GARLIC (*Allium sativum* Linn.) AS A NUTRACEUTICAL: REVISITING THE POTENTIAL THERAPEUTIC EFFECTS IN HEALTH AND DISEASES

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ABSTRACT
Garlic (*Allium sativum* Linn.) is one of the oldest authenticated herb with a long history of use throughout the world for both its culinary and therapeutic properties. The use of garlic in food was well documented by many civilizations including Chinese, Greeks, Romans, Egyptians and Babylonians. It has been reported that garlic as a dietary component may reduce the risk of cardiovascular disease. Organosulfur compounds present in garlic have also been known to possess antithrombotic, lipid-lowering, antioxidative, hypocholesterolemic, anticancer, and anti-inflammatory activities and it combat viral respiratory infections by modulating immune system. Garlic also enhances the fibrinolytic process which results in dissociation of clots and thrombi. The anti-hypertensive action of garlic by lowering peripheral resistance is also reported. It is also proved to have an antiosteoporotic potentiality in hypogonadal conditions. Antioxidants present in garlic may protect against neuronal cell damage and reduce the risk of Alzheimer’s disease and dementia. Aged garlic extract also has the potential to ameliorate experimentally induced lead and arsenic toxicity in animal model. By reducing oxidative stress and suppressing inflammatory cytokines through activation of Nrf2 garlic principles could ameliorate gentamicin-induced nephrotoxicity in wistar rats. The phytoactive/phytotherapeutic principles present in garlic which act as nutraceuticals proved immense importance as biomedical remedy since ancient times up to ongoing Covid 19 pandemic period. This review describes the wide therapeutic approach of this traditional
medicinal herb and its experimental evidences in the context of modern medicine and future therapeutics.

**KEYWORDS:** Garlic, Organosulfur, Cholesterol, Anti-viral, Phytoestrogen.

**INTRODUCTION**

Indian bio-resources, food culture and ethnicity are exclusively dynamic, spanning back to the beginning of human civilization. Spices play a vital role in Indian cuisine since very long time. Spices brings out the unique natural taste, aroma and taste of foods. Garlic is widely used as seasoning for food dishes all over in India. Though garlic is widely used as an herb or spice, it is botanically a vegetable. It is an aromatic bulbous perennial food plant of the botanical family Liliaceae. It grows wild almost everywhere in the world. There are different types or subspecies of garlic, most notably hardneck garlic and softneck garlic. Garlic is a common ingredient of food and had been used for its medicinal properties since the days of the pharaohs. The Chinese have used garlic to heal for over 3000 years and Sanskrit records document its use as far back as 5000 years ago. Through the long period of history, a pattern of effective uses of garlic emerged which served to guide modern researchers in the 20th century. It is most often used as a seasoning or a condiment and is believed to have some medicinal value, notably against hypertension.

**Composition of Garlic**

Garlic contains alliin, ajoene, carbohydrates like sucrose, glucose, enzymes such as allinase, peroxidase and miracynase, Vitamin B, Vitamin C, folic acid, pantothenic acid, niacin, fructose, glucose, minerals (mainly: manganese, potassium, calcium, phosphorus and magnesium, selenium, sodium, iron, zinc and copper in minor quantities), amino acids eg, glutamic acid, arginine, aspartic acid, leucine, lysine, valine, isoleucine, phytoestrogens eg., lignin and quercetin.\(^\text{[1,2]}\) Plenteous attention has been given to its main bioactive compounds, particularly polyphenols, flavonoids, flavanols, tannins, saponins, polysaccharides, sulfur-containing compounds (including alliin, allicin, ajoene, allylpropyl disulfide, DATS, S-allylcysteine (SAC), vinylthiins, and other compounds, such as β-phellandrene, phellandrene, citral, linalool, and geraniol. There are more than twenty well-known polyphenolic compounds in garlic, including kaempferol 3,7-di-O-rhamnoside, kaempferol-3 glucuronide, kaempferol-3-O-glucoside, kaempferol-3-O-beta-d-glucoside-7-O-alpha-L-rhamnoside, luteoline, and apigenine.\(^\text{[3]}\)
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**Organosulfur Compounds from Garlic**

Two classes of organosulfur compounds are found in whole garlic cloves: 1) gamma-glutamylcysteines and 2) cysteine sulfoxides. Allylcysteine sulfoxide (Alliin) accounts for approximately 80% of the cysteine sulfoxides in garlic. When raw garlic cloves are crushed, chopped or chewed, enzymes known as allinase are released. Allinase catalyzes the formation of sulfenic acids from cysteine sulfoxides. Sulfenic acids spontaneously react with each other to form unstable compounds called thiosulfinates. In the case of alliin, the resulting sulfenic acids react with each other to form a thiosulfinate known as allicin. Allicin is a very unstable compound that is formed from alliin by alliinase upon crushing fresh garlic. It can be rearranged to produce diallyl sulfides, dithiins, and ajoene. Allicin has been determined to be the agent behind the spiciness of raw garlic. The chemical opens thermo TRP (transient receptor potential) channels which are responsible for the sense of noxious heat in foods. The formation of thiosulfinates is very rapid and has been found to be complete within 10 to 60 seconds of crushing garlic. Allicin breaks down to form a variety of fat-soluble organosulfur compounds including diallyl sulphide (DAS), diallyl disulfide (DADS) and diallyl trisulfide (DATS) or in the presence of oil, ajoene and vinyl dithins. Crushed garlic does not change its gamma glutamyl cysteine. Another extensively studied garlic preparation is aged garlic extract (AGE). Sliced raw garlic stored in 15-20% ethanol for more than 1.5 year is refereed to aged garlic extract. This whole process is supposed to cause considerable loss of allicin and increased activity of certain newer compounds, such as S-allyl cysteine, S-allyl mercaptocysteine, allixin, N-0-(Ideoxy- D-fructos- -yl)-L-arginine, and selenium which are stable and significantly antioxidant. Medicinally used, garlic oil is mostly prepared by steam-distillation process. Steam-distilled garlic oil consists of the diallyl, allylmethyl, and dimethyl mono to hexasulfides.

**GARLIC’S HEALTH BENEFITS**

Garlic is claimed to have many significant medicinal benefits. Garlic is of substantial value in few primary areas: as preventive of cardiovascular/circulatory disease, as an anti-infective /bacteriocide, as an anti-cancer, as an antioxidant and as a phytoestrogen. Various in vitro and in vivo studies have showed that garlic compounds are able to modulate various signaling pathways, including nuclear factor-κB, matrix metalloproteinases, nuclear factor erythroid 2 like 2, protein kinase B (pAkt), mitogen-activated protein kinase, c-Jun N-terminal kinases, caspases, p38, transforming growth factor beta 1 (TGF-β1), TGF-β type II receptor, psmad2/3, smad4 and smad7, cytokines, intercellular adhesion molecule, notch pathway,
5’ AMP-activated protein kinase pathway, vascular endothelial growth factor\textsuperscript{[9]}, cyclooxygenase 2, inducible nitric oxide synthase leading to improved anti-inflammatory and antioxidant properties, as well as chemopreventive and antiproliferative effects.\textsuperscript{[6,10]} However, it should be taken into account that these compounds have a very low availability.

**Hypocholesterolemic/Hypolipidemic Activity of Garlic**

Garlic have both hypocholesterolemic and hypolipidemic effects. Allyl propyl disulphide (C\textsubscript{3}H\textsubscript{5}-S-S-C\textsubscript{3}H\textsubscript{5}) and diallyl disulphide (C\textsubscript{3}H\textsubscript{5}-S-S-C\textsubscript{3}H\textsubscript{5}) the two unsaturated oils present in garlic have potent lipid reducing action.\textsuperscript{[11]} The organic disulphides present in the two oils are good acceptors of hydrogen and are supposed to be metabolized in the liver utilizing NADPH. Thus the availability of NADPH for fatty acid biosynthesis is decreased by the hepatic metabolism of garlic principles. The organic disulphides could also inactivate thiol group enzymes like HMG-CoA reductase and CoASH, the rate limiting enzyme for cholesterol biosynthesis and the multi-enzyme complex for fatty acid biosynthesis respectively.\textsuperscript{[12,13]} The antiatherogenic effects of the lipid soluble organosulphur compounds from garlic can be attributed to reactions that inhibit HMG-CoA reductase and other lipogenic enzymes.\textsuperscript{[14]} Among water-soluble compounds, S-allyl cysteine (SAC), S-ethylcysteine (SEC), and S-propylcysteine (SPC) could inhibit cholesterol synthesis by 40-60% compared with 20-35% by gamma-glutamyl-S-allylcysteine (GSAC), gamma-glutamyl-S-methylcysteine (GSMC) and gamma-glutamyl-S-propylcysteine (GSPC). Lipid-soluble sulfur compounds (i.e., diallyl sulfide, diallyl disulfide, diallyl trisulfide, dipropyl sulfide and dipropyl trisulfide) at low concentrations (0.05-0.5 mol/L) slightly (10-15%) inhibited cholesterol synthesis but became highly cytotoxic at high concentrations (1.0-4.0 mol/L). All water-soluble compounds, except S-allylmercaptocysteine, are not cytotoxic, considering from the release of cellular lactate dehydrogenase into the culture medium.\textsuperscript{[15]} Enteric-coated garlic powder supplements with 9.6 mg allicin-releasing potential may have value in mild to moderate hypercholesterolemic patients when combined with a low fat diet. The efficacy of garlic for lipoprotein metabolism might require increased allicin bioavailability that could be enhanced through an enteric-coated dose.\textsuperscript{[16]} Also a variety of garlic-derived organosulfur compounds have been found to inhibit platelet aggregation in vitro.\textsuperscript{[17]}

**Anti-diabetic Activity of Garlic**

Garlic has been proved to decrease the pancreatic cell injury, oxidative stress, and pathological changes in streptomycin-induced type 1 diabetic rats.\textsuperscript{[18]} AGE had a dose-
dependent anti-diabetic effect on streptomycin-induced diabetic rats.\textsuperscript{[19]} A meta-analysis performed on 768 patients with type 2 diabetes mellitus in nine randomized controlled trials showed that garlic supplements significantly reduced fructosamine and glycosylated hemoglobin in diabetic patients. This study demonstrated that garlic supplements were effective in the management of type 2 diabetes mellitus.\textsuperscript{[20]} Thus, garlic and its bioactive components might be effective agents to help treat diabetes and diabetic complications.

**Anti-inflammatory Activity of Garlic**

Garlic derived organosulfur compounds have been found to inhibit the activity of the inflammatory enzymes, cyclooxygenase and lipoxygenase \textit{in vitro} and to decrease the expression of inducible nitric oxide synthase (iNOS) in inflammatory macrophages.\textsuperscript{[21]} Organosulfur compounds of garlic have also been found to decrease the production of inflammatory signalling molecules in cultured macrophages\textsuperscript{[22]} and human whole blood.\textsuperscript{[23]} Garlic extract could also suppress the production of leukocyte inflammatory cytokines such as tumor necrosis factor-\(\alpha\) (TNF-\(\alpha\)), interleukin (IL)-1\(\alpha\), IL-6, and interferon-\(\gamma\) \textit{in vitro} and act as a therapeutic potential in the treatment of inflammatory bowel disease.\textsuperscript{[24]} The lipid-soluble sulfur compounds allicin and diallyl disulfide also repress NF-\(\kappa\)B and turn down the expression of inducible nitric oxide (NO) synthase (iNOS) in LPS-stimulated macrophages.\textsuperscript{[25]} It was also reported that garlic extract exerted anti-inflammatory activity by inhibiting Toll-like receptor-mediated signaling pathways at the receptor level.\textsuperscript{[26]} Toll like receptors play a key role in sensing diverse microbial products and inducing innate immune responses. Result of experimental studies confirmed that Ethyl acetate fraction of garlic inhibited the LPS-induced dimerization of TLR4, followed by inhibition of NF-kappaB activation and the expression of cyclooxygenase 2 and inducible nitric oxide synthase.\textsuperscript{[26]} In a murine macrophages cell line infected with \textit{Leishmania} aged garlic extract (AGE) induced IL-12 production\textsuperscript{[27]} and, in addition, INF-\(\gamma\) and inducible nitric oxide synthase (iNOS) were overexpressed.\textsuperscript{[27]} Nevertheless, in peripheral blood monocytes, AGE upregulated IL-10 and diminished IL-12 production\textsuperscript{[24]}, which might cause downregulation of proinflammatory cytokines TNF-\(\alpha\), IL-6, INF-\(\gamma\), and IL-2 by T cells which acts as negative feedback in the signaling proinflammatory response.\textsuperscript{[24,28]} In a study for evaluation of the effects of DADS on airway inflammation using an ovalbumin-induced model of allergic asthma and RAW264.7 cells, DADS decreased nitric oxide production with a reduction in the levels of interleukins (IL)-1\(\beta\) and IL-6 in RAW264.7 cells stimulated with LPS. DADS also decreased the expression of proinflammatory proteins including inducible nitric oxide synthase (iNOS),
nuclear factor (NF)-κB, and matrix metalloproteinase (MMP)-9, where as the expression of antioxidant proteins including Nrf-2 and hemeoxygenase (HO)-1 are increased. In *in vivo* experiments, DADS decreased the inflammatory cell count in the bronchoalveolar lavage fluid (BALF) with IL-4, IL-5, IL-13, and immunoglobulin E. DADS showed its capability in attenuating the airway inflammation and mucus hypersecretion induced by ovalbumin (OVA) challenge.\(^{[28]}\)

**Anti-oxidant Activity of Garlic**

Anti-oxidant properties have also been attributed to garlic principles.\(^{[29]}\) The use of garlic as a traditional medicine to prevent inflammation and cellular oxidative stress has been well documented. It is effective to prevent or ameliorate oxidative stress probably through its intrinsic antioxidant properties and/or to its ability to modify antioxidant enzyme expression. Chronic oral administration of raw garlic has been reported to augment myocardial endogenous antioxidants.\(^{[30]}\) Aged garlic extract (AGE), have also shown to have promising antioxidant potential. However, raw garlic homogenate had been reported to exert antioxidant potential but at higher doses it was toxic to the heart, liver and kidney.\(^{[31]}\) Diallyl disulphide (DADS) protects gentamicin induced nephropathy in rats through amelioration of oxidative stress and preservation of the activity of the antioxidant enzymes in kidney.\(^{[32]}\) In some oxidant stress damage conditions, alliin could also act as an important inhibitor by reducing reactive oxygen species (ROS) and inhibiting the MAP kinase.\(^{[33]}\)

**Antibiotic Activity of Garlic**

Garlic has long been known to have potent antibacterial properties. Garlic extract inhibits the growth of oral pathogens and certain proteases and so may have therapeutic value particularly for periodontitis.\(^{[34]}\) Garlic cloves continue to be used as a remedy for infections (especially chest problems like pulmonary tuberculosis or phthisis), digestive disorders and fungal infections such as thrush. Whole clove used as suppositories are sometimes used as a home remedy for bacterial vaginosis. Recent studies have confirmed allicin’s efficacy against many bacteria including *Staphylococcus aureus*, *Escherichia coli*, *Proteus vulgaris*, *Salmonella enteriditis*, *Citrobacter species*, *Klebsiella pneumonia* and mycobacteria. Garlic has been used as a folk remedy for many decades to protect against the flu and common cold viruses. Garlic proved its effectiveness against nosocomial strains that frequently display above average resistance to many antibiotics. Garlic has been proven to be a natural antibiotic against Methicillin-resistant *Staphylococcus aureus* (MRSA). Fresh garlic extract, DAS,
DAD impart protective activity against MRSA by affecting the pathogen distribution and plasma titre of pro-inflammatory cytokines, endothelial injury-associated proteins and coagulation and anti-coagulation factors as well as tissue lipid peroxidation. Fresh garlic extract may be used to aid the treatment of infections from multi-drug resistant strains.\[^{35}\]

**Anti-viral Activity of Garlic**

Allicin and other numerous sulphur compounds present in garlic could kill the Herpes simplex virus types I and II (those responsible for oral and genital herpes), various flu viruses, influenza B, HIV (type 1), vesicular stomatitis virus, coxsackievirus species, and gammaretrovirus.\[^{36,37}\] Some organosulfars of garlic have shown to prevent viral hepatitis in a number of preclinical studies. In one randomized double blinded clinical trial the hepatoprotective effects together with safety and acceptability of an oral capsule containing garlic oil with dimethyl-4,4'-dimethoxy-5,6,5',6'-dimethylene dioxybiphenyl-2,2'-dicarboxylate (DDB) in chronic hepatitis patients was reported.\[^{38}\] Pre-clinical data suggests that garlic and its organosulfar compounds have potent antiviral activity against different human, animal and plant pathogenic viruses through obstructing viral entry into host cells, inhibiting viral RNA polymerase, reverse transcriptase, DNA synthesis and immediate-early gene I (IEG1) transcription. These compounds are also able to downregulate the extracellular-signal-regulated kinase (ERK)/mitogen activated protein kinase (MAPK) signaling pathway.\[^{36}\] Molecular docking analysis proved that alliin has much higher anti-viral potential to prevent Covid-19. This bioactive component alone or in adjunct with other therapeutic drug could be an effective remedy to eradicate SARS-CoV-2 with the lowest side effects and toxicity.\[^{39,40}\] Quercetin could also inhibit protease present in SARS-CoV-1 during the multiplication in host cells via blocking the viral attachment stage.\[^{41}\] Randomized clinical trials on different commercial garlic preparations also showed that garlic plays a significant therapeutic role in various viral infections such as cold and flu, viral-associated warts, as well as immune enhancing activity in viral infected patients. Research shows that crude garlic extract and its organosulfar compounds exert their antiviral activity through interaction with the viral cell surface molecule and subsequently repress viral entry into host cells.\[^{42}\] Aqueous garlic extract in gold nanoparticles significantly inhibit measles virus infection in VERO cells with an EC\(_{50}\) 0.01 mg/ml.\[^{42}\] The virucidal activity of GE in gold nanoparticles was due to the interaction with the negatively charged viral surface receptor which blocked viral entry into the host cells.\[^{42}\]
Anti-fungal Activity of Garlic

Antifungal activity of various *Allium sativum* Linn. extracts namely aqueous, ethanolic, methanolic, and petroleum ether against human pathogenic fungi such are *Trichophyton verrucosum*, *T. mentagrophytes*, *T. rubrum*, *Botrytis cinerea*, *Candida* species, *Epidermophyton floccosum*, *Aspergillus niger*, *A. flavus*, *Rhizopus stolonifer*, *Microsporum gypseum*, *M. audouinii*, *Alternaria alternate*, *Neofabraea alba*, and *Penicillium expansum* are widely reported. Garlic extract causes irreversible ultrastructural changes in the fungal cell wall which leads to loss of structural integrity and germination inability. Allicin and garlic oil proved to be potent antifungal against *Candida albicans*, *Ascosphaera apis*. Garlic could penetrate the cellular membrane as well as organelles membranes like the mitochondria membranes causing organelles destruction and cell death. Substantial changes in antioxidant metabolites and antioxidant activity in the presence of DADS were found in *C. albicans* and *C. Tropicalis*. Also High zones of inhibition were noted with ethanol extracts of garlic tested against dermatophytes, saprophytes, and Candida species isolated from infected hospitalized patients.

Anti-cancer Activity of Garlic

S-allylcysteine sulfoxide (alliin), allicin, diallyl disulphide (DADS), S-allylcysteine (SAC) and several storage dipeptides are the organo-sulphur compounds involved in the protective mechanism of garlic against carcinogenesis (Arnault, 2005). It is suggested that the anticarcinogenic effects of garlic compounds may be due to inhibitory reactions on enzymes that activate carcinogens. An investigation revealed that garlic extract has chemopreventive potential against cyclophosphamide (CP), a well known mutagen induced chromosomal mutations in Swiss albino mice. Diallyl disulphide (DADS), Diallyl trisulphide (DATS), ajoene and S-allylmercaptocysteine (SAMC) have been found to induce cell cycle arrest when added to various cancer cells in cell culture. Allicin, ajoene, diallyl sulphide, DADS, DATS and SAMC also have been found to induce apoptosis when added to various cancer cell lines grown in culture. Diallyl disulphide (DADS) has been known to exert potent chemopreventive activity against colon, lung and skin cancers (Kwon et al., 2002). DADS induced apoptosis is triggered by the generation of hydrogen peroxide, activation of caspase -3, degradation of poly (ADP ribose) polymerase (PARP) and fragmentation of DNA.
Neuroprotective role of Garlic

Emerging evidence suggests that aged garlic extract (AGE) attenuates the oxidative damage and neuroinflammation underlying a variety of neurological diseases, such as Alzheimer's disease (AD) as well as other age-related neurodegenerative disorders. A study revealed that AGE and its carbohydrate derivative N-α-(1-deoxy-D-fructos-1-yl)-L-arginine could alleviate neuroinflammation by inhibiting the production of NO and regulating the expression of multiple protein targets related to oxidative stress in lipopolysaccharide-activated murine BV-2 microglial cells. In another study, the anti-neuritis activity of garlic was highly related to the organosulfur compounds in lipopolysaccharide-stimulated BV2 microglia cells.

Aged garlic extract (AGE) and S-allylcysteine (SAC) have been proved to be protective in neuronal cells against beta amyloid toxicity and apoptosis. β Amyloid (Aβ) induces local ROS formation and induces neurotoxicity to hippocampal cells. Aβ also induces the expression of the 78-kDa glucose-regulated protein (GRP-78), a molecular chaperone that regulates protein folding and translocation into the endoplasmic reticulum (ER), as well as the activation of caspase-12 present in the ER. SAC has been shown to decrease the levels of ROS and its neuroprotective effects are mediated predominantly through the caspase-12-dependent pathway in a concentration-dependent manner, but it does not prevent the 4-hydroxynonenal-induced death of hippocampal neurons, which suggest that SAC exerts a unique effect on the ER and can protect against neuronal cell death that is initiated by ER dysfunction in the rat hippocampus.

Garlic was also proved to be neuroprotective against cadmium induced neurotoxicity as reflected in the activities of Acetylcholine Esterase (Ach E), superoxide dismutase (SOD), catalase (CAT), membrane bound Na +/K+ ATPase, Mg2+ ATPase, Ca2+ ATPase in brain tissues of rat. In a separate study, garlic extract activated Na+/K+ ATPase, Ca2+ ATPase, and glutamine synthetase in the hippocampus of diabetic Wistar rats.

Phytoestrogenic Activity of Garlic

Phytoestrogens or plant estrogens are very weak estrogens that occur naturally in many foods. The chemical structure of these estrogens (phenolic estrogens) is similar but not identical to the estrogens produced by the body. Garlic was found to be a substantial contributor of phytoestrogen. It is considered as a dietary source of lignin (Hernandez et al., 2004) and quercetin (Sengupta et al., 2003), which are types of phytoestrogen.
Antiosteoporotic Activity of Garlic

Bone remodelling is a continuous dynamic process coupled by bone resorption of osteoclasts and bone deposition by osteoblast cells. Osteoclasts are the multinucleated giant bone cells responsible for resorbing bone matrix by secreting hydrogen ions and lysosomal enzymes like Cathepsin K and collagen dissolution protease. In a resorption pit assay Alliin inhibited RANKL-induced osteoclastogenesis through scavenging ROS by inhibiting Nox1. In a mouse model of LPS-induced calvarial osteolysis, DADS reduced the LPS induced bone erosion and TRAP positive multinucleated osteoclasts. In this particular model DADS also decreased the proinflammatory cytokines, including IL-1β, IL-6, TNF-α, and NO, which are known to promote and enhance osteoclastogenesis. Allicin also showed significant enhanced collagen formation in vivo. In vivo data from micro-CT and histologic analysis similarly demonstrated the protective effects of DADS against LPS-induced osteolysis. DADS is able to down-regulate the expression of the osteoclast marker genes including TRAP, CTR, MMP9 and CTSK as well as NFATc1 and c-Fos during the course of osteoclast formation and maturation in a dose-dependent manner. DADS could suppress RANKL-induced osteoclast formation and function by suppression of NF-κB and STAT3 signal pathways. In rat model of estrogen insufficiency, oil extract of garlic was effective in preventing bone loss by modulating activities of serum alkaline phosphatase, serum tartrate resistant acid phosphatase, urinary ca: cr and these markers are highly related with type I collagen degradation, bone resorption and increased osteoclastic activity. In the same model of hypogonadal osteoporosis phytoestrogenic active principles of garlic increased the serum estrogen titer by stimulating the extragonadal estrogen synthesis which possibly blocks the demineralization capacity of osteoclasts and preserve bone mass and skeletal health. Also garlic supplementation for 12 weeks might reduce pain severity in overweight or obese women with knee osteoarthritis, which may, at least in part, be mediated via a reduction in the pro-inflammatory adipocytokine, resistin.

CONCLUSION

Garlic and garlic supplements are consumed in many cultures for their hypolipidemic, antiplatelet and procirculatory effects. Allium sativum is a potential nutraceutical and functional food well-known for its immunomodulatory, antimicrobial, anti-inflammatory, antimutagenic, antitumor properties. From ancient times till Covid 19 pandemic this condiment proved its disease preventing efficacy in animal studies, cell lines and also in human subjects. It is believed to be a safe substance, still practicable clinical trials and
research is required to identify possible side effects in any health condition. Long term trials including human subjects are required for using this condiment in different diseases in proper doses considering the bio availability of the active substances present.

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