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AN OVERVIEW OF BACTERICIDAL EFFECT OF GARLIC ON STAPHYLOCOCCUS AUREUS

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Abstract:

Garlic has been recommended by many ancient therapies, including Chinese and Indian medicine, to treat respiratory and digestive problems, as well as microbial infestation and leprosy. The therapeutic effects include numerous benefits for the cardiovascular system, antimicrobial, anticancer, anti-inflammatory, and hormone-like properties. A narrative review was undertaken through the literature in connection to studies published up to the beginning of 2021 on the effect of garlic on staphylococcus aureus bacteria. Garlic aqueous extract is antimicrobial against S. aureus, which is found in hamburger. Furthermore, garlic aqueous extract can be used as a natural addition for hamburger as well as a flavor. Garlic is also antimicrobial against Gram-positive and Gram-negative bacteria.

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INTRODUCTION:

Allium sativum, also known as garlic, is an odoriferous plant in the lilacease family. Many diverse societies have recognized the potential use of garlic for disease prevention and treatment throughout history. "Allium sativum" is derived from the Celtic word "all," which means "burning or stinging," and the Latin word "sativum," which means "placed or cultivated"[1].

Since many years, commercially accessible antimicrobial medicines have been used to control microbial pathogenecity and other infectious disorders [2]. Antibiotic overuse has resulted in the development of multiple drug resistance (MDR) in many bacterial infections. The primary impediment to successful infectious illness treatment is rising medication resistance [3]. The emergence of medication resistance in infections leads us to look for newer natural antibiotics. Natural products are a significant source of new natural medications, and their usage as an alternative medicine for the treatment of many ailments has grown in recent decades [4].

Naturally occurring plants play an important part in the development of ancient medicine since they have many therapeutic characteristics that, in the absence of appropriate diagnostic tools, helped greatly in easing patient pain and enhancing societal well-being [5]. The therapeutic qualities include benefits to the cardiovascular system, the central nervous system, anticancer capabilities, anti-inflammatory properties, antibiotics, and immunity-boosting activities [6]. These extracts are nothing more than plant byproducts generated during secondary metabolism. These herbal medicines are available in a variety of forms, including powder, liquid, and mixes prepared in paste and ointment forms [7]. The ancient traditional science makes use of these features and employs indigenous strategies to keep the health system running [5]. They also employed it for disease prevention, diagnosis, and treatment by accumulating knowledge, skills, and practices derived from diverse cultures' conceptions that are recognized to sustain health [6]. A large segment of the population in undeveloped and emerging nations believes that traditional medicine can treat any sickness and improve health [7]. Garlic (*A. sativum*) is one of the very selected variety of plant species on which lot of research has been carried out to explore its medical propertied qualities and apply it for cure of various health issues including cancer [8].

DISCUSSION:

For the first time, Cavallito and Bailey [9] investigated the chemical characteristics of garlic. They attempted a variety of ways for making garlic extract before settling on the most essential garlic constituents, allicin, diallyl disulfide, and alipin, which have a milder odor. They believed that using extracted allicin in an ethyl alcohol solvent would improve its stability and antibacterial properties [9,10]. S-allyl cysteine sulfoxide, often known as alliin, is an odorless organosulfur component of garlic. When garlic is cut, it is impacted by the cysteine sulfoxide lyase enzyme alliinase, which converts it to allicin. All of these compounds contribute to garlic's pungent odor and have antibacterial and antioxidant capabilities [11].

Allicin is the principal physiologically and biochemically active component of freshly crushed garlic, and it is easily degraded into stable molecules under the effect of heat and time. Two key compounds formed from garlic are 2-propenesulfenic acid and tioacrolein, which result in the synthesis of larger molecules such as diallyl trisulfide and dithiin [12,13]. Garlic, in general, is a possible antibiotic that is effective against germs resistant to pharmaceutical medicines. In the 1970s, Europeans tested garlic extract on ten bacteria and yeast resistant species and discovered that it was particularly resistant against Salmonella, S. aureus, Mycobacterium, and Proteus species [14]. A recent study looked at the antibacterial effects of garlic aqueous extract on 133 different bacteria (both Gram-positive and Gram-negative), including S. epidermidis, S. aureus, Streptococcus pneumoniae, S. pyogenes, Haemophilus influenzae, S. typhi, Pseudomonas aeruginosa, E. coli, Shigella spp., Proteus spp The current investigation examined the minimum inhibitor concentrations (MIC) or lowest densities of garlic aqueous extract that inhibited microorganism growth (**Table 1**) [15].

Table 1. MIC Garlic Aqueous

Type of Microorganism	**MIC, mg/mL**
Gram-positive bacteria	15.6-48.3
Gram-Negative bacteria	22.9-37.2
Molds and yeasts	14.9-15.5

[a]Abbreviation: MIC, minimum inhibitory concentration.

Garlic extract's antibacterial action is principally owing to the presence of large amounts of sulphur-containing chemicals, the most important of which is allicin. After cutting and crushing the cloves, allicin is formed by the enzymatic (alliin lyase) hydrolysis of allicin [2,6]. Garlic extract has antimicrobial/antibacterial properties that are effective against Gram-negative organisms and Gram-positive bacterial Staphylococcus [11,14]. These garlic extracts can also be used to combat resistant organisms such as antibiotic-resistant bacteria and their hazardous by-products [13]. The components that cause this effect are allicin, which primarily inhibits bacterial growth by partially inhibiting DNA and protein synthesis, as well as RNA inhibition synthesis as the principal target [14]. Furthermore, some research have been conducted that demonstrate that allicin has the ability to slow RNA synthesis by trapping the RNA peptides chain reaction and magnify antibacterial activity [15].

S. aureus is a Gram-positive, catalase-positive, aerobic and non-aerobic, halophilic, and immobile bacterium that can ferment manitol. This bacterium has an irregular cluster form and belongs to the Micrococaceae family and yeast in glucose aerobic circumstances, and it is killed at temperatures above 62°C (pasteurization temperature), with the ability to resist this temperature for at least half an hour. Due to the presence of a nauseant polypeptide termed enterotoxin, the presence of golden S. aureus in food is viewed as a possible hazard that results in food poisoning [16,17]. According to studies, S. aureus is an extremely sensitive bacteria to aqueous and alcoholic extracts. The chemical and biological stability of garlic aqueous and alcoholic extracts, as well as their effects on Gram-positive (S. aureus) and Gram-negative (E. coli) bacteria, were described by Fujisawa et al. [13]. S. aureus's organism membrane is made of lipid, which protects it. Allicin, a component of garlic, has the ability to enter this membrane, influencing the RNA mechanism, membrane lysis, and bactericidal impact. The effect of inhibition on the growth of these bacteria is due to the fact that E. coli and K. pneumoniae contain 20% lipid whereas S. aureus has 2% lipid [17].

To prevent bacterial growth, the MIC and garlic aqueous extract should be greater than 7.5 mg/mL. It was also obvious that if we autoclaved the garlic aqueous extract for 15 minutes at 121°C, it would lose its efficacy against all strains of S. aureus and would no longer be effective. Notably, the antibacterial capabilities of raw garlic at room temperature and garlic stored at -10°C were comparable, with fresh garlic having greater benefits. Garlic contains anion molecules such as nitrates, chlorides, sulfides, and organosulphur compounds that may be easily dissolved in water and are responsible for antibacterial characteristics, according to research [18]. Furthermore, various research on garlic have shown that allicin is the most essential ingredient in garlic that provides antibacterial qualities and inhibits the pace of RNA production; yet, allicin's preliminary job is RNA trapping. Lipid is a component of the S. aureus membrane that facilitates the passage of allicin into the membrane and, as a result, impacts the RNA [14].

Several investigations [19] have proven that S. aureus is a major cause of nosocomial and community-acquired infections, both of which result in significant morbidity and mortality. Although scientific antimicrobials were beneficial in the early stages of their development, the rapid growth of drug-resistant S. aureus strains has been a difficulty in the prevention and treatment of many infections [20]. As medicinal chemists look for new bacterial targets to assault, bacteria continue to change; as a result, a vast number of bacterial species have developed resistance to antibacterial drugs [21]. As a result, alternative tactics must be developed. Because garlic is known to act synergistically with antibiotics and resistance to garlic has not been reported, more dose-response preclinical studies and, eventually, clinical studies should be conducted to evaluate the use of an antibiotic/garlic combination for bacteria that are difficult to eradicate. Taking into account the issues, a study on the antibacterial action of garlic on S. aureus found that dilute solutions of garlic can totally suppress the development of S. aureus at concentrations greater than 7.50 mg/ml. This could be due to the action of allicin's biological active ingredient, which exhibits antimicrobial activity primarily through the immediate and total inhibition of RNA synthesis, though DNA and protein synthesis are also partially inhibited, implying that RNA is the primary target of allicin action. According to Onyeagba and his colleagues, crude extracts of garlic and ginger administered singly or in combination did not prevent the development of test organisms including Staphylococcus in vitro. In contrast, the study clearly shown that for S. aureus with inoculum density of 104 CFU/ml, garlic at a concentration of (15.00 - 60.00 mg/ml) was capable of inhibiting bacterium growth [22].

CONCLUSION:

Garlic aqueous extract is antimicrobial against S. aureus, which is found in hamburger. Furthermore, garlic aqueous extract can be used as a natural addition

for hamburger as well as a flavor. Garlic is also antimicrobial against Gram-positive and Gram-negative bacteria. The findings suggest that crude Allium sativum (garlic) extract is efficient as an antibacterial agent against Staphylococcus aureus. As a result, Allium sativum extract may be used as an alternative to the antibacterial drugs to which Staphylococcus aureus has evolved resistance. The use of garlic extract is entirely healthy.

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