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Antimicrobial resistance (AMR) and Potential Medicinal Plants of Rajasthan as an Alternative Approach: A Brief Review

Review Article

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Abstract

Antibiotics and their importance in our life is established fact. Antibiotics are mainly used in infectious diseases to stop the bacterial and other micro-organisms growth. But along with time many microbes have evolved intrinsic mechanism of antimicrobial resistance (AMR) due to indiscriminate and irrational use of antibiotics, thus become less susceptible to medical treatment. Resistance develops in bacteria by target modification, antibiotic inactivation, plasmidic efflux and efflux pump. Antimicrobial resistance is an upcoming threat to human society. Antimicrobial resistance (AMR), causes an estimated 700,000 deaths annually in the world and it is potentially affecting every country. So, its need of time to proper addresses this problem to avoid roar of silent pandemic in future. The present scenario directs to search natural alternatives of antibiotics as well as sensible use of antibiotics. Plant derived antimicrobials can be best alternative for this problem. By using approach of traditional medicines against antimicrobial resistance can be overcome by expanding the screening of medicinal plants for phytochemicals present in them.

Keywords: Antibiotics; Infectious diseases; Traditional medicines; Antimicrobial resistance; Pandemic; Plant derived antimicrobials; Phytochemicals

Introduction

Antimicrobial resistance raised as a major global issue. Antimicrobial resistance (AMR) threatens the ability to successfully treat infectious diseases across the globe [1]. Antimicrobial resistance is the acquired resistance by microorganism like bacteria, viruses, fungi, parasite, etc. against antimicrobial drugs that are used to cure infectious diseases. Major cause of this issue is indiscriminate and irrational use of antibiotics which evolves resistant strains of bacteria. Generally, bacteria that are used as therapeutic or remedial agents have the genetic ability to transmit and develop resistance to drugs therefore it has now become crucial to find alternative treatments for bacterial infections [2,3]. These resistant strains of bacteria transfer this characteristic into their progeny through horizontal and vertical transfer and their progenies are more lethal than parent generation. It becomes critical to treat infectious diseases in such conditions. After developing antibiotic resistance, microbes are known as superbugs. Since beginning of civilization, plants and their products are used as medicines. The medicinal use of plants has even been mentioned in 'Rigveda' between 4500-1600 BC [4].

Drug resistance is along with time, taking a form of severe and an alarming situation attracted the attention of scientific and medical professionals. Now it becomes a need of time to search natural substitutes of antibiotics to combat antibiotic resistant bacteria. As per the report of the WHO (World Health Organization) resistance was more prevalent in cases of bacterial infections which cause most of the deadly infectious bacterial infections worldwide such as respiratory tract infections, diarrhea, meningitis, syphilis, gonorrhea and tuberculosis [5]. According to the WHO, over 80% of the world's population relies on traditional forms of medicine, largely plant based to meet primary health care needs. Plants and other organisms have co-evolved for more than 350 million years and have developed strategies to overcome each other's defense systems [6,7]. Plants have

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effective defense mechanisms, such as the production of secondary metabolites, to combat pests and pathogens and protect themselves with the severe damage caused by these microbial pathogens. Plant's secondary metabolites play a major role in making plants competitive in their own environment and developing adaptations. Secondary metabolites provide specific odors, tastes and colors to the plant tissues.

Exploring Therapeutic Potential of Natural Antimicrobial Agents

Antimicrobial marketers have capability to kill or forestall the increase of microorganisms. Antimicrobial drug treatments are of two types - synthetic/chemicals and natural/plant primarily based totally antimicrobial marketers. Chemical antimicrobial marketers cause excessive aspect outcomes. One of the foremost aspect outcomes is technology of unfastened oxygen radicals (ROS). ROS are very poisonous and were idea to play a major function in generating cancer [8-10]. Herbal drug treatments are a unique department of conventional expertise approximately lifestyles coping with each frame and mind [11]. India being the large important manufacturer of medicinal vegetation and owns the name "the botanical lawn of the world" [9]. Traditional Medicine (TM) gives efficient opportunities to fight MDR [12]. Our conventional medicinal vegetation may be used on many accounts. From pre-ancient duration medicinal vegetation are in use in exceptional sort of medicine functions. Herbal microbial marketers are unfastened radical scavengers and as a way to block the manufacturing of ROS. Recently, WHO (World Health Organization) predicted that eighty percentage of human beings global depend upon natural drug treatments for a few issues in their number one fitness care needs. Treatment with medicinal vegetation is taken into consideration very secure as there may be no or minimum aspect outcomes. These treatments are in sync with nature, that's the largest advantage. The golden truth is that, use of natural remedies is unbiased of any age agencies and the sexes. Nature has served as acritical supply of therapeutics has to cope with the growing public fitness demanding situations of the twenty first century [13]. The plant-primarily based totally drug treatments are greater powerful and less expensive opportunity in comparison to synthesized compounds with inside the remedy of diseases [14]. A specific definition of medicinal vegetation, in any other case referred to as medicinal herbs, has been supplied from the field of ethnobiology. These can consequently be described as plant species with biologically energetic compounds utilized in conventional remedy for pharmacological and healing functions in human and animals [15]. Application of ethnomedicinal expertise with inside the fields of biosciences for research of novel bioactive compounds in addition to the polypharmacological system of plant extracts to be used in number one healthcare has been the relevant hobby in research [16]. Herbal products show a wide spectrum of biological activities and thus are efficiently harnessed for managing diseases [17]. Merging nutritional and therapeutic prospective may provide a powerful weapon for controlling an array of diseases [18]. Secondary metabolites are the result of secondary plant metabolism and occur as an intermediate or end products [19]. The structures of secondary metabolites have been optimized during evolution so they act as defense mechanisms by interfering with molecular targets within the cell in herbivores, microbes, and plants [20]. In addition, many secondary metabolites can affect cell signaling or protect against oxidative or UV stress [21]. Herbal antibiotics work against both gram-negative and gram-positive bacteria. Plant derived antibiotics act predominantly on the breakdown of the cell wall and cell membranes of microorganisms, which can lead to the release of cellular content, protein binding domain disruption, enzyme inactivation, and ultimately leading to cell death [22]. Natural product derived drugs are called ideal antibiotics [23].

Gupta and colleagues reported in their study about antibacterial efficacy of *Alpinia galanga* (L.) against multi-drug resistance isolates of *Mycobacterium tuberculosis* [24]. The antimicrobial activity of extracts obtained from different medicinal plant parts including *Smilax zeylanica*, *Trema orientalis*, and *Acacia pennata* have been reported to exhibit a substantial bactericidal effect on the MDR-ESKAPE [25]. The term "ESKAPE" encompasses six pathogens which are responsible for increasing multidrug resistance and virulence: *Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter* spp.

Antimicrobial potential of Medicinal plants

There are some medicinal plants having antimicrobial properties.

Herbal Material/ Medicinal plant	Medicinal Applications	Phytochemicals Present	Ref. Number
Aak *(Calotropis procera)*	Antioxidant, antimicrobial, anti-inflammatory, anti-allergic, hepatoprotective.	Cardenolides, flavonoids, proteins and peptide enzymes,glycosides, triterpenoids, alkaloids, steroids, tannins, phenolic compounds, anthocyanins, saponins, resins, fatty acids, different enzymes	26,27
Kalmegh *(Andrographis paniculata)*	Antibacterial, antifungal, hepatoprotective, anti-inflammatory, anti-allergic, anti-oxidant, immunostimulant, anti-diabetic.	Andrographolide,neoandrographolide, 14-deoxyandrographolide,flavonoids	28
Turmeric *(Curcuma longa)*	Antioxidant, antimicrobial, anti-inflammatory, anticancer, hypoglycemia and anticoagulant.	Vitamin-C, cineole, tumerone, borneol, zingiberene, d-sabinene, and d-phellandrene	29,30
Eucalyptus *(Eucalyptus globulus)*	Antioxidant, antimicrobial anti-inflammatory and antipyretic.	Flavonols, hydroxybenzoic acids and hydrolyzable tannins	31,32
Gokharu *(Tribulus terrestris)*	Antioxidant, antimicrobial, analgesic, anti-inflammatory and cardiovascular protective	flavonoid, tannin and phenolic acids	33,34

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Crofton Weed *(Ageratinaadenophora)*	Antibacterial	(mono-, sesqui-, di-, and tri-) terpenoids, phenylpropanoids, flavonoids, coumarins, sterols, and alkaloids	28,29
Ashwagandha *(WithaniaSomnifera)*	anti-inflammatory,anti-tumor, anti-stress, anti-oxidant, immunomodulatory, hemopoetic and cardio-protective effects	withanolides mainly withaferine A and withanolide A	37
Neem *(Azadirachta indica A. Juss)*	anti-inflammatory, cytotoxic and antimycobacterial activities, antifungal, hepatoprotective, antimalarial, immunomodulatory, antidiabetic etc.	azadirachtin and the others are nimbolinin, nimbin, nimbidin, nimbidol, sodium nimbinate, gedunin, salannin, and quercetin. Leaves contain ingredients such as nimbin, nimbanene, 6-desacetylnimbinene, nimbandiol, nimbolide, ascorbic acid, n-hexacosanol and amino acid, 7-desacetyl-7-benzoylazadiradione, 7-desacetyl-7-benzoylgedunin, 17-hydroxyazadiradione, and nimbiol	20-22
Wood Sorrel (*Oxaliscorniculata)*	digestion, chronic dysentery, diarrhea, headaches, intoxication, fever, infammations, jaundice, pain, scurvy, antihelminthic, analgesic, astringent, diuretic	Phenolic compounds, C-glycosyl flavones, tannins, palmitic acid, and a mixture of oleic, linoleic, linolenic and stearic acids	39
Tejpat (*Cinnamomum tamala)*	Diabetes, Digestion, Cardiovascular Benefits, Cold and Infection, Pain, Anti-cancer, Menstrual Problems	polyphenols, flavonoids, alkaloids, flavones and flavanols, tannins, carbohydrates, amino acids and proteins, saponins and glycosides	40
Crofton Weed *(Ageratinaadenophora)*	Cuts, wounds, boils, antiseptic		39
Mug wort (*Artemesia vulgaris)*	Antiseptic, diarrhea, dysmenorrhea, asthma, anthelminthic, stomach ulcer, anorexia, heartburn, hyperacidity, spasm of digestive organs, epilepsy		39
Bhumiamla *(Phyllanthus niruri)*	anti-hepatitis B activity. It binds to HbSAg (surface antigen) and inhibits DNA polymerase required for the multiplication of the Hepatitis virus		41
Malabar Nut *(Adhatodavasica)*	Decoction of leaves used to rheumatic fevers and urinary tract infections, dysentery and diarrhoea. It also has mudir-e-haiz (emmenagogue) activity	Vasicine, Vasicol, Vasicinone, Peganine, Adhatonine, Vascinol, Vasicinolone	41
Aloe Vera *(Aloe barbadensis miller)*	Antimicrobial activity against Corynebacterium, Salmonella, Streptococcus, S. aureus		42
Datura *(Datura metel)*	Antibacterial property	ethanol and ethyl acetate solvent extracts of leaves	43
Kali Musli *(Curculigoorchioides)*	Antibacterial property shown by root oil		44

Conclusion

As per the demand of time such kind of research models should be prepared which can counter drug resistant microbes. Drugs prepared by using botanicals are free of any kind of side effects and will not develop antimicrobial resistance in microbes. Herbal medicines have great potential to provide cost effective solution of antimicrobial resistance (AMR). Collaborative work is required among the World Health Organization (WHO), the Food and Drug Administration (FDA), the biotech companies, pharmaceutical and Health industry, and other regulatory bodies on global level to work on clear guidelines for the development of potential herbal drugs for different diseases. Nature has given us the treasure of medicinal plants with many phytochemicals of tremendous value that should be utilized for effective solution of antimicrobial resistance (AMR).

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