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Review Paper

A Review Article on Extraction and Antimicrobial Effects of Garlic Plant (Allium Sativum)

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ABSTRACT

Garlic (Allium sativum L.) is an important medicinal and culinary plant belonging to the family Amaryllidaceae. It has been traditionally used to manage various infections and health disorders. Garlic contains several biologically active compounds, particularly sulfur-containing compounds such as allicin, ajoene, diallyl sulfide and diallyl disulfide.. Among these, allicin is particularly important. When garlic tissue is overwhelmed, the enzyme alliinase converts allicin to allicin. Allicin is chemically unstable and can subsequently form a wide variety of organic sulfur compounds [1].For generations, humans have cultivated garlic (Allium sativum L.), a large bulb within the Amaryllidaceae family, for both culinary and medicinal purposes and is now cultivated throughout the international region, believed to have originated in Central Asia. In traditional medicine, garlic has been used to treat many diseases, such as inflammatory diseases, digestive disorders, infections, and cardiovascular diseases [2,13].The many bioactive compounds in garlic, with sulfur-containing compounds, phenolics, flavonoids, saponins, enzymes, nutrients, minerals, generally pay for their medicinal properties among the additives are allene, allicin, azoene, other sulfides and other compounds are especially important for white garlic it huge biological effect on the chemical composition and biological interest of garlic extracts, as the majority of these chemical compounds are detectable under processing and storage conditions [2,10,13].Extraction is therefore an important step in observing and being aware of the therapeutic properties of garlic. Garlic bioactive components have been extracted using many strategies including aqueous, ethanol, methanol, hydroalcohol, solvent-based extraction procedures The yield and focus of active chemical compounds can be induced through solvent, extraction temperature, time, pH, and processing conditions [1,5].Garlic has gained particular interest for its broad-spectrum antibacterial activity. Many gram-positive and gram-negative bacteria, as well as certain fungi and other

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INTRODUCTION

2. METHODS

This review was prepared by searching electronic databases including PubMed, Scopus, Google Scholar, and ScienceDirect. Keywords used were Allium sativum, garlic, extraction, antimicrobial activity, allicin, and sulfur compounds. . . . Articles published in English between 1999 and 2024 that specifically included garlic extraction methods, phytochemicals, and antimicrobial results were cited along with relevant authoritative research articles, overview articles, and books. Data extraction included information on absorption and distribution, plant taxa, morphology, phytochemicals, extraction procedures, antimicrobial testing methods, kinetic mechanisms, and substances of interest .

2.1 Origin and Distribution .

The origin of garlic has been a topic of conversation for a long time, despite its large cultivation in ancient times. Some resources offer a Mediterranean origin, others offer Central Asia since the primary starting point. The plant is handed over to the United States within the 15th century. Garlic is widely used in European, Asian, and African cuisines, both as a spice and as a medicinal component in traditional and current health practices [10,13].

2.2 Biological Sources and Classification .

The biological supply and taxonomic classes of Allium sativum are given in Table 1 .
<<Table 1>>

2.3 Morphology of garlic

Garlic is a perennial or biennial bulbous herb that is commonly grown as an annual crop. The tubers are usually round or barely flat, and have many nails. Each nail is surrounded by a thin protective coating. The leaves are long, narrow and flattened. The plant develops a fibrous root system. Depending on the species, the size, color, appearance, and chemical composition of the bulbs and nails can vary markedly [10,13].

Three. Phytochemicals

Garlic carries several companies of phytochemicals:
1. Sulfur compounds: allene, allicin, azoene, dialyl sulfide and dialyl disulfide [3].
2. Flavonoids and phenolic compounds contribute to both antioxidants and various biological compounds

4.1 Preparation of Garlic

Fresh garlic bulbs are cleaned, and the outer skin is removed. The nails are washed and dried. Nails can then be crushed or homogenized before extraction [9].
Four.2 Solvent Removal
Crushed garlic can be extracted using solvents such as ethanol, methanol, and water, depending on the objective of observation. The plant material is mixed with the selected solvent and appropriate extraction procedures including crushing are performed. The extract is then filtered and concentrated [9].
4.Three aqueous extraction
Fresh garlic can be extracted with distilled water . . This method is simple and avoids the use of organic solvents. However, the stability of allicin and other compounds should be considered because they can change rapidly after crushing [9].

4.4 Alcoholic Extraction

Ethanolic or methanolic extract can contain a range of bioactive compounds. Alcoholic extraction is commonly investigated when

studying the antimicrobial properties of plant extracts [9].

4.5 Cultivation of Garlic Plant

Garlic is one of the plants that is easy to grow, as it can be grown throughout the year in areas with a temperate climate. The hard-necked garlic is among the most sensitive species to the length of the day compared to other types and strains of garlic. In a cold climate, garlic cloves are planted for propagation during the autumn season before the time of freezing and cooling of the soil. About six weeks after that, the crop is harvested for the period from before the end of spring until the beginning of summer. Garlic plants are planted close to each other, either in the designated soil or in the bulbs. Large bulbs are obtained by planting the lobes in their designated place, and the necessity to leave sufficient distances between them [2,10].

5. ANTIMICROBIAL ACTIVITY

Garlic extracts have demonstrated antimicrobial effects against a variety of microorganisms. Reported activity includes inhibition of several Gram-positive bacteria and Gram-negative bacteria [1,5,6,8,12].

5.1 Methods for Evaluation of Antimicrobial Activity

The antimicrobial effect can be evaluated using laboratory methods such as:
- Agar well diffusion method
- Disc diffusion method
- Broth dilution method
- Minimum inhibitory concentration (MIC) determination

In diffusion methods, the antimicrobial activity is commonly expressed by measuring the zone of inhibition surrounding the sample [5].

5.2 Mechanism of Antimicrobial Action

The antimicrobial activity of garlic is primarily due to organosulfur compounds, particularly allicin. Allicin can react with sulfhydryl (-SH) groups present in important microbial proteins and enzymes. This can interfere with cellular metabolism and other essential functions of microorganisms [1,3,12].
The proposed sequential mechanism is: Garlic (Allium sativum) → Crushing/cutting of garlic → Alliin + Alliinase → Allicin formation → Penetration into microbial cell → Reaction with cysteine/thiol (-SH) groups → Inactivation of essential enzymes + depletion of cellular thiols → Disruption of RNA synthesis, metabolism, and redox balance → Inhibition of growth / microbial cell death.
<<Figure 1: Mechanism of antimicrobial action of Allium sativum>>

5.3 Factors Affecting Antimicrobial Activity

The antimicrobial activity of garlic extract can be influenced by [8,9,10]:
- Garlic variety and age
- Freshness of the plant material
- Crushing or processing method
- Extraction solvent
- Extraction time and temperature
- Concentration of the extract
- Stability of allicin
- Type of microorganism tested
- Storage conditions

5.4 Advantages of Garlic as Antimicrobial Agent

- Natural source of antimicrobial compounds [2]
- Easily available and relatively inexpensive [2]
- Contains multiple biologically active constituents [5,8]
- Useful for research into plant-derived antimicrobial agents [5]

. RESULTS AND DISCUSSION

The literature reviewed indicates that allicin, which is produced when cells are disrupted, is the main source of the medicinal effect of garlic (Allium sativum), a powerful natural antibacterial. The choice of solvent (alcoholic vs. aqueous) and the stability of sulfur compounds against degradation determine how effective garlic extracts are. Although garlic-based solutions are effective against a wide range of bacteria, standardization is essential for reliable antimicrobial outcomes.
Aqueous extracts are simple and avoid organic solvents but suffer from rapid allicin degradation. Alcoholic extracts (ethanol, methanol) generally yield higher concentrations of bioactive organosulfur compounds and are more commonly used in antimicrobial studies. Evaluation methods such as disc diffusion, well diffusion, and broth dilution remain standard for determining zone of inhibition and MIC. The thiol-reactive nature of allicin provides a broad-spectrum mechanism distinct from conventional antibiotics, supporting its potential as an adjunct or alternative in the era of antimicrobial resistance.

CONCLUSION

Garlic (Allium sativum) is a medicinal plant containing several important sulfur-containing compounds with antimicrobial properties. Allicin, formed following crushing of garlic, is one of the principal compounds associated with this activity. Different extraction methods can produce extracts with varying antimicrobial effects. Overall, garlic represents a promising natural source for antimicrobial research, although standardized extraction procedures, controlled laboratory studies, toxicity evaluation, and clinical investigation are necessary before therapeutic applications can be established.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Ankri S, Mirelman D. Antimicrobial properties of allicin from garlic. Microbes Infect. 1999;1(2):125-129.
2. Bayan L, Koulivand PH, Gorji A. Garlic: a review of potential therapeutic effects. Avicenna J Phytomed. 2014;4(1):1-14.
3. Borlinghaus J, Albrecht F, Gruhlke MCH, Nwachukwu ID, Slusarenko AJ. Allicin: chemistry and biological properties. Molecules. 2014;19(8):12591-12618.
4. hang A, Cao SY, Xu XY, et al. Bioactive compounds and biological functions of garlic (Allium sativum L.). Foods. 2019;8(7):246.
5. Bar M, et al. Methods of isolation of active substances from garlic (Allium sativum L.) and its impact on the composition and biological properties of garlic extracts. Antioxidants. 2022;11(7):1345.
6. Fujisawa H, Watanabe K, Suma K, et al. Antibacterial potential of garlic-derived allicin and its cancellation by sulfhydryl compounds. Biosci Biotechnol Biochem. 2009;73(9):1948-1955.
7. Kyung KH. Antimicrobial properties of garlic (Allium species). In: Garlic consumption and health. Nova Science Publishers; 2011.
8. Goncalves S, et al. Phytochemical characterization and antimicrobial activity of several Allium extracts. 2023. [Preprint]
9. Percival SS. Aged garlic extract modifies human immunity. J Nutr. 2016;146(2):433S-436S.

10. Rahman K. Garlic and aging: new insights into an old remedy. Ageing Res Rev. 2003;2(1):39-56.
11. Borlinghaus J, et al. Antimicrobial properties of hydrophobic compounds in garlic: allicin, vinyldithiin, ajoene and diallyl polysulfides. Front Microbiol. 2020.
12. Loi VV, Rossius M, Antelmann H. Redox regulation of protein cysteine thiol modifications by the reactive sulfur species allicin. Free Radic Biol Med. [Year];[Volume].
13. [13] Shadkchan Y, et al. An overview of the antimicrobial properties of allicin and its breakdown products. Mycoses. 2004.

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TABLES AND FIGURES

Table 1: Biological Source and Classification of Allium sativum

CLASSIFICATION	DESCRIPTION
Biological source	Bulb of Allium sativum L
Family	Amaryllidaceae
Common name	Garlic
Part used	Bulb/clove
Kingdom	Plantae
Sub kingdom	Viridian Plantae
Class	Magnoliopsida
Genus / Species	Allium / Allium sativum

Figure 1: Mechanism of action for the antimicrobial effect of garlic (Allium sativum) - flow diagram from crushing to microbial cell death

Figure 2: Morphology of garlic bulb and cloves (to be inserted - 300 dpi JPEG/TIF)