbor endophytes and their terrestrial counterparts are a potential source of new secondary metabolites (Strobel et al., 2008).
Seaweeds are considered as a source of bioactive compounds as they are able to produce a great variety of secondary metabolites characterized by a broad spectrum of biological activities. Compounds with antioxidant, antiviral, antifungal and antimicrobial activities have been detected in brown, red and green algae. Algae are the source of amino acids, terpenoids, phlorotannins, steroids, phenolic compounds, halogenated ketones and alkanes and cyclic polysulphides (Ashtalakshmi and Prabakaran, 2016).

Now a days, infectious diseases are responsible for a high morbidity and mortality rate and are considered as a public health problem because of their frequency and their severity. For the treatment of these diseases, people often use synthetic drug. But, bacteria developed a resistance mechanism to fight against most of the synthetic family of antibiotics. The resistant of microbes is due to indiscriminate utilization of commercial antimicrobial medicines supported by many scientists investigation for modern antimicrobial substances from several medicinal plants and seaweeds (Alagesaboopathi and Kalaiselvi, 2012).

There are several bioactive compounds which are produced by seaweeds and they also possess the ability to prevent the disease caused by some gram negative and gram positive pathogenic bacteria (Kolanjinathan et al., 2009).

Many researchers have been reported antibacterial activity of seaweeds from different localities around the world (Ibtissam et al., 2009; Lavanya and Veerappan, 2011; Osman et al., 2010; Tuney et al., 2006). Several studies have shown that seaweeds and its extracts have different biological activities, including, antitumor (Xu et al., 2004), antiprotozoal (Allmendinger et al., 2010), antiviral (Kim et al.,
antioxidant (Cox et al., 2010) and cytotoxic activity against the human cancer cell lines (Taskin et al., 2010).

Seaweed extracts were also reported to exhibit antimicrobial activity (Gonzalez del val et al., 2001; Kandhasamy and Arunachalam, 2008; Karthikaidevi et al., 2009; Kolanjinathan and Stella, 2009; Lavanya and Veerappan, 2011; Osman et al., 2010; Seenivasan et al., 2010; Vallinayagam et al., 2009). Seaweeds compounds such as (fatty acids, alkaloids, glycoside, flavonoids, saponins, tannins and steroids) were found to be against human bacterial pathogens (Kolanjinathan and Stella, 2009).

Seenivasan et al. (2012) screened the antibacterial activity of extracts of marine algae representing Chlorophyta and Rhodophyta collected from the Vishakapatnaam Coast against two pathogens and also tested their ability to inactivate the enzyme penicillinase in vitro. Extracts of marine algae were reported to exhibit antibacterial activity (Dharmesh et al., 2014). Vanitha et al. (2003) reported that the antibacterial action of nine seaweeds collected from the Kanyakumari Coast against human upper respiratory tract pathogens, which include both gram-positive and gram-negative bacteria.

Potential antioxidant activities of enzymatic extracts from seven species of brown seaweeds were evaluated using four different reactive oxygen species (ROS) scavenging assays containing DPPH free radical, superoxide anion, hydroxyl radical and hydrogen peroxide scavenging assay (Heo et al., 2003).

The antioxidant activity, by free radical scavenging (DPPH-decolorization method) and inhibition of lipid peroxidation (Fe$^{2+}$/Ascorbate), in three species of
seaweeds *Sargassum dentifolium*, *Laurencia papillosa* & *Jania corniculata* (Egyptian isolates) were analyzed (Sanaam and Shanab, 2007).

Supercritical CO₂ extraction, ultrasonic-aid extraction and membrane separation technology were applied to prepare *Sargassum pallidum* polysaccharides (SP) and to study its antioxidant and anti-proliferative activity (Hong Ye et al., 2008). *In vitro* antioxidant activities of three selected Indian red seaweeds viz., *Euchema kappaphycus*, *Gracilaria edulis* and *Acanthophora Spicifera* and three selected Indian brown seaweeds *Sargassum marginatum*, *Padina tetrastomatica* and *Turbinaria conoides* were evaluated by (Kumar et al., 2008 a & b).

The acetone and ethanol extracts of seaweeds (*Chaetomorpha linum* (Muller) Kützing, *Grateloupia lithophila* Boergesen, *Sargassum wightii* Greville) at varying concentrations were shown as a potential reducing agent, hydrogen peroxide, nitric oxide scavengers, ABTS, DPPH, Deoxyribose radical scavengers. Some extracts showed a higher antioxidant activity when compared to the commercial antioxidants (Indu and Seenivasan, 2013).

The study of Cynthia Layse et al. (2011), algae are abundant in the oceans and represent a rich source of as yet unknown secondary metabolites. He studied the complete chemical profiles and pharmacological potential of the *Gracilaria* species. Most studies raised concerns about antimicrobial activity against *Staphylococcus*, *Streptococcus*, *Candida* and *Herpes* genus. Others referenced the cytotoxicity bioassays in which these algae species were not active, but they produce various types of prostaglandins and others substances that can be toxic to humans such as gastrointestinal disorders and lethality caused by *G. verrucosa* and *G. edulis*, respectively.
Antimicrobial resistance

Antimicrobial resistance is the main reason for spreading various diseases in community. There are different mechanisms for drug resistance. One of antimicrobial resistance is antibiotic resistance bacteria. Some bacteria have resistance to antibiotic represent a big problem in treatment process, hence development of numerous diseases (Elbossaty, 2017).

An antibiotic is a category of drugs which is responsible for destroying or preventing the growth of bacteria. Antibiotics effect on bacteria by disturbing its natural ecological harmony through the process of evolutionary pressure. Antibiotics have several roles they not only used in protecting human life, but also played a pivotal role in medicine and surgery. They have effective roles in treatment of various diseases such as diabetes, renal disease, or rheumatoid arthritis. The most effective antibiotics are penicillin and ciprofloxacin (Ventola, 2015).

Microbes are small organisms which cannot see by naked eye. There are various types of microbes as, bacteria, viruses, fungi, and parasites. Although most microbes are harmless and even useful to living organisms, some can cause disease. These disease-causing microbes are called pathogens. Microbes have the ability to develop resistance to the drugs becoming drug-resistant organisms (Read and Woods, 2014).

An antimicrobial is a kind of drug that destroys or rests the growth of microbes, as bacteria, viruses, fungi, and parasites. Antibiotic resistance is the ability of bacteria to resist the effects of an antibiotic, so the bacteria are not destroyed and their growth still occur. Resistant bacteria to the antibiotic lead to rapid growth of microorganisms and spread them in to other organs. Furthermore infection-causing
bacteria can become resistant to at least some antibiotics. Bacteria that are resistant to numerous antibiotics are known as multi-resistant organisms (MRO). A number of bacteria are naturally resistant to some antibiotics such as bacteria in gut (Sheetal et al., 2014).

**Causes of antibiotic resistance**

There are various methods for spread antibiotic resistance, these are included releasing large quantities of antibiotics into the environment through pharmaceutical manufacturing, during wastewater treatment, and presence of antibacterial in soaps and other products contribute to antibiotic resistance.

Contact with infected farm workers or meat processors, drinking contaminated water, contacting air that is emitted from animal housing or is released during animal transport (Michael et al., 2014). Although using of antibiotics in unnecessary and inappropriate cases as in treatment of disease result from viruses as in common cold, these diseases increase the risk of antibiotic resistance (Ventola, 2015).

**Antibiotic resistance Bacteria**

A number of bacteria have established resistance to antibiotics that were used to treat them. Mutual intestinal bacteria that can cause life-threatening infections can be spread to all regions as a result of carbapenem antibiotic resistance (Schwaber et al., 2011). Common cause of urinary tract infections resistance to fluoroquinolone antibiotics (Lim et al., 2017).

Common cause of severe infections in health facilities and the community. It is resistant to methicillin antibiotic (Tong et al., 2015). WHO estimates that, in
2014, there were about 480,000 new cases of multidrug-resistant tuberculosis (MDR-TB), a form of tuberculosis that is resistant to the 2 most powerful anti-TB drugs. Widely drug resistant tuberculosis (XDR-TB), a form of tuberculosis that is resistant to at least 4 of the core anti-TB drugs, has been recognized in 105 countries. An estimated 9.7% of people with MDR-TB have XDR-TB. Extensively drug-resistant TB (XDR-TB) is resistant to most TB drugs, including isoniazid and rifampicin, any fluoroquinolone, and any of the three second-line injectable drugs (Heaton et al., 2014).

*P. aeruginosa* is a common cause of pneumonia and bloodstream, urinary tract, and surgical-site infections. *P. aeruginosa* have been found to be resistant to nearly all antibiotics, including aminoglycosides, cephalosporins, fluoroquinolones, and carbapenems (Chua et al., 2015).

*Acinetobacter* is a gram-negative bacterium that effects pneumonia or bloodstream infections. *Acinetobacter* species have become resistant to all or nearly all antibiotics as carbapenems (Bitrian et al., 2013). It is a kind of bacteria responsible for inflammation of the urethra, cervix, pharynx, or rectum. *Neisseria Gonorrhea* is resistance to some antibiotics including, Cephalosporin fluoroquinolone, tetracycline, and penicillin (Anderson and Seifert, 2014).

Once exposure to bacteria occurs, infection and bacteria spread occur, so, treatment with suitable drugs as antibiotics must begin. Antibiotics responsible for prevent the growth of bacteria use in the treatment of disease. While in the other cases antibiotics lose their ability to stop growth of bacteria, hence multiplication of bacteria increase and this lead to spread antibiotics resistance bacteria and development of disease and resistance to treatment (Hsiao-Han et al., 2015).
Antibiotic resistance can be occurring through four types of mechanisms which includes drug inactivation or modification, modification of target or binding site, alteration of metabolic pathway and reduced drug accumulation (Jose and Cesar, 2016).

**Need of the study**

Currently, the random use of commercial antimicrobial drugs has caused multiple drug resistance in human pathogenic microorganisms (Aliero et al., 2008). In addition to this problem, hypersensitivity, immune-suppression and allergic reactions are sometimes present from the adverse effects of antibiotics on the host (Nebedum et al., 2009). This situation forced scientists to search for new and effective antimicrobial agents to replace the current practices (Jacquelyn, 2002).

Hospital associated diseases are called nosocomial infections. It develops in the patient during stay in the hospital. A recent study indicates that about 5 to 19% of the patients in acute care hospitals develop nosocomial diseases. Bacteria are the leading cause of nosocomial disease and viruses are a distant second. Occasionally fungi cause disease but rarely protozoa are involved. Mostly nosocomial diseases are caused by gram negative bacilli like *E. coli*. The use of therapeutic and diagnostic equipment (such as intravenous and urinary catheters), surgical procedure and transplantation has increased the risk of nosocomial diseases. Increased antibiotic therapy leads to the development of drug resistance against wide spectrum of antibiotics.

The emergence of the resistant bacteria has created a major concern and an urgent need for new antibacterial agents (Davis, 1994; Spratt, 1994). Marine natural products, the secondary or non-primary metabolites produced by living organisms,
have been exploited by people for a variety of purposes including their use as food, fragrance, pigments, insecticides and medicines. Each year, an increasing number of novel marine metabolites are reported indicating that the marine environment is likely to continue to be a prolific source of new natural products, for many years to come. Because of the diversity of marine organisms in various habitats, marine natural products encompass a wide variety of chemical classes including terpenes, shikimates, polyketides, acetogenins, peptides and alkaloids of varying structures and multitude of compounds of mixed biosynthesis.

Plants that remain the most common source of antimicrobial agents. Their usage as traditional health remedies is the most popular for 80% of world population in Asia, Latin America and Africa and is reported to have minimal side effects (Safary et al., 2009). In recent years, pharmaceutical companies have spent a lot of time and money in developing natural products extracted from plants, to produce more cost effective remedies that are affordable to the population. The rising incidence in multidrug resistance among the pathogenic microbes has further necessitated that there is a need to search for newer antibiotic sources. It is well known that some plants containing active compounds are able to inhibit the microbial growth. Studying plant-based antimicrobial properties provides additional information in developing natural antibiotics and discovering the alternative of antimicrobial drugs for the treatment of infectious diseases. Mangroves are diversified group of plants that grow in estuarine environment, have been a source of interest for their novel natural products like alkaloids, flavanoids, glycosides, saponins, tannins, etc., are known to exhibit antiviral, antibacterial and antifungal activities (Bhimba et al., 2010).
Seaweeds are the only source of phytochemicals namely agar agar, carrageenan and algin, which are extensively used in various industries such as food, confectionary, textiles, pharmaceuticals, dairy and paper industries mostly as stabilizing and thickening agents. They are also used for human consumption, animal feed and as manure in several countries. The greatest use of agar is in association with food preparation and in the pharmaceutical industry as a laxative or as an outer cover of capsules. Being rich in minerals, vitamins, trace elements and bioactive substances, seaweeds are called medical food of the 21st century (Sajid Khan and Satam, 2003).

Marine environment is unique with respect to its biological and chemical diversities and represents a source of novel antimicrobial compounds. In recent years, there are numerous reports of macro algae derived compounds that have a broad range of biological activities such as antibacterial, antifungal, antiviral, antineoplastic, antifouling, anti-inflammatory, antitumor, cytotoxic and antimitotic activities (Megha et al., 2013). Most of the compounds of marine algae show antibacterial activities. Many metabolites isolated from marine algae have been shown to possess bioactive efforts (Aruna et al., 2010). Hence, this study has been undertaken to find out the new antibacterial metabolites from marine floral living resources against nosocomial and bacterial pathogens.