Section: Research Paper

Garlic (*Allium sativum L.*): A review of its Biological properties and potential medicinal Uses

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Abstract

Garlic is a spice and a microorganism-controlling agent. According to recent studies, the extract of garlic is antibacterial against various organisms, such as fungi and bacterial against various organisms, such as fungi and bacteria. The active ingredient, allicin, has been identified. Garlic's broad-spectrum medicinal potential comes from its ability to kill beneficial bacteria. Additionally, garlic plants may help suppress germs that are pathogenic in the environment. Garlic (*Allium sativum L. fam. Alliaceae)* is a well-studied herbal remedy that also has culinary and culinary-seasoning applications. Garlic comprises enzymes like allinase, sulfur-containing substances like alliin, and allicin, which is formed enzymatically from alliin. Many diseases and conditions, including illnesses, injuries, diarrhea, arthritis, cardiovascular disease, and diabetes, have traditionally been treated with this method. Garlic has been shown to offer a variety of health benefits in laboratory settings, including as an antibiotic, blood pressure regulator, heart protector, cholesterol reducer, cancer fighter, immune system booster, and hypoglycemic. Garlic is being tested for elevated blood pressure, hypercholesterolemia, type 2 diabetes, artery disease, and reducing the risk of cancer. Possible benefits in terms of lowering cholesterol and blood pressure, preventing blood clots, and shielding against cancer have all been the subject of these thorough studies. Allergies to garlic are rare.

Key words: Garlic, Antibaterial, Allicin, Immune booster, Arthritis

Introduction

The plant species *Allium sativum L.*, which belongs to the *Alliaceae* group and is often known as garlic, has been historically revered for its culinary and medicinal uses. The ancient word 'all', signifying pungent, might have given garlic its name. Although now grown virtually everywhere, garlic is thought to have been first produced in Central Asia prior to making its way to China, the Near East, the Mediterranean basin, and eventually Western Europe, Southern Africa, and Mexico (1). Garlic has been used medicinally for millions of years. Sanskrit writings date its medical use to 5,000 years ago, while Chinese medicine has employed it for 3,000 years. The Egyptians, Babylonians, Greeks, and Italians all used garlic to make themselves healthier. In 1858, Pasteur discovered garlic's antibacterial qualities, which were used to avoid gangrene during World Wars I and II. Garlic is utilized to lower levels of blood pressure and lipids, fight bacteria, and prevent cancer. Heterogeneous compounds of sulfur are rapidly absorbed, changed, and processed as active substances. Garlic decreases the amount of total cholesterol by 10% and improves HDL/LDL ratios, according to many randomized studies. Garlic is also a mild antihypertensive that decreases arterial pressure by 5–7%, according to controlled experiments. Garlic reduces endothelial clots by inhibiting the aggregation of platelets and increasing fibrinolytic action. In vitro results imply antibacterial activity, but human experiments have not been conducted (2).

Garlic cultivation is of global importance among Allium species. Dehydrated garlic is a flavor and a cooking ingredient. This article covers plant growth physiological science, bulb and flowering production, and winter. Garlic is sterile and naturally propagated, so it's anticipated to have little between-species variation. Winter lows vernalize subtropical garlic seedlings. Garlic bulb and flower growth are complexly affected by external variables. Inflorescence production is inhibited by short photoperiods following introduction. Short photoperiods greatly limit stockpiling-leaf production, which favors inflorescence development and increases flushing. The bloom's development is greatly influenced by post-induction conditions (3).

Garlic's (*Allium Sativum*) disease fighting properties

Garlic can cure multiple illnesses by reducing the growth of germs and fungi. Over 3,000 years ago, garlic (*Allium sativum*) was used in cardiac therapy. Garlic lowers triglycerides in animals, according to numerous studies. The enzyme alliinase forms allicin from allin while fresh garlic is pulverized. Research from science supports garlic's antidiabetic, antimicrobial, and perhaps cancer-fighting abilities. Garlic is hepatoprotective, antihelmintic, and an antioxidant. Garlic heals wounds, coagulates, fights inflammation, and modulates the immune system (4).

1.Antimicrobial

Garlic has been widely used for its medicinal uses, but its method of working is now being studied. Along with its positive effects on the cardiovascular system and immunity, garlic offers

a long list of medical characteristics, particularly those that kill viruses, microorganisms, and parasites. Physiological studies and the identification of many new drugs have increased as herbal treatments have gained more acceptance. This overview covers garlic's past uses and sulfur biochemistry to prepare for future research into its antibacterial effects. Garlic is widely used for its medicinal benefits, but its method of working has only recently been studied. Along with its positive effects on the cardiovascular system and immunity, garlic offers a long list of medical characteristics, particularly those that kill viruses, bacteria, fungi, and protozoa. Biomedical studies and the identification of many new drugs have increased as herbal treatments have become increasingly common. This paper discusses garlic's sulfur biochemistry and prior uses to prepare for further Garlic antimicrobial research (5).

1.1 Antibacterial properties.

The allicin in garlic

Over 100 years prior, garlic clove water extractions yielded many allyl sulfates. Cavallito and the others didn't wait until 1944 (6). In 1947, diallyl disulfide's mild oxidation created allicin, revealing its atomic structure. This substance gives mashed garlic cloves their outstanding antimicrobial powers (7). After the clover's Latin name, Allium sativum, scientists dubbed the oxygenation sulfur component allicin. Pure allicin tastes like garlic and miscibles badly when immersed in water (8). An oxygen-filledfromulfuric acid protein, which stoll and seebeck recognized, produced, and named alliin (9). To resolve the debate over whether or not allicin is present in annihilated cloves but not in unscented unaltered cloves, is found in considerable amounts in garlic. Garlic's digestive enzyme alliinase transforms the compound alliin into allicin (10).

Raw garlic homogenates contain antimicrobial allicin. Investigations with pure allicin have shown antimicrobial properties against a wide variety of microorganisms, such as multiple-drug-enterotoxicogenic varieties of E. coli; antifungal properties, especially for Candida albicans; antiparasitic action, such as for certain significant intestinal organisms that are protozoan organisms like Entamoeba histolytica and Giardia lamblia; and antiviral effects. The thiol chains of many digestive enzymes, including ethanol dehydrogenase, a substance called reduction, and RNA polymerase, may be chemically reactive with allicin, which may alter the essential digestion of cysteine amino acids related to the E. coli structure or improve its virulence (11).

Antibacterial properties of Allicin

Garlic is known for its antibacterial properties. Garlic preparations have been shown to be effective against a wide range of microorganisms, including both gram-negative and gram-positive bacteria and pathogens. Garlic kills M. TB and other acid-fast bacteria (12). Allicin's antibacterial effects are broad. Most drugs had higher than 50% deadly dosages. Allicin has been

shown to be effective against resistant antibiotic isolates of Escherichia coli, Enterococcus, Shigella dysenteriae, Shigella flexneri, and Shigella sonnei, in addition to Staphylococcus aureus, which is methicillin-resistant. S. flexneri Y was suppressed by allicin in the rabbit model of experimental shigellosis. Allicin failed to kill mucoid P. aeruginosa, Bacteria hemolyticus, and enteric faecium strains. The reason is unknown. It is thought that hydrophilic capsular or mucoid layers stop allicin from getting into yeast, but this needs more research (13).

1.2 Antiviral

Natural garlic extracts' main active component, allicin, fights viruses in vitro and in vivo. Garlic extracts have been shown to be effective against a wide variety of viruses, including human cytomegalovirus, influenza B, shingles viruses types 1 and 2, parainfluenza viruses types 1 and 3, vaccinia virus, vesicular stomatitis virus, and rhinovirus type 2 (14). Allicin's presently-condensing derivative, ajoene, acts as an antiviral. HIV-infected cells' center-dependent activities are inhibited by ajoene (15).

1.3 Antifungal

Mycotoxins such as aflatoxin are suppressed by garlic extracts (16). Allicin's minimal inhibitory dosage is 7 g/mL (17). Yamada and Azuma discovered that concentrations of 1.57–6.25 g/mL of pure allicin were sufficient to prevent the growth of Candida, Cryptococcus, Trichophyton, Epidermophyton, and Microsporum. Allicin inhibits hyphae and the development of spores (18).

1.4 Anti parasites

Many ancient cultures knew of garlic's antiparasitic properties. Freshly minced garlic was used by Albert Schweizer to cure diarrhea and intestinal worms. Traditional Chinese medicine treats digestive problems with an alcoholic garlic clove extract. After years of research, we found that the human intestinal protozoan parasite, known as Entamoeba histolytica, is especially vulnerable to allicin, with as little as 30 g/mL fully suppressing protozoan development (19). Other parasitic infections' growth was also inhibited by allicin at 30 g/mL (Mirelman et al., unpublished data), including Giardia lamblia, Leishmania major, Leptomonas colosoma, and Crithidia fasciculata. Allicin above 100 M damaged mammalian tumor-cultured cells (20).

Natural remedies are being used to treat oxidative stress, heart disease, cancer, and immunological dysfunction. Conventional therapies are being used more due to positive scientific evidence. Garlic has been used therapeutically throughout history. Garlic scavenges free radicals, protects membranes, and preserves cell viability. The heart is protected from atherosclerosis by decreasing lipids, arterial pressure, which is known to inhibit platelet activity, and thrombotic formation (21).

Several factors, including the induction of phase I and phase II enzymes for detoxification, the generation of reactive oxygen species (ROS), and the mitigation of harm to DNA, have all played a role. Garlic induces the growth of lymphocytes and the killing of macrophages, which releases interleukin-2, necroses tumors by factor-alpha and igf-gamma, and boosts natural killer cells, preventing immune system restriction that increases cancer risk. The next section focuses on the cardioprotective, chemopreventive, and immune-modulatory properties of garlic (22).

Antioxidant ROS oxidize DNA, proteins, and lipids, causing aging illnesses such as cardiovascular, neurological, inflammatory, and cancer. Fresh garlic extracts that are aged to create AGE counteract this oxidative damage. Allixin and selenium are just two of the polyphenols and organic sulfur compounds (OSCs) found in garlic extracts, but there are many more. Garlic extracts left to age for up to 20 months benefit from a transformation in their volatile oxidative components, such as allicin, into more durable and accessible water-soluble OSCs, such as S-allylcysteine and S-allylmercaptocysteine. The anti-inflammatory effects of AGE arise from its ability to scavenge reactive oxygen species (ROS), its ability to increase intracellular enzymes that protect cells like catalase, superoxide dismutase, and peroxidase glutathione, and its ability to raise cytoplasmic thiol amounts.AGE reduces ischaemic/reperfusion damage, the peroxidation of lipids, and LDL Oxidation (23).

2. Cardioprotective

2.1Antihypertensive

According to epidemiological research, a stroke and CHD are linked to high arterial pressure. Nutraceuticals and functional meals are being considered as hypertension treatments. This is for pre-hypertensive people with slightly elevated blood pressure but not high enough to require treatment (24).

Garlic extract's sodium pump activation in the kidneys lowers intracellular Na+ and normalizes Hypertension. Garlic can treat hypertension despite these consequences (25).

In anesthetized normotensive rats, intravenous garlic extract caused dose-related, transient dehydrated and bradycardic responses (26).

2.2Antiatherosclerotic

Prospective epidemiological research has revealed several heart disease risk factors, most of which can be threat reduction-focused. ASCVD is a particularly frequent risk factor. Understanding of ASCVD's pathophysiology and etiology has grown significantly. No studies have shown garlic's capacity to inhibit atherosclerosis, even though it is utilized to treat ASCVD (27). An elevated cholesterol level has been known to cause arteries for ages. Thus, reducing cholesterol can significantly reduce heart attack risk. Recent research reveals LDL oxidation is a major cause of atherosclerosis. Oxidized LDL directly damages endothelial cells, causing

vascular dysfunction. Short-term intake of garlic in humans also boosts LDL oxidation resistance. These findings show that reduced LDL oxidation may contribute to garlic's anti-atherosclerotic effects (28).

2.3Anti-thrombotic

Many intricate mechanisms contribute to platelet collection, which is a factor in cardiovascular disease. Garlic inhibits cyclooxygenase activity and thromboxane A2 production, preventing platelet aggregation. It suppresses intraplatelet Ca2+ mobilization and increases cAMP and cGMP. Garlic increases platelet-derived NO due to its antioxidant effects and NOS stimulation. It can also directly interact with GPIIb and IIIa receptors to reduce platelet binding to fibrinogen. Garlic can avert coronary artery disease by decreasing the formation of platelets via different mechanisms. (29).

2.4 Lipid Lowering

Hyperlipidemia is a primary cause of atherosclerosis. Garlic's fatty acid-lowering and antiatherogenic properties are well established, but its method of action is unknown. garlic-based OSC. Protein internal disulfide causes the OSC's antiatherogenic activity, according to researchers. This reduces the activity of proteins belonging to the thiol (-SH) group, including the reductase HMG-CoA and the multi enzyme complexity involved in fatty acids production. These chemicals may also block carcinogen-activating enzymes (30).

3.Antidiabetic

Type 2 diabetes causes chronic harm to the urinary tract, pupils, nerve endings, circulation, skin, and synapses. Heart attack and stroke indicators include high total lipids (LDL for short), LDL oxidation, accumulation of platelets, diabetes, high blood pressure, and smoking. Garlic reduces these parameters in vitro, according to many studies. Garlic inhibits ACE, the production of lipid enzymes, the accumulation of platelets, the lipid peroxidation of oxidized erythrocytes and LDL, and the oxidative state and diabetes (31).

4. Anticancer

Verifying phytochemical supplements' biological effects and correlative processes is crucial for expanding their use as cancer chemotherapy avoidance or adjuvant medications. Allium crops and their components, allylsulfides and flavonoids, which are ant carcinogenic, Epidemiological investigations, show that allium compounds reduce the risk of cancer. Epidemiological findings match result from laboratories (32).

5.Neuroprotective

Hypertension and gradual kidney damage are linked to oxidative and nitrosative stress. S-allylcysteine (SAC), the most prevalent AGE ODC, is an antioxidant. In nephrectomized animals administered daily with SAC (200 mg/kg ip) and AG (1.2 mL/kg ip), blood pressure, damage to

the kidneys, oxidative, and nitrosative stress were examined. In addition to enhancing SOD activity, SAC and AGE lowered high blood pressure, renal damage, and inducible NOS. SAC's and AGE's antioxidant activities may explain their antihypertensive and renoprotective actions. They can reduce pressure and slow kidney damage (33).

6.Immunomodulatory

BCG treatment and garlic share several effects. Both stimulate the lymphocytes and macrophages phagocytosis. They cause monocyte and lymphocyte overgrowth in transplanted tumors. Both cause splenic enlargement and produce TNF-alpha, igf-gamma, or IL-2 are three examples. They increase the function of target cells, including lymphokine-activated suppressor cells and naturally occurring killer cells. These activities effectively stimulate the immunological response. Garlic may reduce the risk of cancer by reducing immunological suppression. Immune activation may reduce cancer risk. Garlic's immunological activation and other benefits may reduce cancer risk, but this should be tested clinically (34).

7. Anti-aging

Over the last 10–15 years, garlic has been widely researched for healing a wide range of diseases, particularly aging. Its high level of antioxidants may decrease heart illness, accumulation of platelets, coagulation, malignancy, cognitive deterioration, osteoarthritis, growth of cataracts, renew the epidermis, promote circulatory health, and boost vitality. Long-term conditions associated with aging may be prevented or delayed by the powerful antioxidants in garlic (35).

8. Hepatic Protection

Garlic oil protected animals against damage to the liver by increasing hepatooxidative activity, blocking 1,3-dichloro-2-propanol stimulation of metabolism, and reducing hepatic mortality (36). DAS, DADS, and S-methyl-l-cysteine, garlic's constituents, can prevent and treat both acute and ongoing ethyl alcohol-induced damage to the liver (37). Garlic basic oil's DADS decreased nonalcoholic fat liver disorders in obese rats. DADS reduced liver cytokines associated with inflammation and increased antioxidant capacity by inhibiting cytochrome P450 2E1 (38).

The effects of Garlic

Garlic's organosulfur components, including allicin and its byproducts, have significant medicinal properties. Plant-based nutraceutical uses depend on organosulfur substances such as allicin, diallyl disulfide, S-allylcysteine, and the compound diallyl trisulfide. Garlic, a bulb-like vegetable, is employed to season food. Taste and digestion are improved by garlic. Garlic contains several healthy vitamins, acids, and phytochemicals. It has nutrients: sweetness,

carbohydrates, fats, protein, magnesium, phosphorus, potassium, magnesium, sulfuric acid, salt, cellulose, and quartz. Quite healthy. Asthma, bronchitis, persistent high temperatures, pneumonia, allergies, the illness, stubborn infections of the skin like leukoderma, fading of the epidermis and drips, vomiting, diarrhea, discomfort, and your liver expanding are just some of the various illnesses that cloves of garlic possess medicine impacts on and is utilized for treatment (39).

Discussion

Cardiovascular and cancer research have dominated for the past 15–20 decades. Most cardiovascular research has focused on atherosclerosis, serum cholesterol, LDL, HDL, and triglycerides. In patients with high cholesterol and triglycerides, garlic may lower them. The dosage, standardization of garlic formulations, and therapy duration varied across trials. Garlic reduces serum lipids, which may slow atherosclerosis. In addition, extensive in vitro and in vivo research has examined its antithrombotic effects. The discovery that garlic extracts inhibit adenosine deaminase and cyclic AMP phosphodiesterase is intriguing. This may affect the body's pharmacology. Garlic enzyme inhibitors may explain its antithrombotic, vasodilators, and anticancer properties. Epidemiological studies show that garlic reduces malignant illness fatalities. Thus, garlic and its constituents were researched to determine their anticancer and cytotoxic properties via in vitro studies in animals. Garlic might contain anticancer and ant carcinogenic chemicals, based on this research. Epidemiological, medical, and laboratory research shows that garlic has a number of parts that are important to the body's physiology and to the way, drugs work. Cardiovascular, neoplastic, and other disorders benefit from these. Numerous investigations are underway worldwide to create odorless garlic formulations and isolate therapeutically relevant active components (40).

Conclusion

Garlic (*Allium sativum L.*) has been extensively used for a variety of physiological purposes from the beginning of time. Its physiologically active parts determine nutrition usage. European cuisine uses it as an herb or spice. It also has significant therapeutic actions against numerous life-threatening illnesses and conditions. In this overview, garlic's medicinal and culinary uses are briefly covered. Garlic should be consumed as frequently as feasible since it supports the wellness of people, according to the aforementioned statistics.

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