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Color plays an important role in our everyday life. It has a great impact and influence on our moods and emotions and helps us to enjoy our surroundings. Life is unexciting if there is no color in the world. Every color has a unique effect on every individual to stimulate various responses. Colors in food may responsible for enhancement of appetite. Colors in dress may responsible for elevation of mood. Red color has a positive effect on memory, blue color enhances creativity. Surprisingly, 30% of suicidal rate was declined when the Blackfriars bridge in London made across river Thames changed its color to green. The human eye recognizes the light which falls within wavelength ranging from 380-780 nm, generally in visible region. Chemically dyes consist of two groups. One is called chromophores and the second auxochromes. Chromophores are principally responsible for the color of the dye and the auxochromes for the enhancement of the color of the dye.

Invasion of a host by disease causing agents (organisms) and their multiplication and generation of toxins is called infection. Broadly the term disease speaks the condition that affects the normal function of the body. When the normal function of the body is affected by pathogenic microbial agents then it is termed as infectious disease (Willy et al., 2008).

Antimicrobial agents are the most common groups of agents required for the treatment of infectious diseases. The discovery of antimicrobial agents is one of the biggest medical triumphs of 20th century. The antimicrobial agents revolutionized to treat bacterial diseases, starting with sulfonamides in 1930s, penicillin in 1940s, the broad spectrum bacteriostatic antibiotics in 1950s, bactericidal antibiotics in 1960s together with other synthetic analogues and highly specific narrow spectrum antibiotics (Komolafe, 1997).
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Treatment of microbial infections still remain a challenging job due to increasing number of multi drug resistant microbial pathogens and inclusion of emerging infectious diseases like severe acute respiratory syndrome (SARS) and avian influenza (Desai et al., 2013). Though, development of novel synthetic compounds to deal with resistant microorganisms has become one of the most vital spheres of antimicrobial research today, still resistance of pathogenic bacteria and fungi towards available antimicrobial drug is also a worldwide major problem for the clinical management of infectious diseases. Therefore, recently the discovery of new potential antimicrobial agents is a challenge to the researchers to overcome such clinical crisis (Grare et al., 2007).

Antimicrobial resistance is recently a serious threat to public health in all parts of the world. The new resistance mechanisms of the organisms is a challenge to our ability for the treatment of common infectious diseases which may cause in death and disability of those who until could lead a normal course of life. Without effective antimicrobial molecules, the standard treatment may have a chance to be failed. A survey report claimed that Cloxacillin (isoxazolyl congener of penicillin) is highly resistant by Gram positive bacteria like Staphylococcus aureus, Streptococcus species and Enterococcus species (Prasanth et al., 2014).

In all the regions of the world, there are high proportion of antibiotic resistant bacteria causing common infections such as urinary tract infections and pneumonia. A high percentage of hospital acquired infections are caused by highly resistant bacteria like Methicillin resistant Staphylococcus aureus (MRSA) or multidrug resistant Gram-negative bacteria. A survey report by WHO from ten different countries suggested that Gonorrhea may soon become untreatable as the causatives developed their resistance against the third generation Cephalosporin. Antimicrobial resistance is a growing problem in the world and causes millions of death every year (Antimicrobial resistance: global report on surveillance, WHO
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2014). Vancomycin a glycopeptide antibiotic is used for the treatment of infections caused by enterococcus bacterium. But survey report reveals that some enterococcus bacteria are resistant to vancomycin and they are known as vancomycin - resistant enterococcus (VRE). (Cetinkaya et al., 2000).

In year of 2002, the Centers for Disease Control (CDC), USA first declared that Staphylcoccus aureus is also resistant to Vancomycin. Further, they are known as Vancomycin – resistant Staphylcoccus aureus (VRSA). However, it is not new that A. baumanii acquired resistance to aminopenicillins, ureidopenicillins, first & second generation cephalosporins, cephmamics, chloramphenicol and tetracyclines. Since last 35 years of researcher it was observed that A. baumanii is resistant to a number of antimicrobials, hence called as multidrug resistant - Acinetobacter (MDRA) (Aharon et al., 2005).

Recently, multi-drug resistance in various pathogenic organisms has been increased due to indiscriminate use of commercial antibiotics which are commonly used in the treatment of various infectious diseases (Moellering, 2011; Ghebremedhin et al., 2009). Such health problems have encouraged many medicinal chemists to search for the synthesis of novel antimicrobial agents other than the analogues of existing antibiotics (Dougherty and Friedberg, 2010; Edwards and Biagini, 2006; Doughert and Gemcitabine, 2010; Bailey and Summers, 2008) which should kill or inhibit the growth of the infectious microorganisms without or less affecting the host (Pelczar et al., 1993).

According to the survey report of WHO 2013, there were about 480, 000 new cases of multidrug-resistant tuberculosis (MDR-TB). Extensively drug-resistant tuberculosis (XDR-TB) has been identified in 100 countries. The estimation of WHO progress report predicted that within next 20 years 30 million people will be infected by M. tuberculosis. It is too difficult to control TB within the patients suffering from acquired deficiency syndrome.
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(AIDS), as it is leading opportunistic infection. Due to development of bacterial resistance to first-line anti tubercular drugs viz. isoniazid, rifampicin, ethambutol, streptomycin and pyrazinamide, there is a definite chance of spreading of multi-drug resistant strains for which novel and potential antimicrobials are required to conquer over tuberculosis (Raval et al., 2014).

In the present life style, the roles of effective antimicrobials have their own importance. Without antimicrobials the death rates will be more from simple and even common infectious diseases. The immunosuppressive therapies will be demoralized and epidemics would be accelerating in surgery. The essential enzymes are not present in host organism which is responsible for resistance of pathogenic organisms (Swarbrick et al., 2008). Mostly antimicrobial resistance refers to acquired resistance which may causes either due to novel mutation or transfer of genes causing resistance. Microorganisms are resistant to antimicrobial agents as they have acquired resistance genes in their DNA and can also transfer it to the sensitive microbes during the course of their mutation. Therefore, the drug resistance problem needs continuous discovery of novel antimicrobial agents by exploiting the existing molecules with different chemical entities (Kharb and Kaur, 2013).

Despite of a well range availability of antimicrobials, still there is a need of development of new molecules which can overcome the difficulties due to antimicrobial resistance or emerging infectious diseases. Azo molecules have a number of biological activities like antiseptic (Browning et al., 1926), antimicrobial (Jogi et al., 2013), antidiabetic (Garg and Praksh, 1972), antineoplastic (Child et al., 1977), antitumor (Thoraya and Abdallah, 2008) etc.

The azo compounds bear functional group R-N=N-R', where R and R' can be either an aryl or heteroaryl group. The -N=N- represents as azo group. Azo is a French term used for
nitrogen. Even in Greek, the term azo is defined in a very interesting way i.e. \( a: \) (not) and \( zoe: \) (to live). The azo compounds are synthesized by diazotization reaction of a primary aromatic amine and coupled with one or more nucleophiles, mostly an amino, active methylene and hydroxyl group (Olayinka et al., 2010). They are thermo stable in a wide range of pH (Awale et al., 2013).

The azo dye sulfonamide of antibacterial pro-drug such as prontosil (-4-((2, 4-diaminophenyl) diazenyl) benzene sulfonamide) was the first effective chemotherapeutic agent that was used systemically for the treatment of *Staphylococcus* infection in human (Kirshner, 1998). The azo salicylic acid derivative, Sulfasalazine (-2-hydroxy-6- ((4-(N-pyridin-2-ylsulfamoyl) phenyl) diazenyl) benzoic acid) is a proven drug since last 40 years effective against ulcerative colitis (inflammatory bowel disease) with a lot of side effects. The azobis-salicylic acid derivative olsalazine (-5, 5’-(diazone-1, 2-diyl) bis (2-hydroxybenzoic acid)) is a better alternative for sulphasalazine (Mohsen AQM et al., 1987). Azo-salicylic acids have good biological activity and also useful precursors for the synthesis of anticarcinogenic, antiviral, antimicrobial and antimalarial agents (Djurendic et al., 2011). Phenoazopyridine (3-phenyldiazenylpyridine-2,6-diamine) has urinary local analgesic effect. Balsalazide (-5-((4-(2-carboxyethylcarbamoyl) phenyl) diazenyl)-2-hydroxybenzoic acid) is another azo compound used for the treatment of inflammatory bowel disease. One more popular azo molecule, Dacarbazine (5-((3,3-dimethyltriaz-1-enyl)-4H-imidazole-4-carboxamide) is used for the treatment of various types of cancers.

Explosive population growth, improper education, lack of proper food and shelter are major social calamities for the people who are living under poverty line. They even can’t dream for a healthy hygienic livelihood, while they are unable to arrange a regular balanced meal and inviting various infectious pathogenic diseases. It is the social responsibility to explore less toxic and highly effective drug molecules in less cost so that people from all class
can afford. The exploitation of a simple molecule with different functionalities for the synthesis of hybrid azo derived molecules is a worthwhile contribution in medicinal chemistry.

Hence, the objective of this part of the research work is to synthesize and investigate the antimicrobial activities of new azo and bis-azo based molecules with different aryl and heteroaryl functionalities against different microbial strains. Present study is also included to investigate the probable other biological activities by means of different in vivo and in vitro models.

Phenoazopyridine

Sulfasalazine

Prontosil

Dacarbazine

Balsalazide

Olsalazine
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Evans Blue

Congo Red

Black PN (Brilliant Black BN)
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Study on medicinal interest of synthesized azo based heterocyclic compounds
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