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From The Kitchen tothe Medication-Role of Garlic in Oral and Systemic Health

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Abstract: *The trend of these days is to combat various diseases using complementary and alternative healing mechanisms.Dental or oral diseases are being found to be effectively managed by these modalities.Phytotherapy or use of herbs and medicinal plants is in the forefront.Many of the ingredients in our food,the ones that we see in the kitchen like garlic,ginger,turmeric,cloveetc has found to have immense health benefits.This review focus on the use of Garlic against oral and systemic pathogens*
Keywords:*Garlic,Allicin,Oralhealth,Alliumsativum*

I. Introduction

Numerous studies have suggested that there is a strong association between oral and systemic health. The health status is showing a declining trend in developing countries because of the lower socioeconomic status.[1]With the rise in disease incidence resistant pathogenic bacteria, opportunistic infections tend to be on the high and people are always thinking about various alternative way of combating infections.[2]Numerous number of plants have been identified and umpteen number of studies have been carried out.Garlic is one among such plants.[3]With its high trace mineral content and enzymes, sulfur containing compounds, garlic has shown anti-viral, anti-bacterial, anti-fungal and antioxidant abilities.Garlic is found to have action against Gram positive and Gram negative organisms like Klebsiellapneumonia,Mycobacterium Tuberculosis and Pseudomonas aeroginosa[4]

Garlic

Garlic otherwise known as Allium sativum, is a species in the onion genus from Liliaceae family. Garlic is grown globally, but China is by far the largest producer of garlic followed by India, South Korea, Spain, and the United States.Garlic is a perennial plant with white, starry flowers and bulb clusters of individual teardrop shaped cloves encased in dry skin-like papers that unite to create the bulb. The garlic bulb is the part of the plant most often used as flavoring agent and medicinal herb. Garlic can be eaten raw, chopped, minced, or juiced. It has a characteristic pungent, spicy flavor that mellows and sweetens considerably with cooking.

History

` Sanskrit records from approximately 5000 years ago, describe the use of garlic remedies. Chinese, Egyptian, and Greek documents from Hippocrates, Aristotle and Pliny cite numerous therapeutic uses for garlic. In 1844 Theodor Wertheim, a German chemist, distilled a pungent substance from garlic and called it allyl, the Latin name for garlic. Four years later, Louis Pasteur in Paris showed that allyl could inhibit the growth of bacteria. This was a great discovery because 150 years ago, doctors had nothing to eradicate bacteria. .Garlic was used as a remedy for intestinal disorders, flatulence, worms, respiratory infections, skin diseases, wounds, symptoms of aging and many other ailments[5]

Chemistry: The chemistry of garlic is quite complex and clinical pharmacological properties of garlic have been extensively studied. Whole garlic cloves are intact bulbs that contain an odorless, sulfur-containing amino acid derivative, a covalently bonded compound with the chemical formula C6 H11 NO3 S. The primary sulfur-containing constituents in whole, intact garlic are the glutamylcysteines and S allyl cysteine sulfoxides, including alliin.[6]When the bulb is crushed or cut, alliin is altered by the enzyme, alliinase and is converted into allicin. Allicin (C6 H10 O2 S) is an oily, yellow liquid that gives garlic its characteristic odor.[7]Typical volatiles in crushed garlic and garlic essential oil include diallylsulfide (DAS), diallyldisulfide (DADS), diallyltrisulfide, methyl allyldisulfide, methyl allyltrisulfide, 2-vinyl-1,3- dithiin, 3-vinyl-1,2-dithiin (Fenwick and Hanley 1985) and ajoene (Block et al. 1984). At the same time, glutamylcysteines are converted to S-allylcysteine (SAC) via a pathway other than the alliin/allicin pathway. SAC contributes heavily to the health benefits of garlic.[8,9]

Structure fig 1 chemical structure of intact garlic

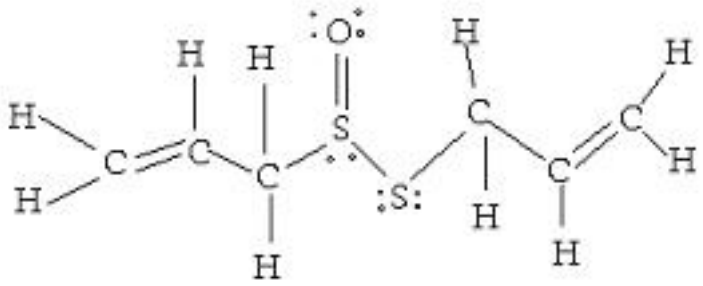

Fig 2 Allium sativum

II. Antimicrobial Activity Of Garlic Against Oral Bacteria:

Cavallito and Bailey[10] confirmed that allicin is primarily responsible for the antimicrobial action of garlic. Its main mechanism of action is by blocking thiol-containing enzymes, including cysteine proteases and alcoholdehydrogenases.[11,12] Cysteine proteinase enzymes are among the main culprits in infection, providing infectious organisms with the means to damage and invade tissues. Alcohol dehydrogenase enzymes play a major role in these harmful organisms' metabolism and survival. The active component of garlic extract, allicin partially inhibits DNA and protein synthesis, and entirely inhibits RNA synthesis. Ghannoum MA[13] described marked inhibitory effect of garlic against C. albicans.Bakri IM[14] reported that garlic extract was slow and less active against oral Gram-positive species when compared to a range of Gram-negative species. This difference between gram negative and gram positive organisms is due to inability of garlic extract to invade the thick peptidoglycan layer in the Gram positive cell envelope. Garlic extract has shown to have a wide spectrum of antibacterial activity, including effects on, Staphylococcus, Streptococcus, Klebsiella, Escherichia, Salmonella,Proteus, Clostridium, Mycobacterium and Helicobacter[15,16] species.Groppo FC[17] et al demonstrated that a mouth wash containing garlic extract was more effective at reducing the total salivary bacterial count and the streptococcal mutans count. According to some investigators garlic was effective against antibiotic resistant organisms.[18] On the other hand; some investigators have demonstrated that certain mucoid bacterial strains were discovered to be resistant to allicin. Due to unidentified reasons, it was assumed that penetration of allicin into the bacteria was restrained by hydrophilic capsular or mucoid layers.[19]

Garlic extract was sensitive particularly to P.gingivlais, P.Intermedia, A. actinomycetemcomitans, F. nucleatum and had lower minimum inhibitory concentration (MICs) and minimum bactericidal concentration (MBCs) than the other gram negative organisms tested. Trypsin like activity and total protease activity are almost completely inhibited by garlic extract, apparently through allicin's affinity for thiol groups.

Antifungal Activity :

Bakri IM[14] et al confirmed the antifungal activity of garlic against C. albicans described by Ghannoum MA .[13]Ledezma et al demonstrated that ajoene , an active compound in garlic may play a role as a topical fungal agent.[20]

Antioxidant Activity:

Oxidative stress is recognized as one of the pathogenic mechanisms of chronic inflammatory diseases, including cardiovascular disorders and cancer. Consequently, compounds with antioxidant properties may be used to prevent oxidative stress-mediated diseases.[21]

Antioxidant properties of garlic have been demonstrated in animal disease models. Aqueous garlic extract reduces oxidative stress and prevents vascular remodeling by suppressing NAD(P)H-oxidase in the fructose-induced metabolic syndrome model in rats.[22] SAC also reduces lipid peroxidation and superoxide radical production, and elevates Cu-Zn-superoxide dismutase activity in 1-methyl-4-phenylpyridinium-induced Parkinsonism in mice[23] .Various study results suggest that garlic has potent antioxidant activity in delaying the onset and development of chronic inflammatory diseases, including cardiovascular disorders, diabetes cancer, and neurodegenerative diseases caused by an imbalance between free radical production and antioxidant defenses.

Anti-Inflammatory Activity:

Agarwal et al demonstrated suppression of the nuclear factor-kappaB activation pathway and inflammatory prostaglandins thus establishing anti-inflammatory activity of garlic.[24]

Antimutagenic Activity

Garlic has known to possess anticancer activity because of its various effects on biological pathways. These include free radical scavenging, inhibition of mutagenesis and effects on cell proliferation and tumor growth. Garlic and its organosulphur compounds modulate the activity of several metabolising enzymes that activate (cytochrome P450s) or detoxify (glutathione S-transferases) carcinogens and inhibit the formation of DNA adducts in several target tissues.[25] Numerous studies have established the role of garlic in cancer prevention particularly in relation to digestive tract cancers, including esophageal and stomach cancers.[26]

Immunomodulatory Activity

Sufficient evidences suggest that garlic may have significant enhancing effects on the immune system. Extensive studies are conducted on animals, in vitro and in vivo. However, the human studies that have been conducted are encouraging. Abdullah TH et al[27] demonstrated positive effects on immunoreactions and increase in the percentage of phagocytosing peripheral granulocytes and monocytes on using an alliin standardised garlic powder preparation. Another human study conducted on AIDS patients with an unrefined garlic extract (5-10 g/day) demonstrated a major increase in the percentage of natural killer cell activity

Antiviral Activity:

Many investigators have demonstrated antiviral activity against human cytomegalovirus, influenza virus type 3, vaccine virus, vesicular stomatitis virus and human rhinovirus type 2.[28]

Therapeutic Applications In Dentistry :

This potent anti- inflammatory, antioxidant, antibacterial effect and immunomodulatory effect of garlic suggest that it has a therapeutic potential in different oral diseases. Garlic produced a significant reduction in the inflammatory infiltrate and potentially inhibited innate immune response associated with periodontal diseases thus suggesting a therapeutic potential in this chronic inflammatory condition. Garlic can be used as a mouth wash, sub gingival irrigant and as a component in local drug delivery system. It has a great role in the treatment of periodontal diseases.[29]

Drug Interactions: Few authors have suggested that garlic affects the drug metabolism and alters their pharmacokinetics. It has been hypothesized that garlic organosulfur compounds may be able to prevent glutathione depletion, a compound necessary for liver detoxification. Sabayanet al[30] demonstrated that garlic provides protection againstreactive oxygen species-induced stress on liver function. Sener et al[31] showed that aged garlic can reverse oxidant effects of nicotine toxicity in rats. Maldonado et al [32] showed that aged garlic extract, do not interfere with the antibiotic activity of gentamycin but may improve gentamycin -induced nephrotoxicity. However, as results remain inconsistent and contradictory more well-designed studies are necessary to clarify whether garlic affects the metabolism of drugs and alters their pharmacokinetics

Adverse Effects : Garlic is generally considered safe but a commonly associated side effect with garlic intake is halitosis, especially when raw forms of the herbs are used. However, Mitchell reported that the odor is decreased when garlic is taken before meals.[33]Odorless garlic formulations are available. However, odorlessgarlic is often prepared either by adding chemical substances to mask the odor or by cooking the garlic, which may destroy some of the active ingredients. Other side effects include nausea and gastric irritation. Although rare, garlic allergy has been attributed to the protein alliinlyase, which has induced IgEmediated hypersensitivity responses from skin prick testing [34.] Saw et al warned not to use garlic while on anticoagulant therapy as garlic has been associated with decreased platelet aggregation and bleeding events[35].

III. Conclusion

Garlic was one of the essential elements of many of our delicacies.It has evolved from kitchen to medicinal value against oral pathogens. The therapeutic properties of garlic have been known to mankind for ages. Garlic and its compounds have been found to attack multiple targets, which provide the basis for their effectiveness in many different diseases. However, the results observed in human clinical and intervention studies have been inconsistent and the risk of garlic drug interactions is attracting increasing interest. Therefore more experiments are necessary to recognize the definite health benefits of garlic. By looking back into history we can apply some old world uses of garlic for new ways to improve oral and overall health.As in most of the cases going back to the green is the watchword in this regard

References

[1]. L. M. Jamieson, E. J. Parker, and J. M. Indigenous child oral health at a regional and state level. Journal of Paediatrics and Child Health 2007; 43: 117–121.
[2]. Tichy J, Novak J. Extraction, assay, and analysis of antimicrobials from plants with activity against dental pathogens (Streptococcus sp.) J Altern Complement Med 1998;4: 39 – 45.
[3]. G. R. Prabu, A. Gnanamani, and S. Sadulla .Guaijaverin — A plant flavonoid as potential antiplaque agent against Streptococcus mutans. J ApplMicrobiol 2006;101:487–495.
[4]. Fani MM, Kohanteb J, Dayaghi M. Inhibitory activity of garlic (Allium sativum) extract on multidrug-resistant Streptococcus mutans. J Indian SocPedodontPrev Dent 2007; 25: 164 – 168.
[5]. Amagase H, Petesch BL, Matsuura H, Kasugai S and Itakura Y. Recent Advances on the Nutritional Effects Associated with the Use of Garlic as a Supplement. J. Nutr 2001; 131: 955–962.
[6]. Lawson LD. Garlic: the science and therapeutic application of Allium sativum L. and related species. In: HP Koch, LD Lawson editors. The composition and chemistry of garlic cloves and processed garlic 2nded. Williams and Wilkins, Baltimore 1996;pp38-39.
[7]. Willis E. Enzyme inhibition by allicin, the active principle of garlic. Biochem J 1956;63:514-20.
[8]. Stoll AE. Seebeck Chemical investigations on alliin, the specific principle of garlic. AdvEnzymol 1951;11:377-400.
[9]. Ankri SD. Antimicrobial properties of allicin from garlic. Microbes Infect 1999;1:125-29.
[10]. Block E. The chemistry of garlic and onions. Sic Am 1985; 252: 114– 119
[11]. Ankri S, Miron T, Rabinkov A, Wilechek M, Mirelman D. Allicin from garlic strongly inhibits cysteine proteinases and cytophathic effects of Entamoebahistolytica. Antimicrob Agents Chemother 1997;41: 2286—8.
[12]. Rabinkov A, Miron T, Konstantinovski L, Wichek M, Mirelman D, Weiner L. The mode of action of allic: trapping of radicals and interaction with thiol-containing proteins. BiochimBiophysActa 1998;1379: 233—44.
[13]. Ghannoum MA. Inhibition of Candida adhesion to buccal epithelial cells by an aqueous extract of Allium sativum (garlic). J ApplBacteriol 1990; 68: 163—9
[14]. Bakri IM, Douglas CWI. Inhibitory effect of garlic extract on oral bacteria. Arch of Oral Biol 2005; 50: 645—651
[15]. Agarwal KC. Therapeutic actions of garlic constituents. Medical Research Reviews 1996;16:111–24.
[16]. Hogg Jennifer. UK Medicines Information Complementary Medicines Summary, "Garlic Supplements". [Serial on the Internet]. Available At http://www.ukmi.nhs.uk/Med_info/documents/GarlicSupps
[17]. Groppo FC, Ramacciato JC, Simoes RP, Florio FM, Sartoratto A. Antimicrobial activity of garlic, tea tree oil, and chlorhexidine against oral microorganisms. Int Dent J 2002; 52:433—7
[18]. Sivam GP. Protection against Helicobacter pylori and other bacterial infection by garlic. J Nutr 2001;131: 1106 – 1108.
[19]. AnkriS, Mirelman D. Antimicrobial properties of allicin from garlic. Microbes Infect 1999;2: 125 – 129.
[20]. Ledezma E, Apitz-Castro R. Ajoene the main active compound of garlic (Allium sativum): a new antifungal agent. Rev IberoamMicol 2006;23:75-80
[21]. Mayne ST. Antioxidant nutrients and chronic disease: use of biomarkers of exposure and oxidative stress status in epidemiologic research. J Nutr 2003;133(Suppl. 3):933-940.
[22]. Vazquez-Prieto MA, Gonzalez RE, Renna NF, Galmarini CR, Miatello RM. Aqueous garlic extracts prevent oxidative stress and vascular remodeling in an experimental model of metabolic syndrome. J Agric Food Chem 2010; 58: 630-635.
[23]. Jones W, Goebel RJ. "Garlic and Health". In Watson RR. Vegetables, Fruits, and Herbs in Health Promotion. Boca Raton: CRC Press 2001;pp205-16.
[24]. Aggarwal BB, Shishodia S. Suppression of the nuclear factor-kappaB activation pathway by spice-derived phytochemicals: reasoning for seasoning. Ann N Y AcadSci 2004; 1030: 434-441.
[25]. Hassan. HT. Ajoene (natural garlic compound): A new anti-leukemia agent for AML therapy. Leuk Research 2004; 28: 667-671.
[26]. Berspalov VG, Shcherbakov AM, Kalinovskii VP, Novik VI, Chepik OF, Aleksandrov VA, Sobenin IA, Orekhov AN. Study of the antioxidant drug "Karinat" in patients with chronic atrophic gastritis. VoprOnkol 2004; 50: 81-85.
[27]. Abdullah TH, Kirkpatrick DH, Carter J.Enhancement of Natural Killer Cell activity in AIDS patients. D Z Onkologie. 21: 52-53
[28]. AnkriS, Mirelman D. Antimicrobial properties of allicin from garlic. Microbes Infect 1999;2: 125 – 129
[29]. Hahn G. Garlic: the science and therapeutic application of Allium sativum L. and related species. In: HP Koch, LD Lawson editors. History, folk medicine and legendary uses of garlic. 2nd ed. Williams and Wilkins, Baltimore; 1996:pp 1-24
[30]. Sabayan B, Foroughinia F, Chohedry A. A postulated role of garlic organosulfur compounds in prevention of valproic acid hepatotoxicity. Med Hypotheses 2007; 68: 512-514.
[31]. Sener G, Sehirli AO, Ipci Y, Cetinel S, Cikler E, Gedik N. Chronic nicotine toxicity is prevented by aqueous garlic extract. Plant Foods Hum Nutr 2005; 60:77-86.
[32]. Maldonado PD, Chánez-Cárdenas ME, Pedraza-Chaverrí. J. Aged garlic extract, garlic powder extract, S-allylcysteine, diallylsulfide and diallyldisulfide do not interfere with the antibiotic activity of gentamicin. Phytother Res 2005;.19: 252-254.
[33]. Mitchell WA.Plant Medicine in practice – using the teachings of John Bastyr. 2003:149.
[34]. Kao S-H, Hsu C-H, Su SN, Hor WT, Chang WH, Chow LP. Identification and immunologic characterization of an allergen, alliinlyase, from garlic (Allium sativum). J Allergy ClinImmunol 2004;113: 161-168.
[35]. Saw JT, Bahari MB, Ang HH, Lim YH. Potential drug-herb interaction with antiplatelet/anticoagulant drugs. Complement TherClinPract 2006;12: 236-241.