



# Role of Plants in Pharmaceutical Sector: Against Multidrug Resistant Human Pathogens

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## Abstract

Irrational drug use has immensely contributed to an increase in the number of microorganisms resistant to the current conventional medicines. In the recent years, plants have provided a good source of cheaper, safe and more scalable drugs to combat infectious diseases caused by multidrug resistant human pathogens. Traditional medicine practices around the globe have utilized plants in the management of various diseases. However, the quality, safety, efficacy of most plants used in the traditional medicine practices have not been investigated and are not documented to ascertain their incorporation in clinical use.

## Introduction

Multidrug resistant is exhibited if a micro-organism becomes resistant to more than one agent that previously the microorganism was susceptible to. The net effect is therapeutic failure. The microorganisms that have been implicated in multidrug resistant include but not limited to: methicillin-resistant *Staphylococcus aureus* (MRSA), MDR-*Mycobacterium tuberculosis* and malarial parasites *Plasmodium* spp. These microorganisms have greatly contributed to mortality and morbidity globally. To curb public health threat posed by these multidrug resistant human pathogens there is need to search for novel antimicrobial agents. Plants from seventy different families have shown phytochemical compounds that when incorporated in clinical use can solve the issue of multidrug resistance [1].

The microorganisms that are likely to show multidrug resistance include: *Acinetobacter* spp, *Pseudomonas aeruginosa*, *Enterobacteriaceae* (Except *Salmonella* and *Shigella*), *Enterococcus* spp and *Staphylococcus aureus*. These microorganisms acquire non-susceptibility to at least one drug in three or more antimicrobial categories. [2]. These microorganisms cause infectious diseases hence there is need for this collection "Role of plants in pharmaceutical sector: Against multidrug resistant human pathogens" to highlight the emerging multidrug resistance in clinical practice other than the common known Multidrug resistance against HIV, Methicillin resistant *Staphylococcus aureus* (MRSA), Resistant *Acinetobacter*, *Mycobacterium tuberculosis* and malaria parasites *Plasmodium* spp. This will aid future management of wound infections, blood infections,

pneumonia and urinary tract infection using phytochemical compounds obtained from plants.

Experimental studies have shown that *Escherichia coli* (*E. coli*) has multidrug resistance against antibacterial agents' amoxicillin, ampicillin and sulfamethoxazole. *Klebsiella pneumoniae* (*K. pneumoniae*) is non-susceptible to aztreonam, ampicillin and amoxicillin. *Stenotrophomonas maltophilia* (*S. maltophilia*) is resistant to nalidixic acid and amoxicillin. *Staphylococcus aureus* (*S. aureus*) is resistant to oxacillin and penicillin -G. *Streptococcus pyogenes* (*S. pyogenes*) is resistant to clindamycin, erythromycin and penicillin G. *Pseudomonas aeruginosa* (*P. aeruginosa*) is resistant to novobiocin and sulfamethoxazole. Crude plant extracts have shown activity against *E. coli*, methicillin resistant *S. aureus* (MRSA), *S. pneumoniae* and *P. aeruginosa* [3]. Therefore, there is need to continuously search for plant extracts to manage multidrug resistance human pathogens and formulate them for clinical use.

It is estimated that four out of every five individuals depend on herbal medicine for primary healthcare needs. This is attributed to the diverse bioactive constituents like cardiac glycosides, alkaloids, terpenoids, phenolics, flavonoids, tannins and saponins which have shown substantial antimicrobial activity against multidrug resistant human pathogens [4]. The role of plants in pharmaceutical sector: Against multidrug resistant human pathogens collection expects continuous advances towards further studies on quality, analysis, safety, clinical efficacy and toxicity investigations to provide novel antimicrobial agents for multidrug resistant human pathogens.

Plants are a source of essential oils with a broad spectrum of phytochemicals like aliphatic components, phenol-derived aromatic constituents and terpenes which provide different mechanism of action for antibacterial activity. The essential oils have been utilized in traditional medicine, modern medicine, pharmaceutical and cosmetic industries. *Asteraceae* species has been studied for antibacterial activity with promising results documented [5]. Therefore, there is need to analyze essential oils and incorporate them in cosmetic, nutraceutical and pharmaceutical industries.

In this collection, medicinal plants and other remedies employed in the management of infectious diseases, their mode of action

depends on arresting the growth and killing of the microorganism. The pharmacological target of the new agents developed to fight multidrug resistance for human pathogens should focus on other targets apart from the cell wall-based mechanisms. Autoinducers agents have been obtained from quorum sensing system, quorum quenching and biofilm formation have a great potential in development of drugs with different mechanism of action to combat multidrug resistant human pathogens [6].

Phytochemical constituents from plants show synergist or potentiator effect on antibacterial agents which have low efficacy. Phytochemicals compounds have also shown activity against multidrug resistant human pathogens which are non-susceptible to conventional therapies and management of biofilms [7]. The elimination of multidrug resistant human pathogens needs a further study to properly explore the small noncoding RNAs (sRNAs) and the enzyme component of the microorganisms. Plant derivatives like terpenoids, tannins and flavonoids are safer than the conventional drugs used in management of infectious diseases. The botanical constituents have several pharmacological benefits linked to their efficacy. They also portray synergism with antimicrobial agents in the management of multidrug resistant human pathogens. The synthetic way to target the metabolic pathways involved in multidrug resistant human pathogens include metabolic engineering of the secondary metabolites [8]. This collection provides an insight on the alternative therapeutic targets to inhibit the spread of multidrug resistant human pathogens.

Verocytotoxin producing bacteria such as *Acinetobacter* species and *Escherichia coli* management is challenging due to increased level of toxin production. Antioxidant activity of plant extracts can be used to inhibit verocytotoxic microorganisms [9].

Essential oils are plant products with considerable antimicrobial activity making them candidates for fighting multidrug resistant human pathogens. Essential oils can be combined with antimicrobial agents to give synergistic effects. Essentials oils are boosted by the nano-formulation strategies to enhance antimicrobial activity. The nano-based approaches provide a potential approach to managing multidrug resistant human pathogens [10].

Plants used in folk medical practices are cheap, they are readily available, they are safe and they are trusted for use. In developing countries, this has posed a huge challenge in the efficacy, quality and safety of the utilized plants. Multidrug resistance human pathogens continue to threaten the public health sector globally even with advances and inventions to develop new remedies for infectious diseases. Irrational drug use and uncontrolled access to antimicrobial agents have greatly contributed to emergence of multidrug resistance human pathogens [11]. Hence, this collection provides an insight in standardizing plants derived remedies which may be a game changer in providing solution to multidrug resistant human pathogens. This will better curating manuscripts of the state-of-the-art research being conducted globally.

The role of plants in pharmaceutical sector: Against multidrug resistant human pathogens collection showcases the need to analyze, document and incorporate the plants in management of infectious diseases caused by multidrug resistant human pathogen globally. Hence curbing the global public health threat posed by Multidrug resistant human pathogens.

**Competing interests:** The author declares no competing interests.

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