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ANTIMICROBIAL AND ANTIOXIDANT EVALUATION OF BIO-ACTIVES PURIFIED FROM MEDICINAL PLANT EXTRACTS AGAINST *KLEBSIELLA PNEUMONIA*- A REVIEW

Biotechnology

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ABSTRACT

Medicinal plants constitute a wealthy supply of antimicrobial agents. An extensive variety of medicinal plant components is used for extract as an uncooked capsule and they own diverse medicinal properties. Natural merchandise is recognized to play an essential function in each drug discovery and chemical biology. Infectious sicknesses account for about 1/2 of all loss of life in tropical countries, about five million humans in Africa. Bacterial and fungal contamination was a chief hassle taken into consideration for many years that reasons spoilage of meals merchandise and diverse sicknesses in flora and humans, which ends up in large losses within side the crop productiveness and fitness issues worldwide. The World Health Organization estimates that plant extracts or their lively ingredients are used as people's medication in conventional treatment plans for 80% of the sector population. The impact of plant extracts on microorganisms was studied through a totally massive wide variety of researchers in special components of the sector. Medicinal flora is famous in nearly a part of the sector in people's medication. Leaves, fruits, barks, and roots have useful outcomes in several sicknesses which include asthma, gastroenteric disorders, diabetes mellitus, persistent bronchitis, and pneumonia. Phytochemical research on medicinal plants proved the presence of diverse additives inclusive of triterpenes, sesquiterpenes, flavonoids, alkaloids, steroids, saponin, tannins, and cardiac glycosides and a number of those compounds were located to own antiviral, antitumor, hypoglycemic and anti-inflammatory properties. The present study was undertaken to evaluate antimicrobial and antioxidant activities from medicinal plant extracts against Klebsiella pneumonia.

KEYWORDS

Antimicrobial, Antioxidant, Bioactive, Medicinal plants, and Klebsiella pneumonia.

INTRODUCTION

Klebsiella pneumonia has recently gained notoriety as an infectious agent due to the increase in serious infections and the lack of effective treatments. These concerns arose in relation to the emergence of strains of *Klebsiella pneumonia* that acquired additional genetic characteristics and became either hypervirulent (HV) or antibiotic-resistant. *Klebsiella pneumonia* was first isolated in the late 19th century and was originally known as Friedlander's bacterium (Friedlander, 1882). It is a Gram-negative, encapsulated, non-motile bacterium that lives in the environment, including soil and surface water, and medical devices (Bagley, 1985). Importantly, *K. pneumoniae* readily colonizes human mucosal surfaces, including the gastrointestinal (GI) tract and oropharyngeal tract, where the consequences of its colonization appear to be benign (Dao *et al.,* 2014). From these sites, strains of *K. pneumoniae* can enter other tissues and cause serious infections in humans. The highly resistant bacteria *K. pneumoniae* appears to follow the adage that "the best defense against an infection is a good defense" instead of "the best defense against a disease is a good attack" when it comes to spreading disease. This is illustrated by the ability of these bacteria to evade and survive rather than actively suppress many components of the immune system and grow at many sites in the host. *K. pneumoniae* causes a variety of infections including, but not limited to, pneumonia, sepsis, urinary tract infection, bacteremia, meningitis, and pyogenic liver abscesses. Primary infections caused by classical *K. pneumoniae* strains usually cause pneumonia or urinary tract infections. Classic strains of *K. pneumoniae* also cause very serious infections, such as bacteremia, and can be either primary or secondary bacteremia resulting from the secondary spread of the primary infection to the lungs or bladder (Zarkotou *et al.,* 2011).

Penicillins, cephalosporins, monobactams, and carbapenems are among the β-lactam antibiotics that are often prescribed over the world (Samaha-Kfoury and Araj, 2003; Ur Rahman *et al.,* 2018). The primary characteristics of β-lactam antibiotic resistance are the synthesis of -lactamase enzymes by -lactam-insensitive cell wall transpeptidases or the active removal of β-lactam molecules by Gram-negative bacteria (Wilke *et al.,* 2005). Popular -lactams for the treatment of infections brought on by bacteria that produce extended-spectrum beta-lactamases (ESBL), including *Klebsiella pneumonia*, including carbapenems (Karuniawati *et al.,* 2013; Okoche *et al.,* 2015). These antibiotics are also considered a last resort in the treatment of life-threatening healthcare-associated infections (Amjad *et al.,* 2011). Unfortunately, bacterial resistance to carbapenems has increased and is well documented (Paterson and Bonomo, 2005; WHO, 2014), and has also been compounded by the production of β-lactamases, efflux pumps and mutations that alter carbapenem expression and/or function. The activity of porins and penicillin-binding proteins (PBP) (Papp-Wallace *et al.,* 2011). Antimicrobial resistance is usually associated with the spread of infectious plasmids and the acquisition of resistance genes, which usually occur through horizontal gene transfer and may also include virulence determinants (Derakhshan *et al.,* 2016). The survival of the pathogen requires the acquisition of resistance and virulence properties (Da Silva and Mendonça, 2012), and some reports suggest that they may play an important role in the pathogenesis of *K. pneumoniae* infections (Vila *et al.,* 2011). Fimbriae (types 1 and 3), siderophores, and capsules are virulence factors that increase the pathogenicity of *Klebsiella pneumonia*. *Klebsiella pneumoniae* strains can synthesize capsules of any serotype K1 to K78; However, K1 and K2 may be associated with increased pathogenicity (Paczosa and Mecsas, 2016).

The majority of *Klebsiella pneumonia* AMR genes are plasmid-borne (Wyres and Holt, 2016) so the ability of AMR genes to amplify and spread in ecological niches is likely related to the permissive properties of the plasmid. Very diverse environmental microbial communities, especially soil, are considered hotbeds of gene transfer (Popa *et al.,* 2011) and Enterobacteriaceae have been identified as part of a "super-permissive community" that supports the spread of plasmids between different soil communities (Klu, 2015). The specific role of *K. pneumoniae* in such activities remains to be investigated, but this species has been associated with hundreds of different plasmids containing many plasmid replicon types (Ramirez *et al.,* 2014), suggesting that it acts as a recipient of plasmids from a wide range of HGT- donors.

One of the most significant sources of medication comes from plants. The role of medicinal herbs in promoting human health capacity in unpleasant and difficult situations has been well documented throughout the world from ancient times to the present day. One of the

most important goals of the Millennium Development Goals is the fight against diseases such as malaria and HIV/AIDS, as well as chronic diseases such as age-related degenerative diseases, cancer, and cardiovascular diseases.

Medicinal plants are rich in secondary metabolites, which are potential sources of drugs and have therapeutic importance. The interest in the use of plant extracts as medicinal agents has grown.

PHYTOCHEMICAL SCREENING OF PLANT EXTRACTS

Phytochemicals may have complementary and/or overlapping mechanisms of action in the body, including antioxidant activity, modulation of enzyme activity, stimulation of the immune system, modulation of hormone metabolism, antibacterial and antiviral activity, binding, covalent binding, and non-specific interactions. The main targets of the complex formation are cell wall and cell membrane adhesion proteins, which deactivate microbial adhesion, which is the first step in the development of infections. They also cause cell wall/membrane rupture (Cowan, 1999; Okuda, 2005; Biradar *et al.,* 2007; Ngoci *et al.,* 2011). It also relaxes microbial enzymes and cell envelope transport proteins through processes that may involve reactions with protein sulfhydryl groups (Samy and Gopalakrishnakone, 2008; Kaur and Arora, 2009; Ngoci *et al.,* 2011). They also collect/complex metal ions (e.g. cobalt, manganese, iron, copper, etc.) that are important for microbial growth as enzyme cofactors and activators. (Biradar *et al.,* 2007, Ogunwenmo *et al.,* 2007, Ngoci *et al.,* 2011; Okuda, 2005). They also inhibit viral reverse transcriptase. The toxicity of phenolic compounds to microorganisms depends on the location and number of hydroxyl groups, and there is evidence that increased hydroxylation increases toxicity Samy and Gopalakrishnakone, 2008, 2008; Przybylski *et al.,* 1998; Cowan, 1999; Biradar *et al.,* 2007; Cowan, 1999; Ngoci *et al.,* 2011). They have an endocrine role, acting together with estrogen receptors. They are also anti-inflammatory, molluscicidal and therefore play an important role in controlling schistosomiasis. They also have anti-diarrheal, antiseptic, antifungal, anti-parasitic, and anti-irritant properties and are also used to control bleeding, heal wounds and improve vascular health by inhibiting arteriosclerotic peptides (Awoyinka *et al.,* 2007; Ogunwenmo *et al.,* 2007; Ngoci *et al.,* 2011). They also play an economic role in the tanning of hides in the leather industry. However, they have an impact on cattle's feed intake and digestibility, and an excessive amount can cause cancer in healthy tissues (Scalbert *et al.,* 2005; Ngoci *et al.,* 2011).

Flavonoids

They are structural derivatives of flavones containing conjugated aromatic systems often linked to sugars such as glycosides and are phenolic and water soluble in nature (Harborne, 1973). They act as antioxidants and thus protect against degenerative diseases. Flavonoids such as quercetin act as chain-breaking antioxidants and prevent oxidation of low-density lipoproteins by macrophages and metal ions such as copper. It reduces oxidative stress (Ngoci *et al.,* 2011). They also work; with "biological modifiers of nature" such as anti-allergic, anti-inflammatory and induce second-step enzymes that eliminate mutagens and carcinogens (Ogunwenmo *et al.,* 2007; Ngoci, *et al.,* 2011). They also act as antimicrobial agents by forming extracellular and soluble proteins and forming a complex in bacterial cell walls. More lipophilic flavonoids can also disrupt microbial membranes (Navarro *et al.,* 2003; Al-Bayati and Al-Mola, 2008; Samy and Gopalakrishnakone, 2008; Kaur and Arora, 2009; Ngoci *et al.,* 2011). Likely targets in microbial cells are surface-exposed adhesins, cell membrane polypeptides, and membrane-bound enzymes. Others, such as catechins in green tea, inactivate bacterial toxins (e.g. choleroxin) and inhibit bacterial glycosyltransferases. Flavonoids can also increase coronary flow, decrease myocardial oxygen consumption, and decrease arterial pressure (Dong *et al.,* 2005; Ngoci *et al.,* 2011). They can also reduce capillary fragility (Harborne, 1973), are anti-allergic and also antispasmodic, and are therefore used to relieve asthma and epistaxis (Ngoci *et al.,* 2011).

Tannins

Tannins are astringent, bitter plant polyphenols that can either bind with proteins and precipitate them or break them down. They play a physiological role acting as antioxidants scavenging free radicals, chelating transition metals, and preventing pro-oxidative enzymes and lipid peroxidation (Navarro *et al.,* 2003; Vit *et al.,* 2008; Ngoci *et al.,* 2011), which regulates oxidative stress and prevents degenerative diseases. They also reduce the mutagenicity of carcinogens (Okuda, 2005; Ngoci *et al.,* 2011) and induce apoptosis, which inhibits the formation of tumours (Scalbert *et al.,* 2005). They have antimicrobial activity by complexing nucleophilic proteins through hydrogen bonding, covalent bonding, and nonspecific interactions. The main targets of the complex formation are cell wall and cell membrane adhesion proteins, which deactivate microbial adhesion, which is the first step in the development of infections. They also cause cell wall/membrane rupture (Cowan, 1999; Okuda, 2005; Biradar *et al.,* 2007; Ngoci *et al.,* 2011).

Saponins

They are surfactants with soap-like properties and can be identified by their ability to foam and hemolyze blood cells (Harborne, 1973). They have many biological functions, including strengthening the respiratory system as an antitussive agent and thus against cough. They also have anti-protozoal activity, so they react with cholesterol in the cell membranes of protozoa, causing the cells to break down, e.g. Yucca saponins are effective against *Giardia lamblia* protozoa. They strengthen the vaccine by acting as adjuvants. They have anti-inflammatory, antiviral, emetic, insecticidal, antifungal, molluscicidal, pesticidal, and antibacterial effects (Ngoci *et al.,* 2011). The mechanism of action of the antibacterial effects involves the membranolytic properties of saponin and lowering the surface tension of the extracellular environment (Al-Bayati and Al-Mola, 2008). They have antitumor effects without killing normal cells. This occurs by reacting with the cholesterol-rich membranes of cancer cells and inducing mitotic arrest, leading to cell apoptosis (Ngoci *et al.,* 2011).

Phytosteroids

Phytosterols are plant steroids that may or may not act as weak hormones in the body. They are similar to animal steroids in terms of their basic ring structure, but they are not the same since different chemical groups are connected to the primary ring in various locations (Ngoci *et al.,* 2011). They also function as sex hormone derivatives (they can be broken down into androgens or estrogen-like compounds, for example), making them potential contraceptive sources (Edeoga *et al.,* 2005; Ngoci *et al.,* 2011). They are also used to treat gastrointestinal conditions and lower serum cholesterol since they have antibacterial, analgesic, and anti-inflammatory properties (Ngoci *et al.,* 2011). They are also used to treat gastrointestinal conditions and lower serum cholesterol since they have antibacterial, analgesic, and anti-inflammatory properties (Ngoci *et al.,* 2011). They have also been shown to be potent inhibitors of macrophage activation, preventing proinflammatory cytokine production and LPS-induced lethality, and are therefore potentially useful as immunosuppressive agents, especially physalins (Soares *et al.,* 2005; Ngoci *et al.,* 2011).

Terpenoids

They are derivatives of isoprene molecules with a carbon backbone built from one or more C15 units (Harborne, 1973). They act as antibacterial, antifungal, antiviral, antiallergic, antiallergic, anti-inflammatory, and antitumor drugs (Roberts, 2007; Ngoci *et al.,* 2011). The mechanism of action is thought to involve membrane disruption by these lipophilic compounds (Cowan, 1999; Ogunwenmo *et al.,* 2007; Samy and Gopalakrishnakone, 2008; Ngoci *et al.,* 2011). Laboratory studies on ginseng-derived terpenes have shown that a possible target of these compounds is the hypothalamic-pituitary-adrenal axis, due to the observed effects on adrenocorticotropic hormone and corticosterone levels (Briskin, 2000; Ngoci *et al.,* 2011).

Cardiac Glycosides

Cardiac glycosides (also called cardenolides) occur as a complex mixture in the same plant and most are toxic, but many have pharmacological effects, especially on the heart (Harborne, 1973). They are used in the treatment of heart failure, where they block the Na/K-ATPase pump, which causes positive ionotropic effects and electrophysiological changes. It strengthens the myocardium and systolic concentration against congestive heart failure (Ogunwenmo *et al.,* 2007; Ngoci et al., 2011). They are also used in the treatment of atrial fibrillation and as decongestants and act as emetics and diuretics (Harborne, 1973; Awoyinka *et al.,* 2007; Ngoci *et al.,* 2011).

CONCLUSION

Medicinal plants have been found to contain important phytoconstituents in herbal medicine (Dahanukar *et al.,* 2002; Somova *et al.,* 2003). Plants have provided active pharmaceutical ingredients for many years and continue to be a source of lead compounds for the development of new drugs (Newman, 2008). For example, plants are

used to treat malaria, fever, and other diseases. Antimicrobial compounds are abundant in medicinal plants. The extract uses a wide variety of medicinal plant parts as raw materials and has various medicinal properties. Natural products are known to play an important role in both drug development and chemical biology. Infectious diseases cause about half of all deaths in tropical countries and about 5 million people in Africa. Bacterial and fungal infections have been a major problem discussed for decades, causing food spoilage and various diseases in plants and humans, leading to significant crop productivity losses and health problems worldwide. According to the World Health Organization, 80% of the world's population uses plant extracts or their active ingredients in traditional medicine in folk medicine (Kivcak B *et al.,* 2002). The effect of plant extracts on microorganisms has been studied by a large number of scientists around the world. Medicinal plants are known in folk medicine in most parts of the world. The leaves, fruits, barks, and roots have beneficial effects on many diseases, including asthma, gastrointestinal diseases, diabetes, chronic bronchitis, and pneumonia. Phytochemical studies of medicinal herbs have revealed the presence of various components such as triterpenes, sesquiterpenes, flavonoids, alkaloids, steroids, saponins, tannins, and mega stigma glycosides, and some of these compounds have been found to have antiviral, tumor, hypoglycemic and anti-. glycemic activities. inflammatory effects. (Kumar VP *et al.,* 2006). This study was conducted to evaluate the antimicrobial and antioxidant activity of medicinal plant extracts against *Klebsiella pneumonia*.

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