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MEDICINAL PLANTS AND *PSEUDOMONAS AERUGINOSA*: IS THAT THE SOLUTION FOR ANTIBIOTIC RESISTANCE

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ABSTRACT: *Pseudomonas aeruginosa* is an opportunistic pathogen causing severe, acute and chronic nosocomial infections in urinary and pulmonary tracts, burns and wounds. There is an urgent and global need for alternative antimicrobial strategies to fight the continuous rise of *P. aeruginosa* resistance to different antibiotics. This review summarizes the antibacterial effect of several plant extracts and essential oil, specifically honey, propolis, and oil extracted from *Cupressus macrocarpa* Leaves, *Taraxacum officinale* extract and *Citrus limon* Peel Extracts.

INTRODUCTION: The multi-drug resistant bacteria to antibiotic is a global problem and widespread, leading to infection that is difficult to treat and may result in death. Antibiotic resistance has affected people in any time or age of life, making it one of the biggest public health problems¹. *Pseudomonas aeruginosa* is an opportunistic pathogen causing severe, acute and chronic nosocomial infections in urinary and pulmonary tracts, burns and wounds. There is an urgent and global need for alternative antimicrobial strategies to fight the continuous rise of *P. aeruginosa* resistance to different antibiotics. Strains of *Pseudomonas aeruginosa* are known to utilize their high level of intrinsic and acquired resistance mechanisms to counter most antibiotics².

In addition, adaptive antibiotic resistance of *P. aeruginosa* is a recently characterized mechanism, which includes biofilm-mediated resistance and is responsible for recalcitrance and relapse of infections. The most exposed patients to the risk of infection and reaching a critical condition are those with weak immunity especially hospitalized and intensive care patients, especially for those who suffer from chronic lung diseases³.

Effect of Honey on *Pseudomonas aeruginosa*: Results from several studies confirm that honeys from different countries and regions may have wide variations in their antimicrobial activity. It has been shown that honey may have antimicrobial action ranging from lesser than 3% to 50% and higher concentrations. Several authors also reported that the antibacterial efficacy of honey differs greatly from plant sources. Honey may inhibit bacterial growth due to several mechanisms, such as the osmotic effect, low pH, hydrogen peroxide generation, and phytochemicals. The combination of these diverse mechanisms may account for the inability of bacteria to develop resistance to honey,



in contrast to the rapid induction of resistance observed with conventional single-component antibiotics. Since *P. aeruginosa* are recalcitrant to antibiotic therapy, the efficacy of honey to inhibit test isolates, irrespective of their antibiotic sensitivity patterns, has important clinical applications. This property may make honey useful in the treatment of drug-resistant infections ⁴.

Effect of Propolis on *Pseudomonas aeruginosa*:

Propolis is a mixture of beeswax and resins collected by the honeybee from different plant buds, leaves, and exudates. Bees use propolis not only as a building material but also as a means of maintaining low bacterial and fungal concentration levels in hive ⁵. Studies showed that the ethanolic extract of propolis (EEP) is more effective on gram-positive bacteria than gram-negative ones; the ethanolic extract of propolis completely inhibits the growth of *Staphylococcus aureus* Staph. epidermidis partially inhibits the growth of *Pseudomonas aeruginosa* and *Escherichia coli* ⁶.

Effect of Essential Oil Extracted from *Cupressus macrocarpa* Leaves:

Cupressus has traditionally been used for treating colds, flu, and rheumatism. It is considered a medicinal tree, as its dried leaves are used for stomach pain, as well as to treat diabetes, and its dried fruit is used to treat inflammation, toothache, and laryngitis and as a contraceptive and astringent. Also, the branches of *Cupressus* are used as antiseptic and antispasmodic.

The essential oil extracted from *C. macrocarpa* leaves treats rheumatism and whooping cough. A previous study found the high activity of *C. macrocarpa* essential oil against *Staphylococcus aureus* and *Pseudomonas aeruginosa* making it a good choice for preservative and therapeutic purposes. The surprising results showed that the essential oil extracted from *C. macrocarpa* had lower minimum inhibitory concentration (MIC) and higher efficacy than some third-generation antibiotics (Ceftriaxone, Cefuroxime, Nitrofurantoin and Colistin) ⁷.

Effect of Essential oil of *Rosmarinus officinalis* and *Salvia officinalis*: *Rosmarinus officinalis* and *Salvia officinalis* are widely used in folk medicine, cosmetics, and flavoring of food products. Furthermore, they are defined as very powerful

aromatic plants, and their essential oils possess antimicrobial, antiviral, antifungal, antioxidant, hepatoprotective, and anticarcinogenic properties. The findings in a previous study showed that the MIC of Rosemary essential oil against *P. aeruginosa* was 0.78% (v/v), and the main compounds with antimicrobial effects in rosemary essential oil are 1,8- cineole, α -pinene, and camphor. *Rosmarinus officinalis* essential oil exhibited higher antibacterial activity against *Pseudomonas aeruginosa* than this *Salvia officinalis* ^{8,9}.

Effect of *Taraxacum officinale* on *Pseudomonas aeruginosa*:

Taraxacum officinale (dandelion) is a wild plant and can be planted, with both types contains good amounts of bioactive chemicals, chicoric acid, taraxasterol, chlorogenic acid, lactones, and vitamins. Roots have high phenolic compound content, making the extract effective against *staphylococcus aureus* and *Pseudomonas aeruginosa*. According to a recent study, the root extract gave a specific efficacy of 17 mm inhibition diameter toward *Pseudomonas aeruginosa* which is known for its antibiotic resistance and the same strain was not sensitive to the reference antibiotic. The importance of these results stems from the possibility of extracting the roots of the plant to affect the *Pseudomonas aeruginosa* ¹⁰.

Effect of *Citrus limon* Peel Extracts on *Pseudomonas aeruginosa*:

Citrus peels are rich in flavonoid glycosides, coumarins, sitosterol, and essential oils, which can be extracted and added to several cosmetic and pharmaceutical products. Other active terpenes, alcohols, aldehydes and esters contribute to the overall antimicrobial effects of the essential oils. The antibacterial potential in crude extracts of different parts (leaves, stem, root, flower, and peels) of Citruslimon against clinically significant bacterial strains has been reported. Citrus flavonoids have a large spectrum of biological activity, including antibacterial, antifungal, antidiabetic, anticancer and antiviral activities ¹¹. A previous research that studied the influence of *Citrus limon*oil in the virulence factors production and motility (swarming and swimming) of two *Pseudomonas aeruginosa* strains showed that Pyocyanin biosynthesis decreases until 64% and swarming motility of *P. aeruginosa* was

completely inhibited by 2 mg mL⁻¹ of lemon oils¹².

CONCLUSION: Many studies have been conducted to evaluate natural treatments against bacterial infections caused by multi-drug resistant bacteria. Due to the high resistance rate of *P. aeruginosa* strains, a lot of research showed be conducted to find new remedies and utilize nature to combat the *P. aeruginosa* virulence factors.

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