The fight against bacterial infection represents one of the high points of modern medicine. The development of antibiotics in the 1940s offered physicians a powerful tool against bacterial infections that has saved the lives of millions of people. However, because of the widespread and sometimes inappropriate use of antibiotics, strains of bacteria have begun to emerge that are antibiotic-resistant. These new, stronger bacteria pose a significant threat to general health and welfare – and a challenge to researchers. Bacterial infections can be caused by a wide range of bacteria which includes gram positive and negative bacteria resulting in mild to life-threatening illnesses that require immediate intervention. The present research work includes a detailed study on Methicillin Resistant *Staphylococcus aureus* (MRSA) and effect of turmeric on gram positive bacteria which includes MRSA and gram negative bacteria which includes *E.coli, Klebsiella sps* and *Enterobacter sps.*

**Fig. 1** Medical illustration of Methicillin-resistant *Staphylococcus aureus* (MRSA)

In the late 1940s and throughout the 1950s, *S. aureus* developed resistance to Penicillin. Methicillin, a form of Penicillin, was introduced to counter the increasing problem of Penicillin-resistant *S. aureus*. Methicillin was one of the most common...
types of antibiotics used to treat S. aureus infections, but in 1961 British scientists identified the first strains of S. aureus bacteria that resisted Methicillin. This was the so-called birth of MRSA.

Courtesy: Centers for Disease Control and Prevention.

One of the most serious contemporary challenges in the treatment of Hospital-Acquired infections worldwide is the appearance and global spread of Methicillin resistant Staphylococcus aureus (MRSA), which carries a uniquely effective drug-resistance mechanism that can protect these pathogens against all members of the large β-Lactam family of antibiotics (M. Ines Cristostomo et al. 2001).

Methicillin-resistant in Staphylococcus aureus (MRSA) was reported in 1961 (Jevons, M.P et al. 1961). Although there were sporadic out-breaks of MRSA, they did not become a major problem until the late 1970’s and early 1980’s when outbreaks were reported from many parts of the world (Grubb, W.B. et al. 1998).

Staphylococcus aureus strains resistant to Methicillin and many other antibiotics are major causes of Nosocomial infections worldwide (Diekma et al. 1999).

Staphylococcus has plagued man for centuries (Kleos, WE et al. 1997). Due to its adaption in the antibiotic era, S. aureus has been able to evolve, acquiring resistance to nearly all antibiotics used to treat it. Resistance to Penicillin was reported in 1942, only 1 year after the miraculous drug was introduced (Rammel Kamp et al. 1942, Martin E et al. 2014).

In the mid-1940’s, the mechanism of Penicillin resistance based on an inducible Beta-Lactamase was revealed (Bondi A Jr et al. 1945).

At present over 80% of S. aureus isolates are resistant to Penicillin because of the action of hydrolytic β-Lactamase enzymes or Penicillinases (Washington Winn et
al. 2006).

*S. aureus* was able to develop resistance to the other available antibiotics such as Erythromycin, Streptomycin and Tetracyclines (Finland, M et al. 1955, Brumfitt, W et al. 1989, Jessen, O et al. 1969).

Semi synthetic Penicillinase-Resistance Penicillins (i.e., Oxacillin and Methicillin) then became the drugs of choice for treatment of infections due to Penicillin- Resistant *S. aureus* (Washington Winn et al. 2006, Jevons, M.P. et al. 1961).

During the 1980’s, resistance to the Penicillinase Resistant Penicillins emerged. The latter type of resistance involved the expression of Transpeptidase (PBP2) with reduced affinity for all available β-Lactam agents including Penicillin & Cephalosporins (Hartman, B et al. 1981).

Once the normally present PBPs have been inactivated by a β-Lactam agent, PBP2 continues to function and allows the synthesis of a stable peptidoglycan structure, thereby allowing the organism to grow and divide. PBP2 transpeptidase is encoded by chromosomal gene mecA, located in a mobile genomic element known as the Staphylococcal Cassette Chromosome (SCC), in this case SCC mec. SCC mec elements are classified by a hierarchical system into types and subtypes and to date 11 types of SCC mec have been identified (Kalayama, Y et al. 2000).

MRSA represents a challenge for virtually all healthcare institutions and guidelines have been promulgated regarding how to manage and control the spread of MRSA within healthcare institutions (Boyee, JM et al. 1995, Wenzel, RP et al. 1998).

Initially MRSA was a nosocomial pathogen and infections due to MRSA were primarily limited to major hospital centers and their healthcare systems (Levine, DP et al. 1982). Community–acquired MRSA was rarely reported. However, during the
1990’s a new epidemic of MRSA began. A unique clone of MRSA acquired in the community was first described in Western Australia (Udo, EE et al. 1993).

It is now clear that individuals within the community and outside of healthcare institutions are also at a risk of acquiring MRSA. Initial reports of Community-acquired MRSA infections reflected certain circumstances and risk behaviours that were responsible for their MRSA infections such as intravenous drug use, outpatient antimicrobial therapy, previous hospitalizations and severe underlying disease (Saravolatz, L. D et al. 1982). MRSA infections are now being seen in communities and populations that do not reflect these risk factors (Layton, M.C et al. 1995).

With the emergence of resistance to the Penicillinase resistant Penicillins, the glycopeptide agent Vancomycin became the treatment of choice for infections due to MRSA. MRSA took almost 40 years to develop even partial Resistance to glycopeptides such as Vancomycin.

However in May 1996, the first documented infection caused by *S. aureus* strain with intermediate Resistance to Vancomycin was reported from Japan (CDC, 1997, Hiramatsu, K et al. 1997).

Since the beginning, *S. aureus* infections have been associated with significant morbidity and mortality. In the Pre-antibiotic era blood stream infections due to *S.aureus* yielded more than 80% mortality (Skinner, D et al. 1941).

The infections caused by MRSA are serious and are difficult to treat. Only a few antimicrobial agents are available for treatment of such infections. The reports from India suggest increasing incidence of MRSA (Sangeeta Joshi et al. 2013, Pulimood, T.B et al. 1996, Mathur, S.K et al. 1994, Pal, N et al. 1991).

On the other hand certain types of Gram-negative bacteria have become increasingly resistant to available antibiotic drugs. Some strains are now resistant to many, most, or
all available treatments resulting in increased illness and death from bacterial infections and contributing to escalating healthcare costs.

Drug-resistant Gram-negative infections, has emerged as major concerns in hospitals, nursing homes and other healthcare settings. In some cases, bacteria can enter the body through urinary and intravenous catheters, ventilators, or wounds and can lead to pneumonia and infections of the bloodstream, bones, joints, and urinary tract. These types of infections disproportionately affect the very ill and the elderly and are often difficult to treat (Itokazu et al. 1996). Alternative agents for decolonization and potentiation of existing therapy are the urgent requirement to combat the dreaded bugs in infection.

Medicinal plants have a long history of widespread use in both developing and developed countries. According to a report of the World Health Organization, 80% of the world’s population relies mainly on traditional therapies which involve the use of plant extracts as their active substances (WHO guideline, 1993).

The Rhizomes of Turmeric (*Curcuma longa*) belongs to the family Zingiberaceae and is widely cultivated throughout the tropical and sub-tropical regions of the world, mainly in India and China (Chirangini, P. G.H et al. 2004). It’s Rhizomes contain Curcumins, the yellow pigment, belonging to the diferuloyl methane group. Turmeric powder is extensively used as a spice, food preservative and colouring agent. It has been used in traditional medicine for various diseases including biliary disorders (Chattopadhyay, T et al. 2004), anorexia, cough, diabetic wounds and hepatic disorders. The main colouring substances in the Rhizomes of curcuma species are curcumin and two related compounds, demethoxycurcumin and bisedemethoxycurcumin (Jayaprakash, G.K. et al. 2004).

Turmeric is a well-known indigenous herbal medicine having many biological
activities. It is an excellent anti-inflammatory herb and is very good in the treatment of arthritis, rheumatoid arthritis, injuries and trauma (Ammon et al. 1991, Baum et al. 2004).

Curcumin also exhibits anti-tumour activities and prevents cancer (Ruby, A.J et al. 1995). It directly helps a cell to retain its integrity if threatened by carcinogens (Sharma, R.A. et al. 2001). Curcumin has been demonstrated to be safe in six human trails and demonstrated to have anti-inflammatory activity (Kuo, M.L et al.1996). The aim of this work was to study the MRSA in detail and check the antibacterial activity of the extracts of *Curcuma longa* (Turmeric) varieties on Methicillin resistant *Staphylococcus aureus* and Gram negative bacteria which includes *Escherichia coli*, *Klebsiella sps*, and *Enterobacter sps*. 