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GARLIC AND ITS CONSTITUENTS: PHARMACOLOGICAL ACTION: A REVIEW

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ABSTRACT

Nowadays garlic plays an important role in many diseases so that it is used as a source of medicine in human beings. So that researches are directing their efforts to determine the medical values of garlic. One of the main active principles of crushed garlic is allicin (diallylthiosulfinate), which is a defence molecule from garlic (Allium sativum L.) with a broad range of biological activities. Garlic extract has antimicrobial activity against many genera of bacteria, fungi and viruses. The chemical constituents of garlic have also been investigated for treatment of cardiovascular disease, cancer, diabetes, blood pressure and hyperlipidaemia.

KEYWORDS

Allium sativum, Immunity booster, Cardiovascular, Antidiabetic, Antimicrobial, Antiviral and Antioxidant activities.

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INTRODUCTON

Garlic (Allium sativum) is used in food and pharmaceutical preparations. Gujarat and Madhya Pradesh are major producers of garlic in India. Oil is the three major classes of food substances; others are carbohydrates and protein. Garlic oils are mainly esters of glycerol and fatty acids, some oils are called trimester and its examples are triglycerides[1].

At room temperature garlic oils are mostly liquid in nature; this is because of the type of fatty acids they contain. More saturated fatty acid oils contain, the more solid it will be and the more unsaturated fatty acid the oils contain the more liquid it will be at room temperature. 28 volatile compounds by

capillary GC and GC-MS analysis was reported, from this 13 were reported for the first time. The volatile compounds suspended in the aqueous phase were also identified. The volatile components of crushed garlic of Mediterranean origin were analysed and three compounds namely, methyl-(Z)-prop-l-enyl disulphide, allyl-(Z)- prop-1-enyl disulphide and allyl-(E)-prop-1-enyl disulphide were identified for the first time[2].

The physical and chemical properties of garlic oils depend on the type of fatty acids in the glycerides. Most of the glycerides, fatty acids are straight chain and all contain even number of carbon atoms. Allicin is one of the major component of garlic. In the absence of active allinase enzyme allin is quite stable, and it can also be found in cooked garlic. It has been demonstrated as antioxidant activity. Allicin was discovered in 1944 by Cavallito *et al*., who first noted its potent antimicrobial activity. Allicin is produced by an enzymatic reaction when raw garlic is either crushed or injured. The enzyme allinase combined with Alliin and produces Allicin[3].

High-performance liquid chromatography (HPLC) having superior resolving power due to the high-pressure separation condition, it is the most preferred chromatographic technique for the separation of biological compounds[4]. The large amounts of endogenous ammonia in garlic tissue render its determination unattractive, however the measurement of pyruvic acid as an indicator of pungency and flavour in both onions and garlic[6].

Chemistry of allicin

Studies of Semmler established the importance of diallyl disulfide and diallyl trisulfide in flavor of garlic distillates. One of the most important biologically active compound of garlic is Allicin (diallyl-thiosulfinate). Allicin was discovered in 1944 by Cavallito and Bailey[7] and then Cavallito *et al*[7] first noted its potent antimicrobial activity. Structure of allicin is shown in Figure A. Allicin is not found in raw garlic and it will rapidly produce by the action allinase enzyme on alliin. The structure of alliin is shown in Figure B. Allinase enzyme will activate donly by crushing or grinding the garlic cloves[7-9] Allicin represents about 70% of the overall thiosulfinates present in the cloves upon mechanical crushing[10,11].

PHARMACOLOGICAL ACTIVITY OF ALLICIN AND OTHER COMPONENTS OF GARLIC

Cardiovascular Activity

Arteries, which supply the heart with blood and oxygen, become narrow and plaque builds up over time. When blood supply becomes restricted, a certain portion of the heart will not get sufficient oxygen and leads to heart attack. The two greatest means of heart disease are high blood pressure and high blood serum cholesterol levels.

In a study conducted in India, 432 coronary artery patients were randomly selected and grouped into 2 and half of them were supplied with garlic juice in milk and the other group patients were not supplied with garlic juice. From the result it shown that within the three years of the study time, many patients had died in the group not supplied with garlic juice[11]. It is well reported to scavenge oxidants, increase superoxide dismutase, catalase, glutathione peroxidase, glutathione levels, lipid peroxidation is inhibited and reduces cholesterol synthesis by inhibition of 3-hydroxy-3-methylglutaryl-Co A. It has been shown to reduce platelet aggregation, arterial plaque formation, decrease homocysteine, lower blood pressure, and increase microcirculation[12].

Immunity booster

Nowadays many viral diseases like HIV/AIDS is increasing day by day, boosting the immunity system is receiving a new attention. Because these diseases have no effective cures or treatments, strengthening the body's ability to fight against these infections has become even more important. Sulfur-containing amino acids are present in garlic and other compounds that seem to initiate increased activity in the immune system[13].

Preliminary studies in humans, using an alliin standardized garlic powder preparation shown positive effects on immunoreactions and phagocytosis. In aged, 600mg garlic powder per day for 3 months is administered which induced significant increase in phagocytosing peripheral

granulocytes and monocytes, for their ability to engulf Escherichia coli bacteria. Another human study was conducted with an unrefined garlic extract (5 to 12 g/day) which was given to HIV/AIDS patients. Seven patients are taken who completed the 12 weeks study, there was a major increase in the natural killer cells activity from a seriously low mean value[14].

Antidiabetic Activity

There is a number of animal studies which support the effectiveness of garlic in reducing blood glucose in streptozotocin-induced as well as alloxan-induced diabetes mellitus in mice. In this most of the studies proved that garlic can reduce blood glucose level in diabetic mice and rabbits[15]. A Study was conducted to evaluate the oral administration of garlic extract for 14 days on the level of total cholesterol, triglycerides, serum glucose, urea and uric acid, in normal as well as streptozotocin-induced diabetic mice. The result of the study showed significant decrease ($p<0.05$) in total cholesterol, triglycerides, serum glucose, urea, uric acid, aspartate amino transferase and alanine amino transferase levels, which increased serum insulin in diabetic mice, but not in normal mice. A comparison study was made between the action of garlic extract and glibenclamide, and from that anti diabetic effect of the garlic was found more effective than the that of glibenclamide[16].

Antimicrobial Activity

Pasteur (1958) described the antimicrobial properties of garlic for the first time, and since many researches had demonstrated its effectiveness and broad spectrum antimicrobial activity against many species of bacteria, fungi, viruses, protozoan and parasites[17]. Garlic is more effective and it is having least side effects as compared to commercial antibiotics; so that garlic is used as an alternative for treatment of various infections. Previously conducted researches confirmed that garlic is not only effective against Gram positive and Gram negative bacteria but also possess antiviral and antifungal activities[18.]

Antiviral Activity

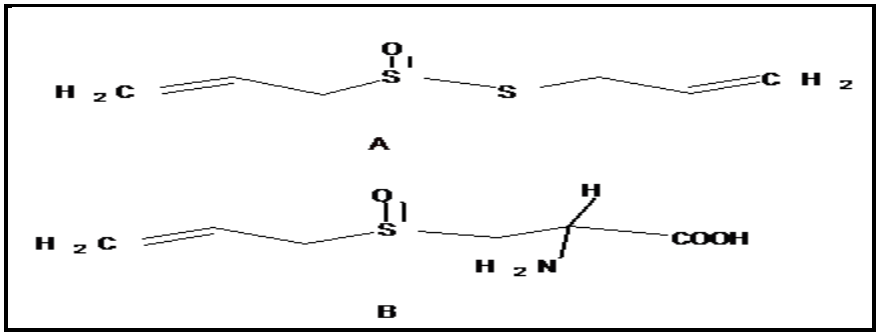
Fresh garlic extracts in which allicin is known to be the main active component have been shown both *in vitro* and *in vivo* antiviral activity. Viruses more sensitive to garlic extracts are the human cytomegalovirus, parainfluenza virus type 3, influenza B, herpes simplex virus type 1, herpes simplex virus type 2, vaccinia virus, human rhinovirus type 2 and vesicular stomatitis virus. The allicin condensation product, ajoene, seems to have in general more antiviral activity on comparision with allicin. Ajoene will block the integrin-dependent processes in a human immunodeficiency virus-infected cell system[18].

Antioxidant Activity

Whole aged and fresh garlic extracts exhibit direct antioxidant effects and it will enhance the serum levels of two antioxidant enzymes they are catalase and glutathione peroxidase[20]. Garlic extract, allicin is efficiently scavenging hydroxyl radicals in dose-dependent fashion, but their effective- ness was reduced about 12% by heating to 100°C for 20 min. Other garlic constituents such as S-allyl cysteine, also have significant antioxidant activity. The sulfur compounds found in fresh garlic appear to be nearly 1000 times more potent as antioxidants than aged extracts. Garlic was able to reduce the radicals present in cigarette smoke[21].

ADVERSE EFFECTS OF GARLIC

One of the main adverse effect commonly associated with intake of raw garlic is its breath odor. Nausea and vomiting are other major adverse effects and care should be taken in consuming high quantities of garlic. Also, the entire bulb produces little juice; it is potent and can act as a strong emetic. Although garlic generally poses little in terms of safety issues, there are isolated cases of topical garlic burns[22] and anaphylaxis. Very rare garlic allergy has been reported that protein allinase, it is having induced immunoglobulin E (IgE) mediated hypersensitivity responses from skin prick testing[23].



CONCLUSION

Allicin (diallyl-thiosulfinate), the most biologically active compound of garlic was discovered in 1944, and it is noted for its potent antimicrobial activity. Traditionally, many cultures used garlic for its different biological and medicinal effects. Although garlic is believed to be a safe substance, long-term trials of reasonable duration would provide insights into the possible side-effects of garlic extracts. Safety of garlic should be tested especially in pregnant or breastfeeding women as well as in young children. It believed that garlic helps in pregnancy that the fetus will receives weight[24]. Long-term and large trials are also needed to evaluate the differences in mortality, serious adverse events, and morbidity of cancer and cardiovascular diseases after garlic therapy.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

BIBILIOGRAPHY

1. Bagudo B U, Acheme O D. Chemical analysis of locally cultivated garlic and it's oil, *Der Chemica Sinica,* 5(1), 2014, 128-134.
2. Prabhakara Rao P G, Jaganmohan Rao L, Ragi-iavan B. Chemical composition of Essential oils of Garlic (Allium sativum L.), *Journal of Spices and Aromatic Crops,* 8(1), 1999, 41-47.
3. Mohammad J. Abdul Ghani. Determination of Alliin and Allicin in different types Garlic using High Performance Liquid Chromatography, *J. of university of anbar for pure science,* 4(2), 2010, 1-8.
4. Nishu Sekar *et al*. Determination of Allicin in Allium sativum using High performance liquid chromatography and Study of Genotoxic effect on Human Leukocytes, *Asian journal pharmaceutical and clinical research,* 8(6), 2015, 153-156.

5. Gupta Rainy, Sharma Amita, Maina Preeti, Shukla R N. Study of Chemical composition of garlic oil and comparative analysis of Co-trimoxazole in response to *In Vitro* Antibacterial activity, *International Research Journal of Pharmacy,* 5(2), 2014, 97-101.
6. Dethier B, Nott K, Fauconnier M L. (BIO) Synthesis, Extraction And Purification Of Garlic Derivatives Showing Therapeutic Properties, *Comm. Appl. Biol. Sci, XX/X,* 78(1), 2013, 178-189
7. Cavallito C J, Bailey J H. Allicin, the Antibacterial Principle of Allium Sativum. I. Isolation, *Physical Properties and Antibacterial Action. J. Am. Chem. Soc,* 66(11), 1944, 1950-1951.
8. Block E. The Chemistry of Garlic and Onions, *Sci. Am,* 252(3), 1985, 114-119.
9. Caporaso N, Smith S M, Eng R H K. Antifungal Activity in Human Urine and Serum after Ingestion of Garlic (Allium Sativum), *Antimicrob, Agents Chemother,* 14, 1983, 700-702.
10. Semmler F W. Uber das atherische knoblauchs (Allium sativum) *Arch. Pharm,* 230(6), 1892, 434-443.
11. Yeh G Y, Davis R B, Phillips R S. Use of Complementary Therapies in Patients with Cardiovascular Disease, *Am. J. Card,* 98(5), 2006, 673-680.
12. Borek C. Garlic reduces dementia and heart-disease risk, *J. Nutr,* 136(3), 2006, 810-812.
13. Lau B H. Suppression of LDL oxidation by garlic compounds is a possible mechanism of cardiovascular health benefit, *Nutr,* 136(3), 2006, 765-768.
14. Abdullah T H, Kandil O, Elkadi A, Carter J. Garlic revisited: therapeutic for the major diseases of our times? *J Natl Med Assoc,* 80(4), 1988, 439-445.
15. Ohaeri O C. Effect of garlic oil on the levels of various enzymes in the serum and tissue of streptozotocin Diabtic rats, *Biosci. Rep,* 21(1), 2001, 19-24.
16. Eidi A, Eidi M, Esmaeili E. Antidiabetic effect of garlic (Allium sativum L.) in normal and streptozotocin-induced diabetic rats, *Phytomed,* 13(9), 2006, 624-629.
17. Ankri S, Miron T, Rabinkov A, Wilchek M, Mirelman D. Allicin from garlic strongly inhibits cysteine protein- ases and cytopathic effects of Entamoeba histolytica, Antimi- crob, *Agents Chemother,* 41(10), 1997, 2286-2288.
18. Tsai Y, Cole L L, Davis L E, Lockwood S J, Simmons V, Wild G C. Antiviral properties of garlic: *In vitro* effects on influenza B, herpes simplex and coxsackie viruses, *Planta Med,* 51(5), 1985, 460-461.
19. Serge Ankri, Talia Miron, Aharon Rabinkov, Meir Wilchek, David Mirelman. Allicin from Garlic Strongly Inhibits Cysteine Proteinases and Cytopathic Effects of Entamoeba histolytica, *Antimicrobial Agents and Chemotherapy,* 41(10), 1997, 2286-2288.
20. Prasad G, Sharma V D, Kumar A. Efficacy of garlic (Allium sativum L.) therapy against experimental dermatophytosis in rabbits, *Indian J. Med. Res,* 75(7), 1995, 465-467.
21. Torok B, Belagyi J, Rietz B, Jacob R. Effectiveness of garlic on the radical activity in radical generating systems, *Arzneimittel for schung,* 44(5), 1994, 608-611.
22. Friedman T, Shalom A, Westreich M. Self-inflicted garlic burns: our experience and literature review, *Int. J. Dermatol,* 45(10), 2006, 1161-1163.
23. Kao S H, Hsu C H, Su S N, Hor W T, Chang W H, Chow L P. Identification and immunologic characterization of an allergen, alliin- lyase, from garlic (Allium sativum), *J. Allergy Clin. Immunol,* 113(1), 2004, 161-168.
24. Lakshmipathy R, Hariharasubramanian, Usha Giridhar. Garlic, *Health a Journal Devoted to Healthful Living,* 94(12), 2016, 4-6.

25. Mohammad Shafiur Rahman. Allicin and other Functional active components in Garlic: Health Benefits and Bioavailability, *International Journal of Food Properties*, 10(2), 2007, 245-268.
26. Mohsen Arzanlou, Bohlooli, Mahsa Ranjbar Omid. Purification of Allicin From Garlic Extract Using Semi-Preparative High Performance Liquid Chromatography, *Jundishapur J Nat Pharm Prod*, 10(2), 2015, 17424.
27. Padhar Bharat, Dave Alankruta R, Chandola H M, Goyal Mandip R, Shukla V J, Khant D B. Comparative Analytical study of single bulb and multi bulb garlic (Allium sativum Linn.), *International journal of Ayurveda and Alternative medicine*, 2(4), 2014, 86-91.
28. Han J, Lawson L, Han G, Han P. A Spectrophotometric Method for Quantitative Determi- nation of Allicin and Total Garlic Thiosulfinates, *Anal. Biochem*, 225(1), 1995, 157-160.
29. Lawson L D. Garlic: A Review of Its Medicinal Effects and Indicated Active Compounds. In Phytomedicines of Europe: Their Chemistry and Biological Activity, *Lawson, L D, Bauer R, Eds, American Chemical Society: Washington, DC*, 4(1), 1998, 176-209.

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